THE

PRACTICE OF PHARMACY

A TREATISE

ON THE MODES OF MAKING AND DISPENSING OFFICIAL, UNOFFICIAL, AND EXTEMPORANEOUS PREPARATIONS, WITH DESCRIPTIONS OF MEDICINAL SUBSTANCES, THEIR PROPERTIES, USES, AND DOSES

INTENDED AS

A HAND-BOOK FOR PHARMACISTS AND PHYSICIANS

AND

A TEXT-BOOK FOR STUDENTS

FIFTH EDITION

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WITH OVER EIGHT HUNDRED ILLUSTRATIONS

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Authority to use for comment the Pharmacopœia of the United States of America, Eighth Decennial Revision, in this volume, has been granted by the Board of Trustees of the United States Pharmacopœial Convention, which Board of Trustees is in no way responsible for the accuracy of any translation of the official weights and measures or for any statements as to strength of official preparations. Alternative quantities are put in square brackets [ ] and an asterisk (*) added to each official formula. The asterisk in the text of this volume has been used in accordance with the direction of the Board of Trustees. Authority to use the National Formulary in abstract has been granted by the American Pharmaceutical Association.

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PREFACE TO THE FIFTH EDITION

THE enactment of Pure Food and Drug Laws by the National Government (1906) and by various States, having caused numerous changes in the United States Pharmacopœia (8th Rev.) has made a revision of this book necessary. In addition, the issue of the third edition of the National Formulary, which differs in some respects from the previous editions, and the fact that it was recognized legally, furnishes another reason for inserting an *abstract* (embodying the latest revisions and corrections) because the American Pharmaceutical Association forbids the publication by others, of the National Formulary *in full*. Since the issue of the Fourth edition of this book, the author has received many letters regretting the omission of the "questions" which were appended to each chapter in the Third edition; in order to supply this demand a revised list of "questions" will be found in this book on page 1369; these are intended to furnish the home student with a convenient means of revising his work and the suggestion is made that he should, after carefully reading a chapter, test his knowledge, by writing on paper the answers to the questions without looking at the text, and when through, comparing the answers with the text and marking his paper according to its deserts; another reason for their insertion is that they may furnish suggestions for State Boards of Pharmacy in framing Examination questions.

J. P. R.

PHILADELPHIA, October, 1907.

PREFACE TO THE FOURTH EDITION

THE publication of the Eighth Decennial Revision of the United States Pharmacopœia, the introduction of many new remedies, and the continued advance in pharmaceutical knowledge in recent years have rendered necessary a new edition of the Practice of Pharmacy.

Notwithstanding the efforts of the author to limit the number of pages by eliminating undesirable subjects, the pressing need of a comprehensive handbook which would serve as a daily companion for the busy pharmacist has necessitated an increase in the size of the book. As it is also a text-book, it is of paramount importance to present the subjects in proper sequence and introduce syllabi and tables which will enable the student to quickly grasp the outlines of the general subjects. The first edition of this work was published in October, 1885, and thus just twenty years have elapsed between the first and last editions. This period has been one of ceaseless activity in the pharmaceutical world, and the effort has been made by the author to keep pace with progressive pharmacy in at least a creditable measure.

This revision is marked by many changes and additions in matter and form and in typographical dress. The necessity for saving valuable space was the primary object in reducing the size of the illustrations wherever this could be done to advantage without sacrificing clearness of detail. This part of the work has been revised by the author's son, J. Percy Remington, B.S., P.D., most of the outline drawings having been made by him, and new cuts reproduced from these. This edition contains more than one hundred illustrations not in previous editions.

An improvement has been made in the arrangement of the official descriptions which now appear in small black-letter type throughout the work; the change will enable readers to find an official requirement more rapidly and easily than by the method used in previous editions of using lines and rules in tabular form.

Since the advent of the first edition of the Practice of Pharmacy the book has had an ever-widening field, and it has been deemed desirable to introduce in this edition preparations of the British Pharmacopœia when dissimilar from those official in the United States Pharmacopœia. Dismissed preparations of the previous Pharmacopœia, which still have considerable vogue, have also found a place.

The metric system of weights and measures has been given the preference in the working formulas, not only for the reason that it is the official method of indicating quantities, but because it is the simplest and best system in use. Unfortunately, the old-form quantities continue to be most largely employed in buying and selling drugs and in prescription work; hence, alternative formulas are appended to official preparations, as in previous revisions, and when used, an asterisk precedes the process, as explained in the special notice on the copyright page.

The old form quantities are not intended to be the equivalents of the metric quantities, and the two systems are not interchangeable; either "metric" or "old form" may be used, but in no case part of one and part of the other; different type distinguishes one from the other.

Part V, which is devoted to magistral or extemporaneous pharmacy, has been extensively enlarged by the addition of a new chapter on Incompatibility, the insertion of new illustrations of autograph prescriptions, and numerous new cuts of apparatus with descriptions. The condensed charts of inorganic chemical substances, vegetable official drugs, and animal substances have been thoroughly revised; these will be found very useful for students in preparing for examination, by enabling them to review the whole subject.

Part VI has been entirely remodelled, so as to permit an alphabetical arrangement of the many unofficial but largely used preparations and special formulas. These can now be quickly found by the busy pharmacist, black-letter titles being used.

Acknowledgments are tendered to Charles H. LaWall, Ph.M., for the revision of and additions to the chapter on Arithmetical Problems. The enlarged index has been prepared by J. Percy Remington, P.D. The tables in Part I and the black-letter official descriptions were compiled by Millicent S. Renshaw, P.D., who also assisted in the proof-reading of the entire work. The tables of Official and Unofficial Substances and preparations in the book were prepared by E. Fullerton Cook, P.D., who also gave valued assistance in every part of the revision. These services are hereby gratefully recognized, particularly as they were rendered immediately after the arduous labors upon the revision of the United States Pharmacopœia had been completed, and often during hours which should have been reasonably devoted to recreation.

In closing, the author desires to express his great appreciation of the reception of this work by his friends in many countries, and to venture the hope that the present edition adequately reflects the progress made in pharmaceutical practice since the last revision.

J. P. R.

Philadelphia, October, 1905.

PREFACE TO THE FIRST EDITION

THE rapid and substantial progress made in Pharmacy within the last decade has created a necessity for a work treating of the improved apparatus, the revised processes, and the recently introduced preparations of the age.

The vast advances made in theoretical and applied chemistry and physics have had much to do with the development of pharmaceutical science, and these have been reflected in all the revised editions of the Pharmacopœias which have been recently published. When the author was elected in 1874 to the chair of Theory and Practice of Pharmacy in the Philadelphia College of Pharmacy, the outlines of study which had been so carefully prepared for the classes by his eminent predecessors, Professor William Procter, Jr., and Professor Edward Parrish, were found to be not strictly in accord, either in their arrangement of the subjects or in their method of treatment. Desiring to preserve the distinctive characteristics of each, an effort was at once made to frame a system which should embody their valuable features, embrace new subjects, and still retain that harmony of plan and proper sequence which are absolutely essential to the success of any system.

The strictly alphabetical classification of subjects which is now universally adopted by pharmacopœias and dispensatories, although admirable in works of reference, presents an effectual stumbling-block to the acquisition of pharmaceutical knowledge through systematic study; the vast accumulation of facts collected under each head being arranged lexically, they necessarily have no connection with one another, and thus the saving of labor effected by considering similar groups together, and the value of the association of kindred subjects, are lost to the student. In the method of grouping the subjects which is herein adopted, the constant aim has been to arrange the latter in such a manner that the reader shall be gradually led from the consideration of elementary subjects to those which involve more advanced knowledge, whilst the groups themselves are so placed as to follow one another in a natural sequence.

The work is divided into six parts. Part I. is devoted to detailed descriptions of apparatus and definitions and comments on general pharmaceutical processes.

The Officinal Preparations alone are considered in Part II. Due weight and prominence are thus given to the Pharmacopœia, the National authority, which is now so thoroughly recognized.

In order to suit the convenience of pharmacists who prefer to *weigh* *solids* and *measure liquids*, the officinal formulas are expressed, in addition to parts by weight, in *avoirdupois weight* and *apothecaries' measure.* These equivalents are printed in **bold type**, near the margin, and arranged so as to fit them for quick and accurate reference.

Part III treats of Inorganic Chemical Substances. Precedence is of course given to officinal preparations in these. The descriptions, solubilities, and tests for identity and impurities of each substance are systematically tabulated under its proper title. It is confidently believed that by this method of arrangement the valuable descriptive features of the Pharmacopœia will be more prominently developed, ready reference facilitated, and close study of the details rendered easy. Each chemical operation is accompanied by equations, whilst the reaction is, in addition, explained in words.

The Carbon Compounds, or Organic Chemical Substances, are considered in Part IV. These are naturally grouped according to the physical and medical properties of their principal constituents, beginning with simple bodies like cellulin, gum, etc., and progressing to the most highly organized alkaloids, etc.

Part V is devoted to Extemporaneous Pharmacy. Care has been taken to treat of the practice which would be best adapted for the needs of the many pharmacists who conduct operations upon a moderate scale, rather than for those of the few who manage very large establishments. In this, as well as in other parts of the work, operations are illustrated which are conducted by manufacturing pharmacists.

Part VI contains a formulary of Pharmaceutical Preparations which have not been recognized by the Pharmacopœia. The recipes selected are chiefly those which have been heretofore rather difficult of access to most pharmacists, yet such as are likely to be in request. Many private formulas are embraced in the collection ; and such of the preparations of the old Pharmacopœias as have not been included in the new edition, but are still in use, have been inserted.

In conclusion, the author ventures to express the hope that the work will prove an efficient help to the pharmaceutical student as well as to the pharmacist and the physician. Although the labor has been mainly performed amidst the harassing cares of active professional duties, and perfection is known to be unattainable, no pains has been spared to discover and correct errors and omissions in the text. The author's warmest acknowledgments are tendered to Mr. A. B. Taylor, Mr. Joseph McCreery, and Mr. George M. Smith for their valuable assistance in revising the proof-sheets, and to the latter especially for his work on the index. The outline illustrations, by Mr. John Collins, were drawn either from the actual objects or from photographs taken by the author. J. P. R.

PHILADELPHIA, October, 1885.

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PRACTICE OF PHARMACY

INTRODUCTORY

THEORETICAL AND PRACTICAL PHARMACY

PHARMACY is the science which treats of medicinal substances. It comprehends not only a knowledge of medicine and the arts of preparing and dispensing them, but also their identification, selection, preservation, combination, and analysis.

The word Pharmacy is also used to designate the place where medicines are sold.

For convenience in study, Pharmacy may be divided into two great classes,—viz., *Theoretical Pharmacy* and *Practical Pharmacy.*

Theoretical Pharmacy.—Inasmuch as all Nature, animate and inanimate, has been laid under contribution to provide remedies for the alleviation of disease, it follows that those sciences which embrace a knowledge of substances obtained from the vegetable, mineral, and animal kingdoms, as well as those which treat of the laws governing them, are called upon to furnish important facts which form the basis of the science of Pharmacy.

Botany, the science of plants, *Mineralogy*, that of inorganic substances found in or on the earth, and *Zoology*, the science which treats of animals, are, however, less important than *Chemistry* and *Physics;* for upon these two Pharmacy is most dependent for its greatest development and its highest degree of usefulness.

Physics or *Natural Philosophy* is that branch of science which describes and explains the changes produced in bodies, by which their specific identity is not destroyed, while *Chemistry* treats of those changes which affect the specific identity of the bodies.

Materia Medica (medicinal materials) is a term applied to designate the substances which are used in the cure of diseases ; it is most intimately connected with *Pharmacognosy*, the science which treats of crude drugs, while the specific definition of Pharmacy limits the latter to the consideration of the preparations made from drugs.

In colleges of pharmacy, as well as in universities where pharmacy is a part of the instruction, it is usual to divide General Pharmacy into three departments,—Chemistry, Botany and Materia Medica, and Theory and Practice of Pharmacy.

Toxicology, the science of poisons, *Microscopy*, which requires the use of optical instruments called microscopes, and *Bacteriology*, a natural science which treats of micro-organisms, form valuable collateral and special subjects of study.

Practical Pharmacy is that branch of Pharmacy which treats of the operations, processes, and methods used in applying the principles of theoretical pharmacy. The practice of pharmacy will receive in this treatise much the greater share of attention ; separate text books on the sciences pertaining to the theory of pharmacy are now very accessible, and these may be referred to for specific and systematic information.

PHARMACOPŒIAS AND DISPENSATORIES

A *pharmacopœia*, in the modern acceptation of the word, is a book containing a list of medicinal substances, with descriptions, tests, and formulas for preparing the same, selected by some recognized authority. The necessity for legalized standards to define the character, establish the purity, and regulate the strength of medicines is recognized by all civilized nations; and although all of the nations of the globe have not yet formally adopted national standards, in nearly every case where this has not been done it will be found that the standards of some other country are in use. The most important pharmacopœias, with the dates of their latest issues, are as follows :

Official Pharmacopœias

Nation	Date of Issue	Title
1. United States	1905	Pharmacopœia of the United States of America Eighth Decennial Revision
Spanish Edition	1909	
2. Great Britain and Ireland	1898	British Pharmacopœia
and Colonies	1900	Indian and Colonial Addendum
3. Germany	1910	Arzneibuch für das Deutsche Reich (Pharmacopœa Germanica, editio V.)
4. France	1908	Codex Medicamentarius Gallicus (Pharmacopée Francaise)
5. Austria	1906	Pharmacopœa Austriaca.
6. Belgium	1906	Pharmacopœa Belgica
7. Chili	1886	Farmacopea Chilena
8. Croatia-Slavonia	1888	Pharmacopœa Croatico-Slavonica
9. Denmark	1907	Pharmacopœa Danica
10. Greece	1899	Ἑλληνικὴ Φαρμακοποιία
11. Hungary	1909	Pharmacopœa Hungarica
12. Italy	1909	Farmacopea ufficiale del Regno d'Italia
13. Japan	1906	Pharmacopœa Japonica
English Edition	1907	
14. Mexico	1896	Nueva Farmacopea Mexicana
15. Netherlands	1905	Pharmacopœa Nederlandica
16. Norway	1895	Pharmacopœa Norvegica
17. Portugal	1876	Pharmacopœa Portugueza
18. Roumania	1893	Pharmacopœa Romana
19. Russia	1910	Pharmacopœa Rossica
20. Servia	1908	Pharmakopœa Serbica
21. Spain	1905	Farmacopea oficial Español
22. Sweden	1908	Pharmacopœa Svecica (Svenska Farmakopén)
23. Switzerland	1907	Pharmacopoea Helvetica
24. Venezuela	1900	Farmacopea Venezolana

Notes on Official Pharmacopœias

1. In quoting this title, it is customary to abbreviate it to "U. S. P. (8th Rev.)." It is advisable to adhere to this form so as to preserve uniformity. The "eighth revision" means, of course, the same as "ninth edition." Formerly it was customary to use the year in which the Decennial Convention met, to designate the Pharmacopœias, thus "U. S. P. 1890 ;" much confusion resulted from this practice because it now requires three or four years to revise such an authority and hence the "U. S. P. 1890" would have been more appropriately termed the "U. S. P. 1893." In the last revision this was corrected by omitting a date upon the back of the book and using the words "Eighth Decennial Revision."
2. The Indian and Colonial Addendum to the British Pharmacopœia (1898) was published in 1900. This is intended especially to furnish an authority for the guidance of the colonies and distant parts of the British Empire.
3. The Swiss Pharmacopœia is published simultaneously in three languages,—German, French, and Italian.

The U. S. Pharmacopœia (Spanish Edition issued 1909) is now used in Cuba, Porto Rico and Philippine Islands. Since 1910 every drug store in Cuba is compelled by law to have a copy. Central and South American countries are now using the Spanish U. S. Pharmacopœia. In the West Indian Islands where French and Spanish is the principal language, the most generally used, unofficial work of reference is Dorvault's "L'Officine," an extensive commentary and supplement to the French Pharmacopœia, either in the French original, or in its Spanish translation and adaptation by Pontes.

Argentine Republic.—French and Spanish Pharmacopœias. Also (not official) Tratado de Farmacia y Farmacognosia. By Carlos Murray.
Bolivia.—French, Spanish, and Chilian Pharmacopœias.
Brazil.—French, Portuguese, and Spanish Pharmacopœias. Also (not official) Formulario ou Guia Medica, etc. By P. L. N. Chernovitz. Novo Formulario medico e pharmaceutico, ou Vademecum Medicum. By Th. J. H. Langgaard.
Central American States.—French, Spanish, and Mexican Pharmacopœias. Also, to some extent, the British and that of the United States.
China.—The native druggists and herbalists still regard as their chief authority the old Chinese Encyclopedia of natural history, entitled Pen-tsao-kang-mu, composed by Li-shi-chin between 1552 and 1578. The usual editions of this work are printed in 40 thin volumes, 8vo. Foreign pharmacists use the pharmacopœias of their respective countries. The British is most in use.
Cuba.—The United States Pharmacopœia (Spanish Edition) since 1910.
Ecuador.—French and Spanish, also several foreign pharmacopœias.
Haiti.—French and Spanish Pharmacopœias (chiefly).
Hawaiian Islands.—Chiefly the United States Pharmacopœia. To some extent, also, the British and the German.
Liberia.—The United States Pharmacopœia (chiefly).
Peru.—The French, Spanish, British, and United States Pharmacopœias.
Turkey.—The French Pharmacopœia.
Uruguay.—The French and Spanish Pharmacopœias. Occasionally, also, the British and that of the United States.
Venezuela.—The French and Spanish Pharmacopœias (chiefly). Also, occasionally, the British and that of the United States.

The official pharmacopœias are all issued under the authority of the respective governments, with the exception of the United States Pharmacopœia, which has, however, been accepted by the government and the individual States, through the National and State Pure Food and Drug Acts. Efforts are constantly being put forth to secure the adoption of an International Pharmacopœia. If these should prove successful, a great advance will be made in bringing about a uniformity in the strength of preparations; yet it may well be doubted whether such a work would be as generally useful as the pharmacopœias at present in use, which have been proved by long experience best adapted to the varying needs of the different nations. A practical plan of securing the chief advantages possessed by an International Pharmacopœia has been inaugurated by the establishment of the "International Conference for the Unification of Potent Remedies," which met in the City of Brussels in September, 1902. This body in the final *protocol* agreed upon standards of strengths for potent preparations which they expect the various pharmacopœias of the world to adopt. The United States Pharmacopœia (eighth revision) was the first national pharmacopœia to adopt some of these recommendations. In 1906, representatives from nineteen governments met at Brussels and with certain reservations formally signed the agreements drawn up in 1902 and also formulated details for further unification.

The Pharmacopœia of the United States, Eighth Decennial Revision, was prepared by a committee appointed by the National Convention of 1900 for revising the Pharmacopœia, which met in Washington, D. C., May 2, 1900. Sixty-two medical bodies and fifty-four incorporated pharmaceutical organizations sent delegates to this convention, which selected from those present twenty-six members, consisting of twenty-one pharmacists, chemists, and botanists (seven of which number hold medical degrees), and five physicians, who were designated the "Committee of Revision of the Pharmacopœia of the United States of America." At the Eighth Decennial Convention several important changes in the plan of the work were made, the business portion was separated from that of actual revision by creating a Board of Trustees whose duty is to make contracts, attend to the finances, and place the book on sale. The convention was incorporated, and it now carries on its work under a charter issued at Washington under the laws of the District of Columbia. The Committee of Revision, as soon after their election as possible, met, elected officers, and the Chairman organized the work of revision and appointed sub-committees to report upon the special parts of the work in the several departments. The reports were laid before the whole committee for action, and by vote they were then adopted, amended, or rejected. The Committee of Revision represent geographically various parts of the United States, and it is necessary to conduct the revision by mail communications, which are voluminous. The Board and Committee remain in office until the next decennial convention meeting, or until their successors are appointed. Permission to use the text of the Pharmacopœia is granted upon application to the Chairman of the Board of Trustees under certain regulations which are necessary to guard the copyright. As the U. S. Pharmacopœia will be largely quoted in this treatise, its plan and the outlines of its main features should be thoroughly understood at the outset.

Nearly one thousand substances (958), embracing crude drugs and preparations, have been deemed of sufficient importance to merit a place in the U. S. Pharmacopœia. On May 10, 1910, the United States Pharmacopœial Convention met in Washington to revise the Pharmacopœia. A radical change was made. A General Committee of Revision consisting of fifty members was elected by the Convention, they selected fifteen members to form the Executive Committee of Revision ; these fifteen to have immediate charge of the work. In this way it is believed that decisions may be arrived at more readily and the work facilitated.

Under the Food and Drug Acts, the United States Pharmacopœia is now the law of the land. Its standards are obligatory and violations are now punishable by fine or other penalty.

Nomenclature

The names of the various substances are indicated—1. By the OFFICIAL LATIN TITLE, which is always in the Latin language. 2. By the OFFICIAL ENGLISH TITLE. 3. By the SYNONYM. 4. By the BOTANICAL NAME (in the case of plants). 5. By the SYMBOLIC FORMULÆ (in the case of chemicals). Each of these names has a special use.

The following extracts from the Pharmacopœia are given in illustration:

CANTHARIS	[Official Latin title]	**CERATUM RESINÆ**
Cantharides	[Official English title]	**Rosin Cerate**
[Blistering Flies, Spanish Flies]	[Synonym in index]	[Basilicon Ointment]
POTASSII CHLORAS	[Official Latin title]	**CARUM**
Potassium Chlorate	[Official English title]	**Caraway**
$KClO_3 = 121.68$ [Symbolic formula]		The dried fruit of *Carum Carvi.* [Official definition, botanical name in Italics]

1. The Official Latin Title.—Example, **LIQUOR AMMONII ACETATIS.** The official Latin title is thoroughly distinctive, and is intended to be used in designating the drug or preparation where precision is required, as in writing prescriptions, in labelling store furniture, specimens, etc. Latin is selected for the official title because it is universally used and understood as the "language of science," and is not liable to change, as is the case with a living tongue. Although the official titles are usually abbreviated in practice,[1] the proper terminations and full titles should be known and observed carefully, and the habit of using the Latin abbreviations in English conversation strictly guarded against as not only inelegant, but vulgar.[2] A vast amount of careful consideration, extending over many years, has been expended in perfecting a system of pharmacopœial nomenclature which is at once "brief, simple, expressive, distinctive, and convenient." The following may be cited as models: Acacia, Camphora, Opium, Rheum, Sapo, etc., the full pharmacopœial definition of these titles being, respectively, *Acacia.* "A gummy exudation from *Acacia Senegal* Willdenow, and other species of *Acacia* (Fam. *Leguminosæ*)." *Camphora.* "The dextrogyrate modification of the saturated ketone [$C_9H_{16}CO$], obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*), and purified by sublimation." *Opium.* "The concrete, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné (Fam. *Papaveraceæ*), and yielding, in its normal, moist condition, not less than 9 percent. of crystallized morphine." *Rheum.* "The dried rhizome of *Rheum officinale* Baillon, *Rheum palmatum* Linné, and the var. *tanguticum* Maximowicz (Fam. *Polygonaceæ*), or probably other species of *Rheum* grown in China and Thibet, and deprived of most of the bark and carefully dried." *Sapo.* "Soap prepared from sodium hydroxide and olive oil." The *generic* or genus name (the first part of the botanical name) was generally chosen for the official Latin title, as, Pilocarpus, for "the leaflets of *Pilocarpus Jaborandi*" (botanical name). In the case of some old and very well known drugs, this rule could not be adopted without causing confusion, and the *specific* or species name (the second part of the botanical name) was retained, as Ipecacuanha, the official Latin title for "the dried root—of *Cephaelis Ipecacuanha.*" The official Latin title obviously cannot retain the simplicity of a single word where two parts of the same plant are official. Thus, for

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[1] See table of abbreviations in chapter on Prescriptions.

[2] Example of what should be avoided in conversation: "I mixed the *Pulv. Pip. Nig.* with the *Pot. Carb.* and the *Muc. Trag.*, but could not form a mass."

example, the corm and seed of Colchicum must each be defined by affixing the Latin name of the particular part of the plant intended, as *Colchici Cormus* for Colchicum Corm, and *Colchici Semen* for Colchicum Seed ; nor can a single word be chosen for either official title where the specific names of two or more plants of the same genus differ. The generic name of the two official mints is Mentha, and to distinguish them it is necessary to use the full botanical name for each. Thus, the *Mentha Piperita* (Peppermint), *Mentha Viridis* (Spearmint).

There are a very few exceptions to the above principles of nomenclature, as in the case of *Pareira* and *Prunus virginiana*, derived, according to the most recent and reliable authorities, respectively from *Chondrodendron tomentosum* and *Prunus serotina*. These drugs are largely used, and the old names have become so well established that it would lead to confusing and possibly embarrassing mistakes to change them now. The Latin names are generally used in the singular number, although the definition of the drug distinctly indicates plurality ; for instance, *Galla* is the official name for *nutgalls*, as they are termed commercially, and is in the nominative singular (plural, *Gallæ*). The official definition indicates the singular, being "An excrescence on *Quercus infectoria*." *Anthemis* (nominative singular) is the official name for the flower heads of Chamomile. The reason assigned in the preface to the U. S. Pharmacopœia, 1850, for this apparent deviation, is that "the example of the Roman medical writers, particularly of Celsus, might be followed." In the case of compound medicines, such official titles were selected as would usually express the composition of the preparations as fully as possible, indicating the principal ingredients without sacrificing the important consideration of brevity and convenience in abbreviation, as Mistura Rhei et Sodæ, Mistura Cretæ, Pulvis Ipecacuanhæ et Opii, Tinctura Opii Camphorata, Tinctura Aloes et Myrrhæ. In some cases it is desirable to indicate in the title the medical properties or use of the preparation, as in Pilulæ Laxativæ Compositæ, Liquor Antisepticus. Where the number of important ingredients in a preparation is too great to admit of a selection, the participial adjective *compositus* (meaning compound) is added, the feminine (*composita*) or neuter (*compositum*) termination being used respectively where the noun is feminine or neuter, as Spirit*us* Juniperi Composit*us* (masc.), Tinctur*a* Lavandulæ Composit*a* (fem.), Extract*um* Colocynthidis Composit*um* (neut.).

2. **The Official English Title.**—Example, **Solution of Ammonium Acetate.** This name should be used when the drug or preparation is mentioned in ordinary conversation, in commercial transactions, in writing orders for supplies, and in all cases where the use of the Latin official title could be justly criticized as an ostentatious display of erudition. In the U. S. Pharmacopœia, 1880, a large number of English titles used in former Pharmacopœias were changed, the old vernacular names being either dropped altogether or inserted as synonyms. This advanced step was rendered necessary by the increase in articles used in the materia medica and by a desire for greater accuracy and better methods in nomenclature. The confusion which always exists in different localities concerning the common names of drugs is also avoided, as the anglicized Latin name is distinctive. The former English names *Irish Moss*, *Pipsissewa*, *Male Fern*, and *Yellow Jasmine*,

for instance, are replaced by *Chondrus*, *Chimaphila*, *Aspidium*, and *Gelsemium*.

On the other hand, some of the common English names were so fixed by usage that it was not deemed judicious to alter them ; besides, to have changed them would have often substituted a longer and less convenient word. The retention of the English names *Cloves*, *Elm*, *Hops*, and *Ginger* sufficiently illustrates this.

In the U. S. Pharmacopœia, 1890, a very important change was made in the English names of the chemical substances, the basylous or metallic component being given the first place ; for instance, *potassium citrate*, *ammonium bromide*, and *zinc sulphate*, replace the former names *citrate of potassium*, *bromide of ammonium*, and *sulphate of zinc*. This change required many alterations in nomenclature, but it was a necessary step for the Committee of Revision to make the names accord with the established usage of the best modern chemical writers. In the U. S. P. 1890 the salts of iron and mercury were for the first time differentiated by the use of the terms *ous* and *ic* respectively to designate lower and higher forms of the salts ; for example, ferr*ous* sulphate and ferr*ic* sulphate, mercur*ous* iodide and mercur*ic* iodide, replaced the names sulphate of iron and iodide of mercury ; the compounds of mercury, on account of the differences in dose existing among them, were further distinguished by the use of the adjectives "corrosive," "mild," "red," "yellow." For the scale salts of iron, which are of complex composition and not true chemical salts, notwithstanding the fact that the metallic component exists in them in the ferric state, the term "iron" was used in order to emphasize the fact of their defective chemical construction, for they are not definite double salts. These changes in nomenclature were retained in the Eighth Decennial Revision of the Pharmacopœia.

The Pharmacopœial names of chemical substances do not always represent their chemical composition. The enormous multiplication of synthetic remedies, and the length of the systematic names of these bodies, have compelled the use of shorter terms which are more conveniently employed in prescriptions and in commercial transactions. Thus, "metadihydroxybenzene" is a more cumbersome word than "resorcinol," "phenyldimethylpyrazolon" than "antipyrine." If we turn to unofficial substances, a better example is afforded by the use of "analgen," which is dignified by the systematic name of orthoethyloxyanamonobenzoylamidochinoline." In the U. S. P. (8th Rev.) it became necessary to introduce quite a number of synthetic remedies having long scientific names, and trade or proprietary names could not be used as titles in a standard book of this character, hence the long names had to be shortened, and "diethylsulphonedimethylmethane" became "sulphonmethane." The value of a long chemical name lies in the fact that the name indicates its composition, but some of the most useful modern remedies are very complex in their chemical composition, hence the inconvenience. The custom of abbreviating the official Latin titles in writing prescriptions is universal among physicians, and the new official names which are long, will not cause great inconvenience in practice. Thus "Hexamethylenamina" will undoubtedly be abbreviated to "hexa" or "hexameth."

3. **The Synonym.**—Example, [BASHAM'S MIXTURE.] In the Pharmacopœia the definition of the term synonym is restricted to an equivalent name in common use, which is usually antiquated and derived from an unscientific source, and which should really be abandoned, but which common custom and long usage demand shall not be entirely ignored. The synonyms should be rarely or never used, yet it is necessary for the student to be familiar with them in order to recognize their equivalent official Latin or English names when they are used by others. Common names, as snakeroot, dock, Indian hemp, balm, etc., have varying and often opposite meanings in different localities, and confusion and even loss of life have resulted from the unfortunate use of these common names. In the U. S. P. (8th Rev.) synonyms are placed in the index in small type under the official Latin titles; they are no longer to be found in the text as was the case in former editions of the Pharmacopœia.

4. **The Botanical Name.**—By this is meant the systematic name recognized by botanists for plants, which serves in pharmacopœial nomenclature as the basis of the official name. The botanical name usually consists of two Latin words, the first indicating the genus and the second the species to which the plant belongs. *Capsicum fastigiatum* is the botanical name for the particular variety of capsicum or Cayenne pepper which the Pharmacopœia designates. Here the generic or first name is chosen for the official title, and if no description followed the title it would be inferred that any part of any plant in the genus "Capsicum" could be officially used for making preparations; but the specific name, "fastigiatum," limits the use to this species, while the description which follows shows the *part* of the plant which must be employed: "the dried, ripe *fruit* of *Capsicum fastigiatum* Blume (Fam. *Solanaceæ*) deprived of its calyx." Now, Capsicum baccatum, Capsicum frutescens, Capsicum annuum, belonging to different species, are active members of the genus, but their claims are unrecognized, and the fruit from these species is not official. The specific name does not begin with a capital letter, except when it has been at some previous time itself a generic name, as in Rhamnus Frangula, or when it is derived from the name of a person, as in Garcinia Hanburii, or when the word is indeclinable, as in Theobroma Cacao, or when it is a combination of a noun and an adjective, as in Fagara Clava-Herculis. The name of the author follows the botanical name, as, *Capsicum fastigiatum* Blume, and after this the Family[1] to which the plant belongs is indicated in italics, and the whole enclosed in parentheses, as (Fam. *Solanaceæ*). The term Natural Order (Nat. Ord.) was replaced in the U. S. P. (8th Rev.) by the word Family (Fam.), to accord with modern usage among botanical authorities. It must be apparent that the botanical name need not be employed either in writing or speaking in ordinary pharmaceutical work; but its use is absolutely necessary in establishing the identity of any drug authorized by the Pharmacopœia, and hence it is important to know the botanical names.

5. **The Symbolic Formulæ.**—The adoption of certain arbitrary symbols[2] to represent chemical elements leads to a most convenient

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[1] See index for chart of drugs arranged according to the Families.

[2] See index for table of elements, with symbols and atomic and molecular weights.

and useful application, whereby the composition of a chemical is expressed with the utmost brevity and exactness. Plumbi Iodidum and Lead Iodide are both much longer terms than "PbI_2," and not so definite. *Sodium Sulphite* does not always contain the same proportion of water of crystallization, and if the symbolic formula, $Na_2SO_3 + 7H_2O$, were not appended to the official title there might be some doubt about which sulphite was intended; the added $7H_2O$, however, accurately defines it. The *figures* which follow the symbolic formulæ indicate the *molecular weight* (the sum of the weight of the atoms) of the chemical. Thus, in $MgSO_4 + 7H_2O = 244.69$; the atomic weight of Magnesium, Mg, 24.18, is the first factor; this added to Sulphur, S, 31.83, makes 56.01; Oxygen, O, 15.88, multiplied by 4, gives 63.52; then Hydrogen having the atomic weight of 1 if multiplied by 2 and this by 7 gives 14, and seven times O, 15.88, is 111.16; then $56.01 + 63.52 + 14 + 111.16 = 244.69$, the molecular weight of magnesium sulphate.

The Official Definition.—In order to have no question arise as to the exact meaning of the official Latin title, or any other name by which an official substance is known, it is necessary to state explicitly in language that can be thoroughly understood what kind or variety of the substance should be used. In the case of drugs this has been already noticed (see page 29); for chemicals an illustration may be given in Guaiacol Carbonate, which is defined as "a guaiacol derivative $[(C_6H_4(OCH_3)O)_2.CO]$, obtained by the action of carbonylchloride upon sodium guaiacolate." Again Sevum Preparatum, Prepared Suet, is officially defined as "the internal fat of the abdomen of the sheep *Ovis aries* Linné, purified by melting and straining." This excludes beef suet and all other kinds, and states the method of purification.

The Purity Rubric.—This was introduced into the U. S. P. (8th Rev.) to limit the quantity of innocuous impurities in chemicals, by stating in terms of percentage the amount of pure substance that must be present. Thus, under Potassii Iodidum, Potassium Iodide, $KI = 164.76$, will be found the "purity rubric" as follows: "It should contain not less than 99 percent. of pure Potassium Iodide;" the caution to keep in well stoppered bottles is added. It might appear, at first sight, that chemicals should always contain 100 percent. of pure product, but practical experience shows that absolute purity is not attainable without the expenditure of much money, and the presence of minute quantities of impurities (provided that they are harmless) cannot affect the medicinal value of a chemical. Under the pharmacopœias formerly in use, prosecutions were often started, and penalties were imposed by the State authorities, because there was no purity rubric nor allowance for the absorption of moisture or the presence of traces of substances which were innocuous; the purity rubric remedies this defect by definitely stating the amount of permissible impurities.

The Official Description.—Immediately following the official definition of the substances there will be noticed in the Pharmacopœia, in smaller type, what has been termed the *official description;* this consists, usually, in drugs, of a concise statement of their physical characteristics, while in some cases tests of identity, with descriptions of the substances used as adulterants, are appended. In the chemicals the official definition is usually replaced by the symbolic formulæ, and these are followed immediately by the purity rubric and the official description, which is printed in smaller type, exactly as in the case of the drugs; to this description are usually added the solubilities, with the tests of identity and purity of the substance.

Assay Processes.—The assaying of drugs and preparations has become necessary in order to definitely fix their value as medicinal agents, and the U. S. P. (8th Rev.) has introduced many assays of alkaloidal drugs and their galenical preparations. This work requires skill, knowledge, and experience, and each process requires careful study. When alkaloidal drugs are to be assayed, the process which is usually followed consists of dissolving out the desired active principle, from a fluid preparation representing the drug, with the aid of certain solvents which are capable of extracting the desired constituents but which are not miscible with the liquid that is being assayed, and which may, therefore, be easily separated.

This immiscible solvent, after separation, is carefully treated to purify the substance which it has dissolved, and finally the quantity of the substance is determined by one of two methods: *gravimetric*, in which the solvent is evaporated carefully, the residue weighed, and the percentage present in the original drug calculated from this weight; or the process may be *volumetric*, in which case the amount of alkaloid dissolved is determined by its power to neutralize a standard acid volumetric solution, the amount of solution required being carefully noted, and the percentage of alkaloid calculated from the figure obtained. The method of assay is usually inserted near the end of the article. A number of chemical substances, volatile oils, animal products, etc., are also assayed, but for most chemicals it usually suffices to attach a *quantitative test*, which answers a similar purpose, and in which the strength may be determined by either a gravimetric or volumetric process without the elaborate preliminary treatment required in drug assays.

Doses.—An innovation was adopted in the U. S. P. (8th Rev.) by the insertion of the "Average dose" at the end of the greater number of the articles. The dose of a medicine can never be a fixed and unvarying quantity; the age and condition of the patient, the severity of the disease, the idiosyncrasy and tolerance for medicines, must all be reckoned with, and it would be a very unwise physician who disregarded these factors. For these reasons, an "average dose" was used in order to furnish a guide to pharmacists and physicians. The following quotation from the preface of the Pharmacopœia is appended:

"The Convention instructed the Committee 'to state the average approximate (but neither a minimum nor a maximum) dose for adults, . . . the metric system to be used, and the approximate equivalent in ordinary weights or measures inserted in parentheses,' and the Committee was further directed to make the following distinct declaration '*that neither this Convention nor the Committee of Revision created by it, intends to have these doses regarded as obligatory on the physician or as forbidding him to exceed them whenever in his judgment this seems advisable.*' "

The following examples, selected from the Pharmacopœia, are given in illustration:

OPIUM	[Official Latin title]	**SODII HYDROXIDUM**
Opium	[Official English title]	**Sodium Hydroxide**
The concrete, milky exudation obtained by incising the unripe capsules of *Papaver somniferum*, . . . and yielding . . . not less than 9 percent. of crystallized morphine, when assayed by the process given below.	[Official definition]	
	[Symbolic formula and Purity Rubric]	$NaOH = 39.76$ It should contain not less than 90 percent. of pure anhydrous Sodium Hydroxide. . . . It should be kept in well-stoppered bottles made of hard glass.
In irregular, flattened, more or less rounded masses, . . . internally dark brown, somewhat lustrous; odor strong, narcotic; taste bitter and characteristic.	[Official description]	Dry, white flakes, fused masses, or translucent or opaque white pencils, showing a crystalline fracture, odorless, and having a caustic taste. . . . Soluble in about 1 part of Water at 25° C. (77° F.). . . . The aqueous solution . . . should not respond to the Time-Limit Test for *heavy metals*.
Opium, in any condition to be valued . . . . . . **10.0 Gm.** **Ammonia Water . . 3.5 Gm.** **Alcohol,** etc.	[Assay]	
Introduce the Opium . . . into an Erlenmeyer flask, . . . add 100 Cc. of distilled water, . . . and agitate during three hours. . . . The difference, multiplied by 10, represents the percentage of crystallized morphine contained in the Opium.	[Quantitative Test]	Introduce about 1 Gm. of Sodium Hydroxide into a stoppered weighing bottle. . . . Dissolve this in about 50 Cc. of water, and titrate the solution with normal sulphuric acid V.S. . . . Multiply the number of Cc. of the normal sulphuric acid consumed, by 3.976, and divide this product by the weight of the Sodium Hydroxide taken; the quotient represents the percentage of Sodium Hydroxide present.
Average dose.— 0.100 Gm. = 100 milligrammes (1½ grains).	[Dose]	

The Preparations of the Pharmacopœia

Although these will be considered in detail in the body of this work, a few general remarks on them will be appropriate here. The "parts by weight" plan adopted by the U. S. Pharmacopœia, 1880, was dropped in the 1890 revision, and the "solids by weight, liquids by measure" principle accepted. This is more in accord with the methods used in English speaking countries. A great advance was made by the adoption of the metric system for expressing the quantities, which were thus also made definite. Every pharmacist should employ the metric system exclusively in making preparations; but on account of the revolutionary changes made necessary by the adoption of this system of weights and measures, corresponding quantities are given in the working formulas in this book, which are based on the old system of avoirdupois weight and apothecaries' measure. The latter will be found much less convenient than the metric quantities, especially if the operator has procured a set of metric weights and measures and has used them a few times.

The U. S. P. official text is printed in this book by authority from the Board of Trustees of the United States Pharmacopœial Convention, and the official processes are designated by an asterisk (*), printed before the name of the first ingredient, when alternative or "old form" quantities are given. The latter are enclosed in brackets in the text, and are printed in smaller type in the list of ingredients. The object of this arrangement is to indicate that the alternative or old form quantities are not used in the Pharmacopœia.

The old form quantities are not intended to be equivalents of the metric quantities and the two systems are not interchangeable; either "metric" or "old form" may be used, but in no case part of one and part of the other; different type distinguishes one from the other.

National Formulary

The Third Edition of this book was made a standard under the Pure Food and Drugs Act, June 30, 1906. It is the property of the American Pharmaceutical Association. Its origin dates from 1882 when Charles Rice, Ph. D., organized a Committee from New York and Brooklyn to frame a book of formulas for unofficial preparations. The New York and Brooklyn Formulary was subsequently enlarged and the joint Committee presented it to the American Pharmaceutical Association in 1885 as the nucleus for the construction of the National Formulary. The work has gone through three Editions and a fourth is in preparation. It is quoted in the national and state laws as of equal authority with the Pharmacopœia.

It is important to remember that if a drug or preparation is sold under or by a name recognized in the U. S. Pharmacopœia or National Formulary it must not differ from the standard of strength, quality or purity determined by the tests laid down in either of these books official at the time of investigation. A drug or preparation is not deemed to be adulterated if it differs from the official standards, provided such standards be plainly stated upon the bottle, box or container.

Dispensatories

A dispensatory is a commentary on a pharmacopœia. The U. S. Pharmacopœia describes the drugs and chemical substances of the materia medica, establishes the degree of purity of many of them, and defines the strength of the preparations. The dispensatories comment on the substances, giving their physical, medical, and pharmaceutical history, with their doses and uses. The number of substances noticed in the Pharmacopœia is limited. On the other hand, the dispensatories present information about those which are official in our own and other pharmacopœias, and those which are of occasional or rare use, in addition. There are at present two dispensatories which comment especially upon the materia medica and preparations of the U. S. Pharmacopœia,—the United States Dispensatory, which was first published in 1833, and the National Dispensatory, which was first issued in 1879. King's American Dispensatory, adopted by the National Eclectic Medical Association in 1879 as its standard authority, is especially designed for the use of Eclectic practitioners. The plans of these works are similar. The text of the Pharmacopœia is first inserted, and immediately following are appended the comments of the authors and editors. The arrangement of the subjects is strictly alphabetical, the United States Dispensatory dividing them, however, into two classes, distinguished by type of two sizes. The principal portion of the work, that in the larger type, is devoted to a commentary on the preparations of the United States and other Pharmacopœias; the unofficial and less important subjects are to be found in the second part. In the National Dispensatory the unofficial substances are considered either in the body of the book or under subdivisions as allied drugs. The possession of a reliable commentary upon the Pharmacopœia is a *necessity* which is fully realized by pharmacists. The United States Dispensatory is now preferred as a guide, and hence will be frequently quoted.

PART I

CHAPTER I

METROLOGY

Weight, Measure, and Specific Gravity

METROLOGY formerly and according to its strictest signification meant the science of measures, but its present definition includes the measure of the gravitating force of bodies, which always bears a direct ratio to their mass, and is commonly called *weight;* the determination of the bulk or extent of the body, its *measure;* and the relation which measure bears to weight when compared with a standard is known as *specific gravity.*

Weight

A knowledge of the systems of weights and measures in use must necessarily command the early attention of the student, and a short account of the origin of the present systems may be of service in fixing upon the mind the essential distinctions between them. The sense of the weight of a body cannot be conveyed intelligibly to the mind unless a means of comparison is chosen, and as weight is the measure of the gravitating force of a body, so this force is expressed as related to a standard of resistance, this being exactly that which would balance the body and keep it in equilibrium. Such standards are termed *weights.*

The standards which have been chosen by various nations are arbitrary, and instances are common where different standards are in use at the same time in the same country. Many of the ancient standards are clearly referable to parts of the human body, as nail, foot, span, pace, cubit (length of the forearm), orgyia (stretch of the arms). In the history of metrology three periods may be traced: 1. The *Ancient,* during which the old classical standards originated, and which terminated with the decline of the Roman Empire. 2. The *Mediæval,* extending to the sixteenth century. In this period the old standards were lost, but their names were preserved, and European nations adopted various independent standards. 3. The *Modern.* Since the seventeenth century the efforts of most enlightened nations have been directed toward greater accuracy and simplicity, and during the present century toward international uniformity.

In Great Britain, in the year 1266, the 51st act of the reign of Henry III. declares "that by the consent of the whole realm of England the measure of the King was made,—that is to say, that an English silver penny called the sterling, round and without clipping, shall weigh *thirty-two grains of wheat,* well dried and gathered out of the middle of the ear; and twenty pence (pennyweights) do make an ounce, and twelve ounces a pound, and eight pounds do make a gallon of wine, and eight wine gallons do make a bushel, which is the eighth of a quarter."

The sixteen-ounce pound (avoirdupois) was derived from a more ancient source, and was undoubtedly of Roman origin, and introduced at the time of the first civilization of the British island. The word "haberdepois," according to Gray, was, however, first used in English laws in 1303.

A statute of Edward I. (A.D. 1304) states "that every *pound* of money or of *medicines* is of *twenty shillings weight*, but the pound of all other things is *twenty-five shillings weight*. The *ounce* of *medicines* consists of *twenty pence*, and the *pound* contains *twelve* ounces (the Tower Pound), but in other things the pound contains *fifteen* ounces, in both cases the ounce weighing twenty pence."

These laws unfold the theory of the ancient weights and measures of Great Britain, and reveal the standard,—*i.e.*, a natural object, grains of wheat; a difference existed then between the troy and the avoirdupois pound, but the weights now in use are one-sixteenth heavier than those of Edward I., owing to the change made in the value of the coin by the sovereign subsequently; in addition to this, the true pennyweight standard was lost, and on the next revision of the weights and measures the present troy and avoirdupois standards were adopted. The old Tower or troy ounce and the avoirdupois ounce were intended to have the same weight, but after the revision it was found that the troy ounce was heavier than the avoirdupois ounce by forty-two and a half grains.

The subsequent adoption of troy weight by the London College of Physicians in 1618, on the recommendation of Sir Theodore Turquet de la Mayerne, who compiled their first Pharmacopœia, has entailed upon all apothecaries who are governed by British customs, to this day, the very great inconvenience of buying and selling medicines by one system of weights and compounding them by another.

In the next century efforts were made toward reforming the standards, and the Royal Society, in 1736, began the work, which ended in the preparation, under the direction of the House of Commons, by Mr. Bird, of the standard "yard" and standard "pound" troy in 1760. Copies of these have been made, no intentional deviation has been made since, and they are still the standards used most largely in the United States. In 1816, on account of the growing popularity of the French metrical system, and in view of the desirability of securing a standard which could easily be recovered in case of loss or destruction and which should be commensurable with a simple unit, steps were taken in England to secure these advantages. The labors of English scientists led to the adoption of the *Imperial* measures and standards, which were legalized January 1, 1826, and are now in general use in Great Britain.

In this system the *yard* is equivalent to 36 inches, and its length was determined by comparison with a pendulum beating seconds of mean time, in a vacuum, at the temperature of 62° F. at the level of the sea, in the latitude of London, which length was found to be 39.1393 inches. The *pound troy* (containing 5760 grains) was determined by comparison with a given measure of distilled water under certain conditions. Thus, a cubic inch of distilled water was weighed with brass weights in air at 62° F., the barometer at 30 inches, and it weighed 252.458 grains. The standard for measures of capacity (either dry or liquid) is the *gallon*, and this contains 10 pounds avoirdupois (each 7000 grains) of distilled water weighed in air at 62° F., the barometer standing at 30 inches, the *bushel* containing 8 such gallons. In 1819–20 efforts were made in the United States to secure uniformity in the standards which were in use by the several States. Finally, after a lengthy investigation, the Secretary of the Treasury, on June 14, 1836, was directed by Congress to furnish each State in the Union with a complete set of the revised standards, and thus we have the *troy pound* (5760 grains), the *avoirdupois pound* (7000 grains), and the *yard* (36 inches) all identical with the British standards; but the *gallon* is quite different, the old wine gallon of 231 cubic inches, containing 58372.2 grains of distilled water at its maximum density, weighed in air of the temperature of 62° F., the barometer standing at 30 inches, *being retained*, while the bushel contains 77.6274 pounds of water under the same conditions.[1]

In 1864 the use of the metric measures was legalized in Great Britain, but not made compulsory, and in 1866 the United States followed the same course.

By the United States law of July 28, 1866, all lengths, areas, and cubic measures are derived from the international meter equivalent to 39.37 inches. Since 1893 the United States Office of Standard Weights and Measures has been authorized to derive the yard from the meter, 1 yard equals $\frac{3600}{3937}$ meter, and the customary weights are referred to the kilogramme by Executive order approved April 5, 1893. All capacities are based on the equivalent 1 cubic decimeter equals 1 liter, the decimeter being equal to 3.937 inches. The gallon still remains at 231 cubic inches and the bushel contains 2150.42 cubic inches. The customary weights are derived from the international kilogramme based on the value that 1 avoirdupois pound = 453.5924277 grammes and that $\frac{5760}{7000}$ avoirdupois pound equals 1 troy pound.

Apothecaries' Weight (also called Troy Weight)

Pound		Troy Ounces		Drachms		Scruples		Grains
1	–	12	=	96	=	288	=	5760
		℥ 1	=	8	=	24	=	480
				ʒ 1	=	3	=	60
						℈ 1	=	gr. 20

The British Pharmacopœia, while giving alternative equivalents in the metric system, has adopted avoirdupois weight (termed Imperial weight) for expressing quantities which are to be weighed. Avoirdupois weight is also in general use in the United States for commercial purposes.

Avoirdupois Weight

Pound		Ounces		Grains
℔ 1	=	16	=	7000
		oz. 1	=	437.5

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[1] Slight variations in these original equivalents are recommended by various investigators, and have been in use since Hassler made his report in 1832. (See Barnard on the Metric System, page 153.)

It will be observed that the troy ounce contains 42½ grains *more* than the avoirdupois ounce, while the troy pound contains 1240 grains *less* than the avoirdupois pound. Fortunately, one unit common to troy, or apothecaries', and avoirdupois weight has been saved,—namely, *the grain.* The abbreviations of the denominations of apothecaries' weight are represented by the signs ℥, ounce, ʒ, drachm, ℈, scruple, and gr. grain; these have long been in use, but are very likely to be mistaken for one another in rapid or careless writing. The abbreviations or signs for avoirdupois weight differ from those of troy weight, and care should be used not to confound them; they are lb., pound, oz., ounce, gr., grain.

Measures

Apothecaries' or Wine Measure, U.S.

Gallon		Pints		Fluidounces		Fluidrachms		Minims
Cong. 1	=	8	=	128	=	1024	=	61440
		O. 1	=	**16**	=	128	=	7680
				f℥ 1	=	8	=	480
						fʒ 1	=	♏ 60

Imperial Measure, Br.

(Adopted by the British Pharmacopœia)

Gallon		Pints		Fluidounces		Fluidrachms		Minims
C. 1	=	8	=	160	=	1280	=	76800
		O. 1	=	**20**	=	160	=	9600
				fl. oz. 1	=	8	=	480
						fl. dr. 1	=	min. 60

When the subject of the weights and measures in ordinary use is studied, the want of simplicity and close relation is clearly apparent. The pint of distilled water at 15.6° C. (60° F.) weighs 7291.2 grains, the fluidounce 455.7 grains, and at 25° C. (77° F.), the temperature adopted for taking specific gravities and solubilities by the U. S. P. (8th Rev.), the pint weighs 7273.3 grains and the fluidounce 454.6 grains, or, more accurately, 454.581 grains. We have thus three ounces in use of different values,—troy ounce, 480 grains; avoirdupois ounce, 437.5 grains; and fluidounce, 454.6 grains.

The U. S. gallon of water weighs 8.33 avoirdupois pounds, and the pint weighs 1.0416 avoirdupois pounds; the pound equals 0.9601 pints.

The Imperial measure differs from our wine measure principally in having twenty fluidounces in the pint instead of sixteen. A convenient relation exists, however, between measure and weight in the *Imperial gallon, which contains ten avoirdupois pounds of water* at 15.6° C. (60° F.).

The Imperial fluidounce contains the same number of grains as the avoirdupois ounce (437.5), which is 18.2 grains less than that of the U. S. fluidounce of water at the same temperature (455.7). Although this difference may be considered trifling in one fluidounce, it is not so when multiplied by four or eight, and this is one serious objection to the use of the English graduated measures in the United States, because they indicate Imperial fluidounces instead of U. S. fluidounces.

Approximate Measures

In apportioning doses for a patient, the practitioner is usually compelled to order the liquid medicine to be administered in certain quantities that have been established by custom, and estimated as follows:

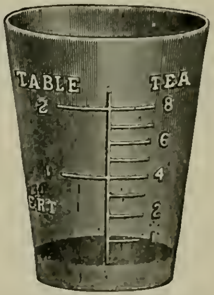
	Old form	Metric
A tumblerful	f℥viii	240 Cc.
A teacupful	f℥iv	120 Cc.
A wineglassful	f℥ii	60 Cc.
A tablespoonful	fʒiv	16 Cc.
A dessertspoonful	fʒii	8 Cc.
A teaspoonful	fʒi	4 Cc.

A drop, through a popular error, is considered to be 1 minim.[1]

The equivalents given above for the teaspoonful, dessertspoonful, and tablespoonful are authorized by the U. S. P. (8th Rev.).

In almost all cases the modern teacups, tablespoons, dessertspoons, and teaspoons, after careful tests by the author, were found to average 25 percent. greater capacity than the theoretical quantities given above, and the use of accurately graduated medicine glasses, which may be had now at a trifling cost, should be insisted upon (see Fig. 1).

FIG. 1



Graduated medicine glass

The Metric System.—This system, which originated with Prince de Talleyrand, Bishop of Autun, France, in 1790, seems destined to become universal, as it is now legally used by the majority of all civilized nations, and finds especial favor with scientists even in countries where its use is not compulsory. The starting-point was the *unit of length*, the **meter**, which is the $\frac{1}{40.000.000}$ part of the earth's circumference around the poles. From this, the *unit of capacity* was derived, the **liter**, which is the cube of $\frac{1}{10}$ part of a meter. The *unit of weight*, the **gramme**, was also derived from the meter, it being the weight of that quantity of distilled water, at its maximum density, 4° C. (39.2° F.), which will fill the cube of $\frac{1}{100}$ part of a meter.[2] The name Metrical System, it will thus be seen, is very appropriate, as *each unit is derived from the meter;* it is also known as the *Decimal System*, because in obtaining the multiples and subdivisions the number ten (*decem*) is used solely. The prefixes, which indicate *multiplication*, are of Greek derivation, and are usually spelled with a capital letter,—**Deka**, 10; **Hecto**, 100; **Kilo**, 1000; **Myria**, 10,000; while *division* of the units is expressed by Latin prefixes, the initial letters not being capitals,—**deci**, $\frac{1}{10}$; **centi**, $\frac{1}{100}$; **milli**, $\frac{1}{1000}$. The word Gild has been suggested as a useful mnemonic, thus:

G	I	L	D
reek	ncreases,	atin	ecreases

---

[1] See comparative table, page 73.

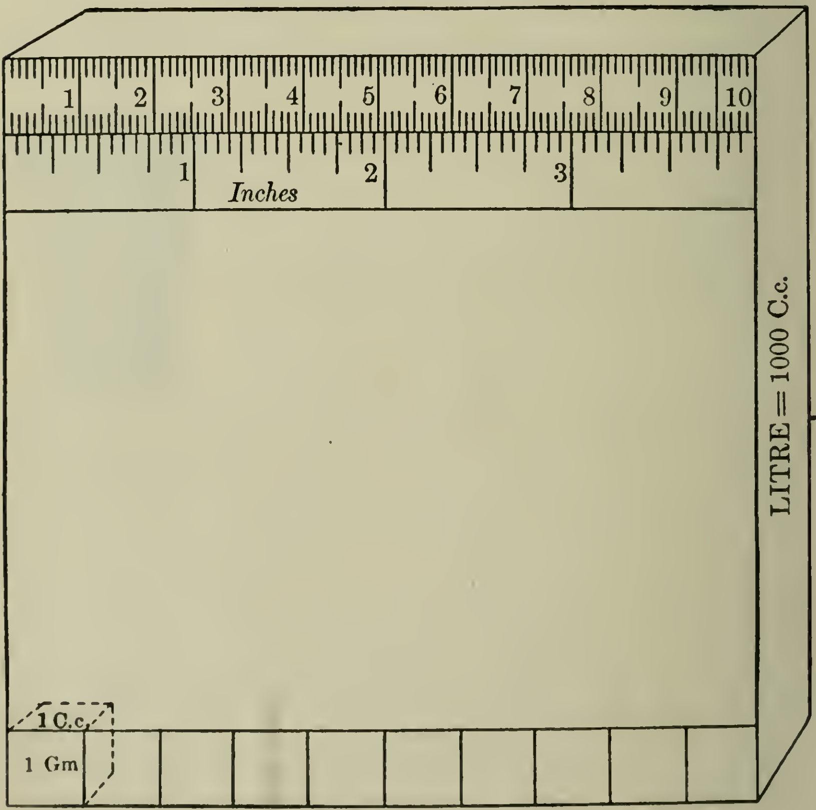
[2] The unit of surface measure, the *are*, being the square of ten meters, and the unit of solid measure, the *stere*, having the capacity of a cubic meter need not claim the attention of the practical pharmacist.

The following table gives a view of the system adapted to the use of the student :

	Abbreviation	Meter		Abbreviation	Liter		Abbreviation	Gramme
1 milli	meter, mm. =	.001	1 milli	liter, ml. =	.001	1 milli	gramme, mg. =	.001
1 centi	meter, cm. =	.01	1 centi	liter, cl. =	.01	1 centi	gramme, cg. =	.01
1 deci	meter, dm. =	.1	1 deci	liter, dl. =	.1	1 deci	gramme, dg. =	.1
	Meter, M.	**1.**		**Liter, L.**	**1.**		**Gramme, Gm.**	**1.**
1 Deka	meter, Dm. =	10.	1 Deka	liter, Dl. =	10.	1 Deka	gramme, Dg. =	10.
1 Hecto	meter, Hm. =	100.	1 Hecto	liter, Hl. =	100.	1 Hecto	gramme, Hg. =	100.
1 Kilo	meter, Km. =	1000.	1 Kilo	liter, Kl. =	1000.	1 Kilo	gramme, Kg. =	1000.
1 Myria	meter, Mm. =	10000.	1 Myria	liter, Ml. =	10000.	1 Myria	gramme, Mg. =	10000.

In pharmaceutical practice a number of the above measures are rarely or never used. Of the measures of length, the *millimeter* (mm.) and *centimeter* (cm.) are employed in the U. S. Pharmacopœia in the descriptions of drugs, accompanied by the equivalent measure in inches or its fractions, while in microscopy *micromillimeter* (mkm.), or preferably, micron (μ), signifying the thousandth part of a millimeter, is used. In measures of capacity, the term *milliliter* is generally replaced by *cubic centimeter* (Cc.) in chemical and pharmaceutical prac-

FIG. 2



Metric diagram

tice, while it and the liter are alone chosen as the most convenient units. In weight, the *milligramme*, *centigramme*, *gramme*, and *kilogramme* are selected; the latter being the commercial unit for larger quantities of drugs, and called *kilo.* This habit of appropriating only certain of the most convenient denominations for practical work has an analogy in the disuse of the theoretical terms of the system of United States coinage. Thus, the double eagle, eagle, and dime are ignored, while dollars and cents are preferred as units. The principal merits of the metric system are: 1. That every weight and measure bears a simple relation to the initial unit, the meter. 2. That every unit is multiplied or divided by the same number (*i.e.*, 10) to obtain the various denominations, and increase or decrease is expressed by simply moving the decimal point. 3. Its almost universal adoption makes it an international system.

Length.—*Meter.* Each side of the square (Fig. 2) measures 1 decimeter, one is graduated into tenths (*centimeters*); and these into tenths (*millimeters*); (the scale beneath shows the comparison with inches): 10 decimeters = 1 METER = 39.3700 in. (remember three threes, 3 ft., 3 in., 3 eighths).

Capacity.—*Liter.* A hollow cube having each side of the same size as the square would hold a LITER = 1000 Cc. = 2.1133 pints.

Weight.—*Gramme.* The weight of distilled water at 4° C. (39.2° F.) contained in a cube of the $\frac{1}{1000}$ of a liter is equal to a GRAMME = 15.432 grains, and measures 1 *cubic centimeter* (see Fig. 2).

The advantages of the metric system have become more and more apparent upon examination, and its simplicity, brevity, and adaptability to everyday needs are now universally conceded. The progress which it had made in this country up to 1890 fully warranted its exclusive adoption in the U. S. Pharmacopœia; hence definite quantities were given and metric weights and measures alone employed. The necessity for knowing thoroughly the denominations of all the systems in present use is one of the evils common to the age in which we live, and it must ever be a source of regret that when the young Republic, more than a century ago, abolished the complex system of coinage and adopted the decimal system, it did not go a step farther and adopt the same principle in weights and measures.

The chief disadvantage of the metric system is one which inheres to the decimal principle of arithmetic,—namely, that the number ten cannot be divided more than once without producing a fraction, as, 10, 5, 2.5, 1.25, 0.625. The practice of dividing five into the three parts of 2, 2, and 1 partly compensates for this defect, and metric weights are constructed on this principle. The use of the metric weights and measures in the text of the U. S. Pharmacopœia makes it necessary for every pharmacist to become familiar with them, and therefore an easy method of remembering their relations to one another and their equivalents in other systems is desirable. The following equivalents are derived from those established by Congress for use in legal proceedings, or are based upon the trustworthy determinations of Captain Clarke and Prof. Miller, while the accompanying rules, which show the methods of using the equivalents, are preferred, for scientific determinations, on account of giving more accurate results. When very fine calculations are unnecessary, it will be found that the tables of equivalents given on pages 46 to 54 will prove sufficiently accurate for most pharmaceutical work.

To convert metric weights or measures into those in ordinary use :

Rule.—**Multiply the metric quantities by the corresponding equivalent.**

Ex.—The equivalent of *one meter* is 39.370+ inches, and five meters would be 196.85 inches : 39.370 × 5 = 196.85. To convert

Meters	into	*inches,*	multiply by	39.370
Centimeters	“	*inches,*	“	0.3937
Millimeters	“	*inches,*	“	0.03937

As *one liter*, or 1000 *Cc.*, is equal to 33.8149+ fluidounces, or 35.235 Imperial fluidounces, to convert

Liters	into	*fluidounces,*	multiply by	33.815
Cubic centimeters	“	*fluidounces,*	“	0.0338
Liters	“	*pints,*	“	2.113
Liters	“	*Imperial pints,*	“	1.7617
Liters	“	*Imperial gallons,*	“	0.2202
Cubic centimeters	“	*Imperial fluidounces,*	“	0.0352

As *one gramme* is equal to 15.432+ grains, or 0.03527 avoirdupois ounce, or 0.03215 troy ounce, to convert

Grammes	into	*grains,*	multiply by	15.432
Centigrammes	“	*grains,*	“	0.15432
Milligrammes	“	*grains,*	“	0.01543
Kilogrammes	“	*avoirdupois ounces,*	“	35.2739
Grammes	“	*avoirdupois ounces,*	“	0.03527
Kilogrammes	“	*avoirdupois pounds,*	“	2.2046
Kilogrammes	“	*troy ounces,*	“	32.1507
Grammes	“	*troy ounces,*	“	0.03215

To convert the weights and measures in ordinary use into metric weights and measures :

Rule.—**Multiply the quantities by the corresponding metric equivalent.**

As *one inch* is equal to 0.0254 meter, *one fluidounce* to 29.572+ cubic centimeters, *one Imperial fluidounce* to 28.3807 cubic centimeters, *one* grain to 0.0648 gramme, *one avoirdupois ounce* to 28.3495 grammes, and *one troy ounce* to 31.1035 grammes, to convert

Inches	into	*meters,*	multiply by	0.0254
Inches	“	*centimeters,*	“	2.5399
Inches	“	*millimeters,*	“	25.3997
Pints	“	*liters,*	“	0.4731
Fluidounces	“	*cubic centimeters*	“	29.572
Imperial pints	“	*liters,*	“	0.5676
Imperial gallons	“	*liters,*	“	4.5409
Imperial fluidounces	“	*cubic centimeters,*	“	28.3807
Grains	“	*grammes,*	“	0.0648
Grains	“	*centigrammes,*	“	6.4799
Grains	“	*milligrammes,*	“	64.799
Avoirdupois ounces	“	*kilogrammes,*	“	0.02835

Avoirdupois ounces	into	*grammes,*	multiply by	28.3495
Avoirdupois pounds	"	*kilogrammes,*	"	0.4536
Troy ounces	"	*kilogrammes,*	"	0.0311
Troy ounces	"	*grammes,*	"	31.1035

It will be observed that there is a slight difference in the smaller quantities, increasing in the larger, between the equivalents in the following tables and those above given. This is owing to the fact that the temperature used as a basis for the metric units is 4° C., instead of 15.6° C., the usual temperature in practice, and the equivalents in the old form weights and measures in the table must correspond. The column upon the left of the page gives the weight in grains from one hundred pounds down; the difference in value from the next column is due to the variation in temperature standards; the fluidounce equivalent at 15.6° C. (60° F.) is 455.7 grains; the fluidounce at 25° C. (77° F.) weighs 454.6 grains; the fluidounce at 4° C. (39.2° F.) in vacuo weighs 456.392 grains. For practical work in pharmacy the discrepancy is too trivial to give serious annoyance.

TABLE OF METRIC AND OLD FORM EQUIVALENT WEIGHTS AND MEASURES

(100 lbs. av. to $\frac{1}{1000}$ of a grain)

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.				
Equivalent in grains. (Temp. 15.4° C., 60° F.)*	Grains.	Avoirdupois.				Fluid.				Fluid-ounces and fractions.
		lb.	oz.	grains.	Gm.] [Cc.	gal.	pts.	fluid oz.	minims.	
698938.5	**700000**	**100**	...	......	45359.2	11	7	13	369.1	1533.769
693403.1	694456.0	99	3	143.5	**45000**	11	7	1	298.6	1521.622
677994.3	679023.7	97	0	23.7	**44000**	11	4	15	388.0	1487.808
663991.8	**665000**	**95**	...	......	43091.3	11	3	1	38.9	1457.081
647176.5	648159.0	92	9	221.5	**42000**	11	0	12	86.9	1420.181
641625.6	642599.6	91	12	349.6	41639.8	**11**	...	...	......	**1408**
629044.6	**630000**	**90**	...	......	40823.3	10	6	4	188.2	1380.392
616358.4	617294.3	88	2	419.3	**40000**	10	4	8	265.4	1352.553
594097.5	**595000**	**85**	...	......	38555.4	10	1	7	337.4	1303.703
585540.3	586429.5	83	12	179.5	**38000**	10	0	4	444.0	1284.925
583296.0	584181.4	83	7	118.9	37854.3	**10**	...	...	......	**1280**
559150.7	**560000**	**80**	...	......	36287.4	9	4	11	7.2	1227.015
554722.7	555564.8	79	5	377.3	**36000**	9	4	1	142.8	1217.298
524966.4	525763.3	75	1	325.8	34068.9	**9**	...	...	......	**1152**
524203.6	**525000**	**75**	...	......	34019.4	8	7	14	156.5	1150.326
523904.2	524700.1	74	15	137.6	**34000**	8	7	13	320.1	1149.669
493086.5	492835.4	70	8	335.3	**32000**	8	3	10	20.2	1082.042
489256.8	**490000**	**70**	...	......	31751.5	8	3	1	306.2	1073.638
466636.8	467345.2	66	12	95.2	30283.5	**8**	...	...	......	**1024**
462268.9	462970.7	66	2	95.7	**30000**	7	7	6	199.2	1014.415
454309.7	**455000**	**65**	...	......	29483.5	7	6	4	455.5	996.949
431450.8	432106.0	61	11	293.4	**28000**	7	3	2	377.8	946.787
419362.9	**420000**	**60**	...	......	27215.5	7	1	8	.....	920.261
408307.2	408927.0	58	6	302.0	26498.0	**7**	...	...	......	**896**
400632.8	401241.3	57	5	53.8	**26000**	6	6	15	76.3	879.159
385224.2	385808.9	55	1	371.4	**25000**	6	4	13	166.1	845.346
384416.2	**385000**	**55**	...	.....	24947.6	6	4	11	275.0	843.573
369815.1	370376.6	52	14	251.6	**24000**	6	2	11	255.4	811.532
349977.6	350509.0	50	1	71.4	22712.6	**6**	...	...	....	**768**
349169.1	**350000**	**50**	...	......	22679.6	5	7	14	421.3	766.884
338997.1	339511.8	48	8	11.8	**22000**	5	6	7	434.0	743.904
314522.3	**315000**	**45**	...	......	20411.7	5	3	2	94.1	690.196
308179.0	308647.1	44	1	209.6	**20000**	5	2	4	132.5	676.276
291648.0	292090.7	41	11	178.2	18927.2	**5**	...	...	......	**640**
279575.1	**280000**	**40**	...	......	18143.7	4	6	5	243.4	613.507
277360.9	277782.4	39	10	407.4	**18000**	4	6	0	311.0	608.648
246513.3	246917.7	35	4	167.7	**16000**	4	1	13	10.4	541.021
244628.4	**245000**	**35**	...	......	15875.7	4	1	8	393.1	536.819
233318.4	233672.6	33	6	47.6	15141.7	**4**	...	...	......	**512**
231134.2	231485.3	33	1	47.8	**15000**	3	7	11	99.4	507.207

* For explanation, see page 45.

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.				
Equivalent in grains. (Temp. 15.4° C., 60° F.)	Grains.	Avoirdupois.				Fluid.				Fluid-ounces and fractions.
		lb.	oz.	grains.	Gm.] [Cc.	gal.	pts	fluid oz.	minims.	
215725.2	216053.0	30	13	365.5	**14000**	3	5	9	188.6	473.393
209763.3	**210000**	**30**	...	......	13607.8	3	4	12	62.9	460.131
184907.1	185188.3	26	7	125.8	**12000**	3	1	5	367.2	405.765
174988.8	175254.4	25	0	254.4	11356.3	**3**	...	...	......	**384**
174734.5	**175000**	**25**	...	......	11339.8	2	7	15	212.2	383.442
154089.5	154323.6	22	0	323.6	**10000**	2	5	2	66.2	338.138
139787.3	**140000**	**20**	...	......	9071.8	2	3	2	361.4	306.753
138680.4	138891.2	19	13	203.7	**9000**	2	3	0	155.5	304.324
123718.6	123458.9	17	10	83.9	**8000**	2	0	14	245.2	270.511
116659.2	116836.3	16	11	23.8	7570.9	**2**	...	...	......	**256**
107862.8	108026.5	15	6	401.5	**7000**	1	6	12	334.6	236.697
104840.6	**105000**	**15**	...	......	6803.9	1	6	6	31.2	230.065
97851.4	**98000**	**14**	...	......	6350.3	1	5	6	349.2	214.728
92453.7	92594.1	13	3	281.6	**6000**	1	5	4	423.8	202.883
90862.0	**91000**	**13**	...	......	5896.7	1	4	7	187.2	199.390
83872.6	**84000**	**12**	...	......	5443.1	1	3	8	25.1	184.052
77044.8	77161.8	11	0	161.8	**5000**	1	2	9	33.1	169.069
76883.2	**77000**	**11**	...	......	4989.5	1	2	8	343.2	168.715
69893.9	**70000**	**10**	...	......	4535.9	1	1	9	180.9	153.377
69340.3	69445.6	9	14	320.6	**4500**	1	1	8	77.8	152.162
62904.4	**63000**	**9**	...	......	4082.3	1	...	10	18.8	138.039
61635.8	61729.4	8	13	41.9	**4000**	1	...	7	122.5	135.255
58329.6	58418.1	8	5	230.6	3785.4	**1**	...	...	......	**128**
55915.1	**56000**	**8**	...	......	3628.7	...	...	122	336.7	122.701
53931.3	54013.2	7	11	200.7	**3500**	...	...	118	167.2	118.348
48925.7	**49000**	**7**	...	......	3175.1	...	...	107	174.6	107.364
46226.9	46297.1	6	9	359.6	**3000**	...	...	101	211.9	101.441
45570.0	45639.2	6	8	139.2	2957.4	...	...	**100**	......	**100**
43747.2	43813.6	6	4	63.6	2839.1	...	...	**96**	......	**96**
41936.3	**42000**	**6**	...	......	2721.6	...	...	92	125.3	92.026
41013.0	41075.3	5	13	387.8	2661.6	...	...	**90**	.....	**90**
38522.6	38580.9	5	8	80.9	**2500**	...	...	84	256.8	84.535
36456.0	36511.4	5	3	198.9	2365.9	...	...	**80**	......	**80**
34946.9	**35000**	**5**	...	......	2268.0	...	...	76	330.2	76.688
31899.0	31947.4	4	9	9.9	2070.2	...	...	**70**	......	**70**
30817.9	30864.7	4	6	239.7	**2000**	...	...	67	301.2	67.628
29276.9	29321.5	4	3	9.0	**1900**	...	...	64	118.1	64.246
29164.8	29209.1	4	2	334.1	1892.7	...	...	**64**	......	**64**
27957.5	**28000**	**4**	...	......	1814.4	...	...	61	168.4	61.351
27736.1	27778.2	3	15	215.7	**1800**	...	...	60	415.1	60.865
27342.0	27383.5	3	14	258.5	1774.4	...	...	**60**	......	**60**
26195.2	26235.0	3	11	422.5	**1700**	...	...	57	232.1	57.484
24654.3	24691.8	3	8	191.8	**1600**	...	...	54	49.0	54.102
23113.4	23148.5	3	4	398.5	**1500**	...	...	50	346.0	50.721
22785.0	22819.6	3	4	69.6	1478.685	...	...	**50**	......	**50**
22329.3	22363.2	3	3	50.7	1449.111	...	...	**49**	......	**49**
21873.6	21906.8	3	2	31.8	1419.538	...	...	**48**	......	**48**
21572.5	21605.3	3	1	167.8	**1400**	...	...	47	162.8	47.339
21417.9	21450.4	3	1	12.9	1389.964	...	...	**47**	......	**47**
20968.1	**21000**	**3**	...	......	1360.778	...	...	46	6.3	46.013
20962.2	20994.0	2	15	431.5	1360.390	...	...	**46**	......	**46**
20506.5	20537.6	2	14	412.6	1330.817	...	...	**45**	......	**45**

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.				
Equivalent in grains. (Temp. 15.4° C., 60° F.)	Grains.	Avoirdupois.				Fluid.				Fluid-ounces and fractions.
		lb.	oz.	grains.	Gm.] [Cc.	gal.	pts.	fluid oz.	minims.	
20050.8	20081.2	2	13	393.7	1301.243	...	...	**44**	......	**44**
20031.7	20062.1	2	13	374.6	**1300**	...	...	43	459.8	43.958
19595.1	19624.9	2	12	374.9	1271.669	...	...	**43**	......	**43**
19193.4	19168.5	2	11	356.0	1242.095	...	...	**42**	......	**42**
18683.7	18712.1	2	10	337.1	1212.522	...	...	**41**	......	**41**
18490.8	18518.8	2	10	143.8	**1200**	...	...	40	276.8	40.577
18228.0	18255.7	2	9	318.2	1182.948	...	...	**40**	......	**40**
17772.3	17799.3	2	8	299.3	1153.374	...	...	**39**	......	**39**
17316.6	17342.9	2	7	280.4	1123.801	...	...	**38**	......	**38**
16949.8	16975.6	2	6	350.6	**1100**	...	...	37	93.6	37.195
16860.9	16886.5	2	6	261.5	1094.227	...	...	**37**	......	**37**
16405.2	16430.1	2	5	242.6	1064.653	...	...	**36**	......	**36**
15949.5	15973.7	2	4	223.7	1035.080	...	...	**35**	......	**35**
15493.8	15517.3	2	3	204.8	1005.506	...	...	**34**	......	**34**
15409.0	15432.4	2	3	119.9	**1000**	...	...	33	390.6	33.814
15336.6	15060.9	2	2	185.9	975.932	...	...	**33**	......	**33**
14638.5	14660.7	2	1	223.2	**950**	...	...	32	59.1	32.123
14582.4	14604.5	2	1	167.0	946.358	...	...	**32**	......	**32**
14126.7	14148.2	2	...	148.2	916.875	...	...	**31**	......	**31**
13979.1	**14000**	**2**	...	......	907.185	...	...	30	324.2	30.676
13867.9	13889.1	1	15	326.6	**900**	...	...	30	207.6	30.432
13671.0	13691.8	1	15	129.3	887.211	...	...	**30**	......	**30**
13542.0	13562.5	**1**	**15**	......	878.635	...	...	29	344.1	29.717
13215.3	13235.0	1	14	10.4	857.637	...	...	**29**	......	**29**
13105.5	**13125**	**1**	**14**	......	850.486	...	...	28	363.9	28.759
13097.7	13117.5	1	13	430.0	**850**	...	...	28	356.0	28.742
12759.6	12779.0	1	13	91.5	828.064	...	...	**28**	......	**28**
12668.5	12687.5	**1**	**13**	......	822.136	...	..	27	383.8	27.800
12327.1	12345.9	1	12	95.9	**800**	...	...	27	24.5	27.051
12303.9	12322.6	1	12	72.6	798.490	...	...	**27**	......	**27**
12231.4	**12250**	**1**	**12**	......	793.787	...	...	26	403.7	26.841
11848.2	11866.2	1	11	53.7	768.916	...	...	**26**	......	**26**
11794.9	11812.5	**1**	**11**	......	765.437	...	...	25	423.6	25.883
11556.6	11574.3	1	10	199.0	**750**	...	...	25	173.0	25.360
11392.5	11409.8	1	10	31.8	739.343	...	...	**25**	......	**25**
11357.9	**11375**	**1**	**10**	......	737.087	...	...	24	443.4	24.924
10936.8	10953.4	1	9	15.9	709.769	...	...	**24**	......	**24**
10921.3	10937.5	**1**	**9**	......	708.738	...	...	23	463.3	23.966
10786.4	10802.6	1	8	302.6	**700**	...	...	23	321.4	23.670
10484.3	**10500**	**1**	**8**	......	680.388	...	...	23	3.1	23.007
10481.1	10497.0	1	7	434.5	680.195	...	...	**23**	......	**23**
10047.3	10062.5	**1**	**7**	......	652.039	...	...	22	23.0	22.048
10025.4	10040.6	1	6	415.6	650.621	...	...	**22**	......	**22**
10015.8	10031.0	1	6	406.0	650.	...	...	21	469.9	21.979
9610.7	**9625**	**1**	**6**	......	623.689	...	...	21	42.9	21.09
9569.7	9584.2	1	5	396.7	621.048	...	...	**21**	......	**21**
9245.2	9259.4	1	5	71.9	**600**	...	...	20	138.1	20.288
9173.7	9187.5	**1**	**5**	......	595.340	...	...	20	62.7	20.131
9114.0	9127.8	1	4	377.8	591.471	...	...	**20**	......	**20**
8736.7	**8750**	**1**	**4**	......	566.990	...	...	19	82.6	19.172
8658.3	8671.4	1	3	358.9	561.900	...	...	**19**	......	**19**
8475.1	8487.8	1	3	175.0	**550**	...	...	18	286.8	18.598

Weights, Old Form.					Metric Weight and Measure.	Measures, Old Form.				
Equivalent in grains. (Temp. 15.4° C., 60° F.)	Grains.	Avoirdupois.				Fluid.				Fluid-ounces and fractions.
		lb.	oz.	grains.	Gm.] [Cc.	gal.	pts.	fluid oz.	minims.	
8300.1	8312.5	**1**	**3**	......	538.641	...	...	18	102.5	18.214
8202.6	8215.1	1	2	340.1	532.327	...	...	**18**	......	**18**
7863.1	**7875**	**1**	**2**	......	510.291	...	...	17	122.4	17.255
7746.9	7758.7	1	1	321.2	502.753	...	...	**17**	......	**17**
7704.5	7716.2	1	1	278.7	**500**	...	...	16	435.3	16.907
7426.5	7437.5	**1**	**1**	......	481.942	...	...	16	142.2	16.297
7291.2	7302.3	1	...	302.3	473.179	...	...	**16**	......	**16**
6989.5	**7000**	**1**	...	......	453.592	...	...	15	162.1	15.338
6933.9	6944.6	...	15	382.1	**450**	...	...	15	103.8	15.216
6835.5	6845.9	...	15	283.4	443.606	...	...	**15**	......	**15**
6552.5	6562.4	...	**15**	......	425.243	...	...	14	182.0	14.379
6379.8	6389.5	...	14	264.5	414.032	...	...	**14**	......	**14**
6163.8	6172.9	...	14	47.9	**400**	...	...	13	252.3	13.526
6115.9	**6125**	...	**14**	......	396.893	...	...	13	201.8	13.421
5924.1	5933.1	...	13	245.6	384.458	...	...	**13**	......	**13**
5678.9	5687.5	...	**13**	......	368.544	...	...	12	221.7	12.462
5468.4	5476.7	...	12	226.7	354.884	...	...	**12**	......	**12**
5393.2	5401.3	...	12	151.3	**350**	...	...	11	400.7	11.835
5241.9	**5250**	...	**12**	......	340.194	...	...	11	273.1	11.570
5012.7	5020.3	...	11	207.8	325.311	...	...	**11**	......	**11**
4805.4	4812.5	...	**11**	......	311.845	...	...	10	261.4	10.545
4622.6	4629.7	...	10	254.7	**300**	...	...	10	69.2	10.144
4557.0	4563.9	...	10	188.9	295.737	...	...	**10**	......	**10**
4368.3	**4375**	...	**10**	......	283.495	...	...	9	281.3	9.586
4101.3	4107.5	...	9	170.0	266.163	...	...	**9**	......	**9**
3931.8	3937.5	...	**9**	......	255.146	...	...	8	301.2	8.628
3852.0	3858.1	...	8	358.1	**250**	...	...	8	217.7	8.453
3645.6	3651.1	...	8	151.1	236.590	...	...	**8**	......	**8**
3494.8	**3500**	...	**8**	......	226.796	...	...	7	321.0	7.669
3189.9	3194.7	...	7	132.2	207.016	...	...	**7**	......	**7**
3081.9	3086.5	...	7	24.0	**200**	...	...	6	366.1	6.763
3057.7	3062.5	...	**7**	......	198.447	...	...	6	340.9	6.710
2734.2	2738.4	...	6	113.4	177.442	...	...	**6**	......	**6**
2621.2	**2625**	...	**6**	......	170.097	...	...	5	360.8	5.752
2311.3	2314.9	...	5	127.4	**150**	...	...	5	34.6	5.072
2278.5	2282.0	...	5	94.5	147.869	...	...	**5**	......	**5**
2184.2	**2187.5**	...	**5**	......	141.748	...	...	4	380.7	4.793
1926.2	1929.0	...	4	179.0	**125**	...	...	4	108.8	4.227
1822.8	1825.6	...	4	75.6	118.295	...	...	**4**	......	**4**
1747.2	**1750**	...	**4**	......	113.398	...	...	3	400.5	3.834
1540.7	1543.2	...	3	230.7	**100**	...	...	3	183.1	3.381
1386.7	1388.9	...	3	76.4	**90**	...	...	3	20.8	3.043
1367.1	1369.2	...	3	46.7	88.721	...	...	**3**	......	**3**
1310.6	1312.5	...	**3**	......	85.049	...	...	2	420.4	2.876
1232.7	1234.6	...	2	359.6	**80**	...	...	2	338.5	2.705
1155.7	1157.4	...	2	282.4	**75**	...	...	2	257.3	2.536
1078.6	1080.3	...	2	205.3	**70**	...	...	2	176.1	2.367
924.6	925.9	...	2	50.9	**60**	...	...	2	13.8	2.029
911.4	912.8	...	2	37.8	59.147	...	...	**2**	......	**2**
873.6	**875**	...	**2**	......	56.699	...	...	1	440.3	1.917
770.6	771.6	...	1	334.1	**50**	...	...	1	331.5	1.691
616.6	617.3	...	1	179.8	**40**	...	...	1	169.2	1.353

From 1 troy ounce to ⅞ ounce av.

Weights, Old Form.			Metric Weight and Measure.	Measures, Old Form.	
Equivalent in grains. (Temp. 15.4° C., 60° F.)	Grains.	Drachms.	Gm.] [Cc.	Fluid-drachms.	Minims.
479.3	**480**	**8=1℥**	31.103	8.413	504.8
477.6	478.4	7.973	**31**	8.385	503.1
474.7	475.4	7.923	30.805	**8⅓**	**500**
469.3	**470**	**7⅚ = 47/48℥**	30.455	8.238	494.3
465.2	465.9	7.765	30.190	**8⅙**	**490**
462.3	463.0	7.717	**30**	8.115	486.9
459.3	**460**	**7⅔ = 23/24℥**	29.807	8.063	483.8
455.7	456.392	7.607	29.573	**8**	**480**
449.3	**450**	**7½ = 15/16℥**	29.159	7.888	473.3
446.8	447.5	7.459	**29**	7.845	470.7
446.1	446.9	7.449	28.958	**7⅚**	**470**
439.3	**440**	**7⅓ = 11/12℥**	28.512	7.713	462.8
436.8	437.5	**1℥ av..**	28.350	7.668	460.1
436.7	437.4	7.290	28.341	**7⅔**	**460**
431.4	432.1	7.202	**28**	7.575	454.5
429.3	**430**	**7⅙ = 43/48℥**	27.864	7.537	452.2
427.2	427.9	7.132	27.725	**7½**	**450**
419.4	**420**	**7 = ⅞℥**	27.216	7.362	441.7
417.7	418.3	6.972	27.109	**7⅓**	**440**
416.1	416.7	6.945	**27**	7.303	438.2
409.4	**410**	**6⅚ = 41/48℥**	26.568	7.187	431.2
408.3	408.9	6.815	26.493	**7⅙**	**430**
400.6	401.2	6.687	**26**	7.033	422.0
399.4	**400**	**6⅔ = ⅚℥**	25.920	7.012	420.7
398.7	399.3	6.655	25.877	**7**	**420**
389.4	**390**	**6½ = 13/16℥**	25.271	6.837	410.2
389.2	389.8	6.497	25.261	**6⅚**	**410**
385.2	385.8	6.430	**25**	6.762	405.8
379.7	380.3	6.338	24.645	**6⅔**	**400**
379.4	**380**	**6⅓ = 19/24℥**	24.624	6.662	399.7
370.2	370.8	6.180	24.029	**6½**	**390**
369.8	370.4	6.173	**24**	6.492	389.5
369.4	**370**	**6⅙ = 37/48℥**	23.976	6.485	389.1
360.8	361.1	6.022	23.413	**6⅓**	**380**
359.5	**360**	**6 = ¾℥**	23.328	6.310	378.6
354.4	354.9	5.915	**23**	6.222	373.3
351.3	351.8	5.863	22.796	**6⅙**	**370**
349.5	**350**	**5⅚ = 35/48℥**	22.680	6.135	368.1
341.8	342.3	5.705	22.180	**6**	**360**
339.5	**340**	**5⅔ = 17/24℥**	22.032	5.960	357.6
339.0	339.5	5.658	**22**	5.952	357.1
332.3	332.8	5.547	21.563	**5⅚**	**350**
329.5	**330**	**5½ = 11/16℥**	21.384	5.785	347.1
323.6	324.1	5.401	**21**	5.680	340.8
322.8	323.3	5.388	20.948	**5⅔**	**340**
319.5	**320**	**5⅓ = ⅔℥**	20.736	5.610	336.6
313.3	313.8	5.230	20.332	**5½**	**330**
309.5	**310**	**5⅙ = 31/48℥**	20.088	5.433	326.0
308.1	308.6	5.143	**20**	5.410	324.6
303.8	304.3	5.072	19.716	**5⅓**	**320**

WEIGHTS, OLD FORM.			METRIC WEIGHT AND MEASURE.	MEASURES, OLD FORM.	
Equivalent in grains. (Temp. 15.4° C., 60° F.)	Grains.	Drachms.	Gm.] [Cc.	Fluid-drachms.	Minims.
299.5	**300**	**$5=\frac{5}{8}$℥**	19.440	5.258	315.5
294.3	294.7	4.912	19.099	**$5\frac{1}{6}$**	**310**
292.8	293.2	4.887	**19**	5.140	308.4
289.6	**290**	**$4\frac{5}{6}=\frac{29}{48}$℥**	18.792	5.083	305.0
284.8	285.2	4.753	18.483	**5**	**300**
279.6	**280**	**$4\frac{2}{3}=\frac{7}{12}$℥**	18.144	4.908	294.5
277.4	277.8	4.630	**18**	4.870	292.2
275.3	275.7	4.595	17.867	**$4\frac{5}{6}$**	**290**
269.6	**270**	**$4\frac{1}{2}=\frac{9}{16}$℥**	17.496	4.733	284.0
265.8	266.2	4.437	17.251	**$4\frac{2}{3}$**	**280**
262.0	262.4	4.373	**17**	4.598	275.9
259.6	**260**	**$4\frac{1}{3}=\frac{13}{24}$℥**	16.848	4.557	273.4
256.3	256.7	4.278	16.635	**$4\frac{1}{2}$**	**270**
249.6	**250**	**$4\frac{1}{6}=\frac{25}{48}$℥**	16.200	4.382	262.9
246.8	247.2	4.120	16.019	**$4\frac{1}{3}$**	**260**
246.5	246.9	4.115	**16**	4.328	259.7
239.6	**240**	**$4=\frac{1}{2}$℥**	15.552	4.207	252.4
237.3	237.7	3.962	15.103	**$4\frac{1}{6}$**	**250**
231.1	231.5	3.858	**15**	4.057	243.4
229.7	**230**	**$3\frac{5}{6}=\frac{23}{48}$℥**	14.904	4.032	241.9
227.9	228.2	3.803	14.787	**4**	**240**
219.7	**220**	**$3\frac{2}{3}=\frac{11}{24}$℥**	14.256	3.857	231.4
218.4	218.75	**$\frac{1}{2}$℥ av.**	14.175	3.835	230.1
218.36	218.69	3.645	14.171	**$3\frac{5}{6}$**	**230**
215.8	216.1	3.602	**14**	3.787	227.2
209.7	**210**	**$3\frac{1}{2}=\frac{21}{48}$℥**	13.608	3.682	220.9
208.9	209.2	3.487	13.555	**$3\frac{2}{3}$**	**220**
200.3	200.6	3.343	**13**	3.517	211.0
199.7	**200**	**$3\frac{1}{3}=\frac{5}{12}$℥**	12.960	3.505	210.3
199.4	199.7	3.328	12.938	**$3\frac{1}{2}$**	**210**
189.9	190.2	3.170	12.322	**$3\frac{1}{3}$**	**200**
189.7	**190**	**$3\frac{1}{6}=\frac{19}{48}$℥**	12.312	3.330	199.8
184.9	185.2	3.087	**12**	3.247	194.8
180.4	180.7	3.012	11.706	**$3\frac{1}{6}$**	**190**
179.7	**180**	**$3=\frac{3}{8}$℥**	11.664	3.155	189.3
170.8	171.1	2.852	11.090	**3**	**180**
169.7	**170**	**$2\frac{5}{6}=\frac{17}{48}$℥**	11.016	2.980	178.8
169.5	169.8	2.830	**11**	2.975	178.5
161.4	161.6	2.693	10.474	**$2\frac{5}{6}$**	**170**
159.8	**160**	**$2\frac{2}{3}=\frac{1}{3}$℥**	10.368	2.805	168.3
154.1	154.3	2.572	**10**	2.705	162.3
151.9	152.1	2.535	9.858	**$2\frac{2}{3}$**	**160**
149.8	**150**	**$2\frac{1}{2}=\frac{15}{48}$℥**	9.719	2.630	157.8
142.4	142.6	2.377	9.242	**$2\frac{1}{2}$**	**150**
139.8	**140**	**$2\frac{1}{3}=\frac{7}{24}$℥**	9.072	2.453	147.2
138.7	138.9	2.315	**9**	2.435	146.1
132.9	133.1	2.218	8.626	**$2\frac{1}{3}$**	**140**
129.8	**130**	**$2\frac{1}{6}=\frac{13}{48}$℥**	8.424	2.278	136.7
123.3	123.5	2.058	**8**	2.163	129.8
119.8	**120**	**$2=\frac{1}{4}$℥**	7.776	2.103	126.2
113.9	114.1	1.902	7.393	**2**	**120**
109.8	**110**	**$1\frac{5}{6}=\frac{11}{48}$℥**	7.128	1.928	115.7

Weights, Old Form.			Metric Weight and Measure.	Measures, Old Form.	
Equivalent in grains. (Temp. 15.4° C., 60° F.)	Grains.	Drachms.	Gm.] [Cc.	Fluid-drachms.	Minims.
109.2	109.375	$\frac{1}{4}$℥ av.	7.087	1.917	115.0
107.8	108.0	1.800	**7**	1.893	113.6
99.8	**100**	$1\frac{2}{3} = \frac{5}{24}$℥	6.480	1.753	105.2
94.9	95.1	1.585	6.161	**$1\frac{2}{3}$**	**100**
92.5	92.6	1.545	**6**	1.623	97.4
89.0	**90**	$1\frac{1}{2} = \frac{3}{16}$℥	5.832	1.578	94.7
85.4	85.6	1.427	5.545	**$1\frac{1}{2}$**	**90**
79.9	**80**	$1\frac{1}{3} = \frac{1}{6}$℥	5.184	1.401	84.1
77.1	77.2	1.287	**5**	1.351	81.2
76.0	76.1	1.268	4.929	**$1\frac{1}{3}$**	**80**
69.9	**70**	$1\frac{1}{6} = \frac{7}{48}$℥	4.536	1.227	73.6
66.5	66.6	1.110	4.313	**$1\frac{1}{6}$**	**70**
61.6	61.7	1.028	**4**	1.082	64.9
59.9	**60**	$1 = \frac{1}{8}$℥	3.888	1.051	63.1
56.9	57.0	.950	3.697	**1**	**60**
54.6	54.6875	$\frac{1}{8}$℥ av.	3.544	.958	57.5

From 50 grains to 1 minim

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims.	Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims.
50	3.240	52.6	36.1	2.341	**38**
49.0	3.175	51.5	**36**	2.333	37.9
48	3.110	50.5	35.2	2.280	**37**
47.5	3.081	**50**	**35**	2.268	36.8
47	3.046	49.4	34.2	2.218	**36**
46.6	3.019	**49**	**34**	2.203	35.8
46.3	**3**	48.7	33.3	2.156	**35**
46	2.981	48.4	**33**	2.138	34.7
45.6	2.957	**48**	32.3	2.095	**34**
45	2.916	47.3	**32**	2.074	33.7
44.7	2.896	**47**	31.4	2.033	**33**
44	2.851	46.3	**31**	2.009	32.6
43.7	2.834	**46**	30.9	**2**	32.5
43	2.786	45.2	30.4	1.972	**32**
42.8	2.773	**45**	**30**	1.944	31.6
42	2.722	44.2	29.5	1.910	**31**
41.8	2.711	**44**	**29**	1.879	30.5
41	2.657	43.1	28.5	1.848	**30**
40.9	2.619	**43**	**28**	1.814	29.4
40	2.592	42.1	27.6	1.787	**29**
39.9	2.588	**42**	**27**	1.750	28.4
39	2.527	41.0	26.6	1.725	**28**
38.98	2.526	**41**	**26**	1.685	27.3
38.03	2.464	40.0	25.7	1.664	**27**
38	2.462	39.97	**25**	1.620	26.3
37.1	2.403	**39**	24.7	1.602	**26**
37	2.398	38.9	**24**	1.555	25.2

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims.	Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims.
23.8	1.540	25	12	0.778	12.6
23.2	1.5	24.4	11.6	0.75	12.2
23	1.490	24.2	11.4	0.739	12
22.8	1.479	24	11	0.713	11.6
22	1.426	23.1	10.5	0.678	11
21.9	1.417	23	10	0.648	10.5
21	1.361	22.1	9.5	0.616	10
20.9	1.355	22	9	0.583	9.5
20	1.296	21.03	8.6	0.555	9
19.3	1.25	20.3	8	0.518	8.4
19.02	1.232	20	7.7	0.5	8.1
19	1.231	19.97	7.6	0.493	8
18.1	1.171	19	7	0.454	7.4
18	1.166	18.9	6.7	0.431	7
17.1	1.109	18	6	0.389	6.3
17	1.102	17.9	5.7	0.370	6
16.2	1.047	17	5	0.324	5.3
16	1.037	16.8	4.8	0.308	5
15.4324	1	16.2	4	0.259	4.2
15.2	0.986	16	3.8	0.246	4
15	0.972	15.8	3	0.194	3.2
14.3	0.924	15	2.9	0.185	3
14	0.907	14.7	2	0.130	2.1
13.3	0.863	14	1.9	0.123	2
13	0.842	13.7	1	0.065	1.0517
12.4	0.801	13	0.9508	0.06161	1

From $\frac{9}{10}$ grain to $\frac{1}{1000}$ grain.		Measures of length.				
					Inches	
Grammes.	Grains.	Centimetres.	Inches.	Millimetres.	in decimal fractions.	in common fractions.
0.058	$\frac{9}{10}$	100	39.37	25.4	1	1
0.057	$\frac{8}{9}$	99.0	39	25	0.98	
0.056	$\frac{7}{8}$	96.5	38	24.5	0.96	
0.055	$\frac{6}{7}$	95	37.40	24	0.94	
0.054	$\frac{5}{6}$	93.9	37	23.8	0.94	$\frac{15}{16}$
0.052	$\frac{4}{5}$	91.4	36	23.5	0.92	
0.049	$\frac{3}{4}$	90	35.43	23	0.90	$\frac{29}{32}$
0.045	$\frac{7}{10}$	88.9	35	22.5	0.89	
0.043	$\frac{2}{3}$	86.4	34	22.2	0.87	$\frac{7}{8}$
0.040	$\frac{5}{8}$	85	33.46	22	0.87	
0.039	$\frac{3}{5}$	83.8	33	21.5	0.85	
0.036	$\frac{9}{16}$	81.3	32	21	0.83	
0.032	$\frac{1}{2}$	80	31.50	20.6	0.81	$\frac{13}{16}$
0.028	$\frac{7}{16}$	78.7	31	20.5	0.81	
0.026	$\frac{2}{5}$	76.2	30	20	0.79	
0.022	$\frac{1}{3}$	75	29.53	19.5	0.77	
0.020	$\frac{5}{16}$	73.6	29	19.1	0.75	$\frac{3}{4}$
0.016	$\frac{1}{4}$	71.1	28	19	0.75	
0.013	$\frac{1}{5}$	70	27.56	18.5	0.73	

From $\frac{9}{10}$ grain to $\frac{1}{1000}$ grain.		Measures of length.				
Grammes.	Grains.	Centimetres.	Inches.	Millimetres.	Inches	
					in decimal fractions.	in common fractions.
0.012	$\frac{3}{16}$	68.6	**27**	**18**	0.71	
0.011	$\frac{1}{6}$	66.0	**26**	17.5	0.69	$\frac{11}{16}$
0.009	$\frac{1}{7}$	**65**	25.59	**17**	0.67	
0.008	$\frac{1}{8}$	63.5	**25**	16.5	0.65	
0.007	$\frac{1}{9}$	61.0	**24**	**16**	0.63	
0.0065	$\frac{1}{10}$	**60**	23.62	15.9	0.62	$\frac{5}{8}$
0.0054	$\frac{1}{12}$	58.4	**23**	15.5	0.61	
0.0042	$\frac{1}{15}$	55.9	**22**	**15**	0.59	
0.0040	$\frac{1}{16}$	**55**	21.65	14.5	0.57	
0.0036	$\frac{1}{18}$	53.3	**21**	14.3	0.56	$\frac{9}{16}$
0.0032	$\frac{1}{20}$	50.8	**20**	**14**	0.55	
0.0027	$\frac{1}{24}$	**50**	19.69	13.5	0.53	
0.0026	$\frac{1}{25}$	48.3	**19**	**13**	0.51	
0.0022	$\frac{1}{30}$	45.7	**18**	12.7	0.50	$\frac{1}{2}$
0.0020	$\frac{1}{32}$	**45**	17.72	12.5	0.49	
0.0018	$\frac{1}{36}$	43.2	**17**	**12**	0.47	
0.0016	$\frac{1}{40}$	40.6	**16**	11.5	0.45	
0.00135	$\frac{1}{48}$	**40**	15.75	11.1	0.44	$\frac{7}{16}$
0.00129	$\frac{1}{50}$	38.1	**15**	**11**	0.43	
0.00108	$\frac{1}{60}$	35.6	**14**	10.5	0.41	
0.00101	$\frac{1}{64}$	**35**	13.78	**10**	0.39	
0.00090	$\frac{1}{72}$	33.0	**13**	9.5	0.37	$\frac{3}{8}$
0.00081	$\frac{1}{80}$	30.5	**12**	**9**	0.35	
0.00065	$\frac{1}{100}$	**30**	11.81	8.7	0.34	$\frac{11}{32}$
0.00058	$\frac{1}{112}$	27.9	**11**	8.5	0.33	
0.00054	$\frac{1}{120}$	25.4	**10**	**8**	0.31	
0.00051	$\frac{1}{128}$	**25**	9.84	7.9	0.31	$\frac{5}{16}$
0.00045	$\frac{1}{144}$	22.9	**9**	7.5	0.30	
0.00043	$\frac{1}{150}$	20.3	**8**	7.1	0.28	$\frac{9}{32}$
0.00040	$\frac{1}{160}$	**20**	7.87	**7**	0.28	
0.00036	$\frac{1}{180}$	17.8	**7**	6.5	0.26	
0.00032	$\frac{1}{200}$	15.2	**6**	6.4	0.25	$\frac{1}{4}$
0.00027	$\frac{1}{240}$	**15**	5.91	**6**	0.24	
0.00025	$\frac{1}{256}$	12.7	**5**	5.6	0.22	$\frac{7}{32}$
0.00022	$\frac{1}{300}$	10.2	**4**	5.5	0.22	
0.00020	$\frac{1}{320}$	**10**	3.94	**5**	0.20	
0.00018	$\frac{1}{360}$	**9**	3.54	4.8	0.19	$\frac{3}{16}$
0.00016	$\frac{1}{400}$	**8**	3.15	4.5	0.18	
0.000135	$\frac{1}{480}$	7.6	**3**	**4**	0.16	
0.000129	$\frac{1}{500}$	**7**	2.76	3.5	0.14	
0.000127	$\frac{1}{512}$	**6**	2.36	3.2	0.13	$\frac{1}{8}$
0.000108	$\frac{1}{600}$	5.1	**2**	**3**	0.12	
0.000101	$\frac{1}{640}$	**5**	1.97	2.5	0.10	$\frac{1}{10}$
0.000093	$\frac{1}{700}$	**4**	1.57	2.4	0.09	$\frac{3}{32}$
0.000090	$\frac{1}{720}$	**3**	1.18	**2**	0.08	
0.000081	$\frac{1}{800}$	2.54	**1**	1.6	0.06	$\frac{1}{16}$
0.000077	$\frac{1}{840}$	**2**	0.78	1.5	0.06	
0.000072	$\frac{1}{900}$	1.5	0.59	**1**	0.04	
0.000068	$\frac{1}{960}$	**1**	0.39	0.8	0.03	$\frac{1}{32}$
0.000065	$\frac{1}{1000}$	0.75	0.30	0.5	0.02	
		0.50	0.20	0.1	0.0039	
		0.25	0.10			

Orthography, Pronunciation, and Reading

Orthography.—There are two methods of orthography of the metric units in use in the United States; in one of these, the original French, the units are spelled metr*e*, litr*e*, gram*me*; in the other, proposed by the American Metric Bureau, the units are spelled met*er*, lit*er*, gram. It would not be appropriate in a treatise of this kind to discuss the merits of either plan, but it is unfortunate that in the U. S. Pharmacopœia of 1890 the question was not settled, the French gram*me* having been retained and met*er* and lit*er* adopted, and the same rule has been followed in the 8th Revision of the Pharmacopœia. While the original orthography is used in the British Pharmacopœia, and is preferred by the author, the custom has now become established in the United States, and it is therefore followed in this work; some minor changes are desirable,—*i.e.*, *deca*, which is changed to *deka*, because *deca* could easily be mistaken for *deci*. In pharmacy particularly, *gramme* is to be preferred to *gram*, because in writing gram it could easily be mistaken for grain, particularly if the *i* in grain were not dotted.

Pronunciation.—Meter is pronounced mee′ter, liter lee′ter, gramme gram, not, as sometimes heard, gram′me; centimeter should be pronounced sen′tee-mee-ter, not son′tee-mee-ter. The latter faulty pronunciation is quite common, and is due to confounding the French pronunciation with the English. Either son-tee-mā′tr (French) or sen′tee-mee-ter (English) would be correct, but to use half of the French and half of the English is obviously improper, and, as the metric system is now anglicized, the simple English pronunciation is less stilted and more appropriate.

Reading.—Some difficulty is usually experienced by those unfamiliar with the metric system in reading the quantities. In the linear measures in Pharmacy, centimeters and millimeters are almost exclusively used; now, 0.05 M. would not be read five hundredths of a meter, but 5 centimeters (5 cm.); if the millimeter column contains a unit, as in 0.055 M., it is read fifty-five millimeters (55 mm.), in preference to fifty-five thousandths of a meter; or it is sometimes read five centimeters and five millimeters.

Fractions of a millimeter must be read decimally, as, 0.0555 m., fifty-five and five-tenths millimeters. In measures of capacity, cubic centimeters are exclusively used; if the quantity is less than a liter, the terms half liter, quarter liter, deciliter, centiliter, milliliter are replaced by 500 Cc., 250 Cc., 100 Cc., 10 Cc., 1 Cc.; in aqueous liquids the cubic centimeter is considered equivalent to a gramme. In weight, when the quantity is relatively large, and in commercial transactions, the kilogramme is abbreviated to kilo, pronounced kil′o; when less than a kilogramme, and not less than a gramme, the quantity is read with the gramme for the unit; 2000 Gm. would be read two kilos, and 543 Gm. would be read five hundred and forty-three grammes, while 2543 Gm. is usually read two kilos and five hundred and forty-three grammes, although twenty-five hundred and forty-three grammes is sometimes preferred. For quantities below the gramme, decigrammes are not used, but centigrammes and milligrammes are regarded as the most convenient units; they are read in the same way as centimeters and millimeters.

Weighing and Measuring

Among the first operations that the student is called upon to perform are the very important ones of *weighing* and *measuring.* The former process requires the use of the *balance,* or, as more frequently, but less preferably, termed, *scales.* As the successful performance of many of the processes noticed in this work depends upon a thorough knowledge of the principles of the balance, it has been selected as one of the first subjects for consideration, for this instrument in some form or other is relied upon to secure accurate quantities of the substances employed in the various operations of pharmacy.

The balance may be defined as an instrument for determining the relative weights of substances, and should be *correctly constructed, skilfully used,* and *carefully protected from injury,* if accurate results are expected.

Construction of the Balance.—For systematic consideration pharmaceutical balances may be classified as follows: 1. *Single beam, equal arms.* 2. *Single beam, unequal arms.* 3. *Double beam, unequal arms.* 4. *Compound lever balances.* 5. *Torsion balances.*

1. Single Beam, Equal Arm Balances.—The instrument which, notwithstanding many attempts to supplant it, still maintains its supremacy is the *single beam, equal arm balance,* which may be described as consisting of a metallic lever or beam, divided into two equal arms at the centre by a knife edge, upon which it is supported. At exactly equal distances from this point of support, and situated in the same plane, are placed the end knife edges; these suspend the pans which carry the substances to be weighed. A good balance should possess the following requirements:

1. *When the beam is in a horizontal position, the centre of gravity should be slightly below the point of support, or central knife edge, and perpendicular to it.*

The relative sensibility of the balance depends upon the fulfilment of this principle, which may be roughly illustrated by forcing a pin through the centre of an oblong piece of pasteboard; if the edge of the pasteboard is touched slightly it does not oscillate at all, but revolves around the centre to a degree corresponding to the impulse representing equilibrium; if the pin be removed and inserted a very short distance above the centre, and the edge of the pasteboard touched as before, it will oscillate slowly, corresponding to a sensitive beam, the point of support being slightly above the centre of gravity; if the pin be again removed and inserted far above the centre, and the same impulse imparted to the edge, it will oscillate quickly, illustrating stable equilibrium and a beam which comes to rest quickly and is not sensitive. A more elaborate method of illustration is furnished by the use of a beam with a movable fulcrum (see Fig. 3), when the relative position of the knife edge may be made to show, beginning at the top, 1, stable equilibrium; 2, in the centre, equilibrium; and, 3, when the lowest point is reached, unstable equilibrium, and then the slightest impulse upsets the beam.

2. *The end knife edges must be at exactly equal distances from the central knife edge; they must all be in the same plane, and the edges absolutely parallel to each other.*

It is very apparent that the conditions of a good prescription balance cannot be satisfied if there is inequality in the length of the arms of the beam. In Fig. 4 the distance from the central knife edge to the one on the left must be exactly the same as the distance from the central knife edge to the one on the right, otherwise unequal weights would be required to establish equilibrium, or the excess of weight of the longer arm must be subtracted at every weighing, or weighing by substitution resorted to, all manifestly impracticable. If the central knife edge be placed either above or below a line drawn so that it connects the end knife edges, the loading of the pans will either cause the beam to cease oscillating, or diminish the sensibility in proportion to the load. If the knife edges are not parallel, the weight of a body would not be constant upon every part of the pan, but would be greater if placed near the edge on one side, and correspondingly less at a point directly opposite.

Fig. 3

Illustration of equilibrium

Fig. 4

Position of knife edges

3. *The beam should be inflexible, but as light in weight as possible, and the knife edges in fine balances should bear upon agate planes.*

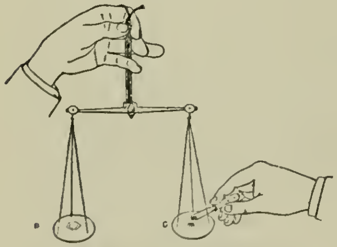
Rigidity of the beam is necessary, because any serious deflection caused by a loading of the pans would lower the end knife edges, and thus accuracy in weighing would be impossible. The beam should not be heavier than necessary, because its sensibility (particularly when light weights were placed upon the pans) would be thereby lessened, and to diminish friction arising from the rusting of the steel knife edges which constantly increases with the age and use of a balance, the bearings of the knife edges should be agate planes. Formerly this condition could not be practically carried out, except in expensive balances, owing to the cost of polished agate; but since the introduction of automatic machines for grinding and polishing this very hard substance, the cost has been so reduced that not only the bearings, but the knife edges themselves, are now made of agate and used upon fine prescription balances, and it is practical economy to employ exclusively those so mounted.

The Tests of a Balance.—Having stated the essential points in the construction of the balance, the tests, which should always be applied before accepting a balance, will now be described. The prescription balance, being one of the most delicate and important of the instruments in use by the pharmacist, is selected for illustration. 1. A perfectly level counter or table is secured, the balance is placed in position, the beam elevated so that it is free to oscillate, and when the oscillations have ceased, the smallest weight to which the balance is sensitive is placed upon the right hand pan,—it should at once respond to the weight; this tests its sensibility with unloaded pans. 2. Both pans are now loaded with the full weight that the balance is designed to carry, and then the smallest weight is placed upon the right hand pan,—the oscillation, although slower than in the first test, ought to be as decided ; this shows its sensibility when loaded. 3. The pans should now be loaded to half the capacity of the balance, and equilibrium perfected by adding, if necessary, a piece of tin foil. The weights on the right hand pan must now be exchanged for those on the left hand pan, and *vice versa ;* if equilibrium is still maintained, *the arms of the beam are equal.* 4. The pans should be moderately loaded and balanced, and one of the larger weights shifted in different positions upon the edge of one of the pans, and any variation in equilibrium carefully noted. This variation, as previously mentioned, indicates a want of parallelism in the knife edges.

Forms of Single Beam, Equal Arm Balances.—There are good reasons for believing that this kind of balance has a very ancient origin ; and at the present time it is used more frequently than any other.

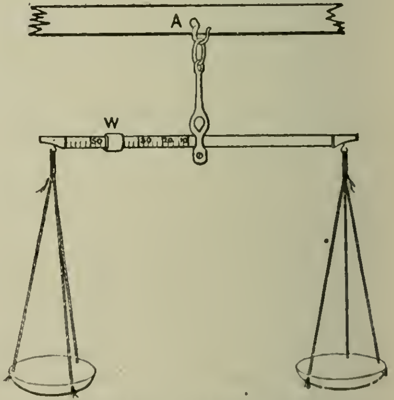
Hand Scales.—The commonest form in which this principle is utilized in pharmacy is seen in the cheap hand scales now fast passing out of use ; in the better qualities the beam is of steel, and the knife edges are enclosed so as to protect them from injury. In those usually seen the beam is of brass, with a steel central knife edge, having a perforation in each end of the beam for the insertion of two wire hooks, to which are attached silken cords for supporting the pans. The manner of holding these scales is shown in Fig. 5. They are now most largely employed in America by physicians and pharmacists having a very limited use for a balance. The silken tassel is held in the left hand, and care should always be taken *to see that the beam oscillates freely and properly* before the weight is placed upon the left hand pan, as the hooks frequently become entangled in the cords and the adjustment is lost. The requisite quantity of the substance to be weighed is placed upon the right hand pan, preferably with a spatula.

FIG. 5



Manner of holding scales

FIG. 6



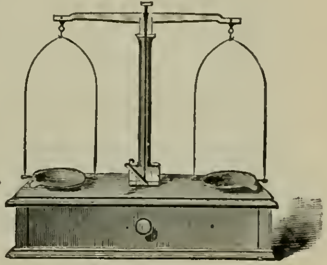
Hand scale with sliding weight

Alkaloids and very poisonous substances should never be weighed upon ordinary hand prescription scales, except when, by previous actual test at the time, they have been shown to be sensitive and accurate ; for, although this form has been in use many years, as now found in commerce they are the most unreliable of all kinds of prescription balances, and, notwithstanding their merits of cheapness and portability, in the end they may prove (through some serious error) an expensive investment. In Fig. 6 is shown an improved form of hand scale in which a sliding weight is used; this may be suspended on a hook at the proper height as shown in the cut.

Prescription Balances.—The advantage of substituting a rigid metallic column for the usually unsteady human arm, as a support to the beam, would seem to be apparent at a glance, for, in addition to the increased stability which is gained, both hands are left free to perform the weighing; more time can usually be devoted to secure equilibrium, and the oscillations can be more readily noticed.

A cheap prescription balance, an improved form of Troemner's "army prescription scale," is shown in Fig. 7; the beam, column, supports, pans, etc., are of lacquered brass, the knife edges of steel, while the drawer beneath is large enough to hold conveniently all the parts; this is a very useful feature where a balance is not in constant use, enabling the operator to set the balance at will, or keep it in the drawer protected from dust and corrosion. It may be made sensitive to the $\frac{1}{24}$ of a grain; but it soon loses this degree of delicacy, because of the rusting of the steel bearings and knife edges. With careful handling, and by protecting it from the atmosphere by covering with a glass shade, or glass case, it will remain in good order for years, and is vastly superior to the hand prescription scales.

Fig. 7



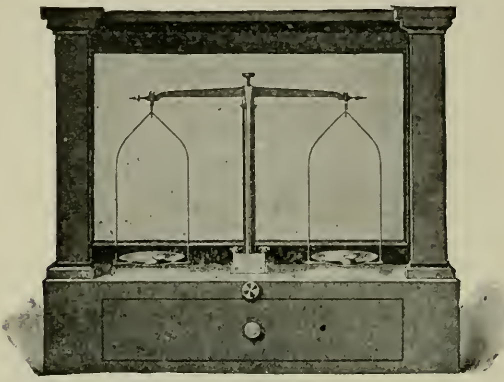
Army prescription scale

A pharmacist who desires to make use of all the modern improvements and secure the best practical results, should have, for *economy's* sake, *two* prescription balances,—one for delicate weighings and the other for ordinary work. These need not have the most fashionable and costly *cases*, but the workmanship of the balance itself cannot be too fine, if by it are secured the absolute essentials of accuracy, sensibility, and durability.

In addition to the theoretical requirements before noted, the finest prescription balances now made by Troemner are provided with solid nickel or solid silver pans and gold plated beams with adjusting screws on the ends to quickly restore equilibrium (see Fig. 8). As the pans are subjected to more wear and tear than any other part of the balance, it is economical to use *solid* rather than *plated* pans, for, as they have to be cleaned repeatedly, constant friction wears off the plating, and the additional cost for replating soon absorbs the difference in price. To secure the best results, when a showy appearance is not desired, a dead black finish to the column is preferable, as the labor of polishing, with the danger to the adjustment that it involves, is dispensed with. If the supports and pans are of solid silver or nickel, and the knife edges and the bearings of agate, a prescription balance is furnished which is durable and really cheap, because it will remain for a long time fully equal to the most exacting demands.

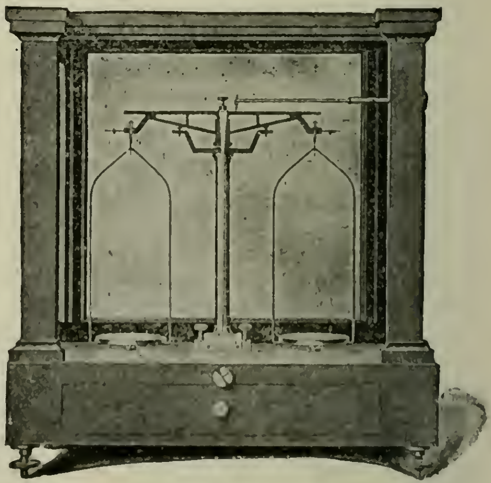
Analytical Balances.—The growing importance of analytical work, in connection with the quantitative tests introduced into the last revision of the U. S. Pharmacopœia, renders the possession of an analytical balance by the pharmacist very desirable. Formerly these delicate objects of mechanical skill were exclusively imported, but for thirty years American manufacturers have devoted unremitting effort to excelling in this fine work, with gratifying success. Fig. 9 shows a Troemner analytical balance of recent pattern. The open, metallic beam is light and rigid, the bearings and knives are of agate, and the bows are wide; the pans will each carry 100 grammes and the balance is sensible to $\frac{1}{4}$ milligramme. The ends of the stirrups are provided with hooks to suspend a body in taking its specific gravity, and a contrivance for arresting the motion of the beam and pans, together with one for elevating the beam entirely from contact with the agate planes when not in use, is provided. This balance is specially constructed for students' use and is not expensive.

Fig. 8



Fine prescription balance

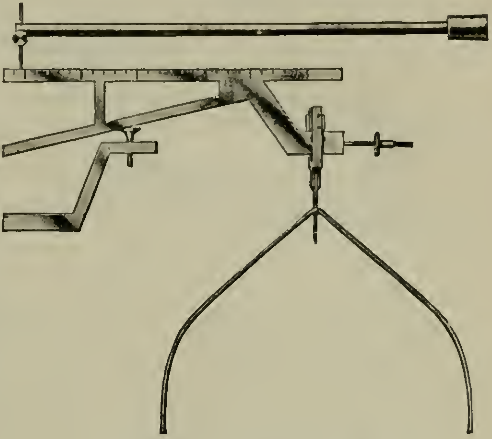
Fig. 9



Analytical balance

Fig. 10 shows an enlarged view of the end of the beam with the beam locked. The right arm of the beam is graduated so that each division represents one-fourth of a milligramme; an aluminum wire rider is pushed along the arm by a sliding rod to any point upon the graduated beam to indicate these fractions. An index needle traverses an ivory scale fixed on the base of the column, and the most delicate oscillations may be thus measured by the needle. If, for instance, *one-tenth of a grain* on one of the pans deflects the needle *ten* divisions on the scale, each one of these divisions would then represent one-tenth of the weight on the pan, or one-hundredth of a grain. With practice, the use of this means of weighing very minute quantities can be brought to great perfection.

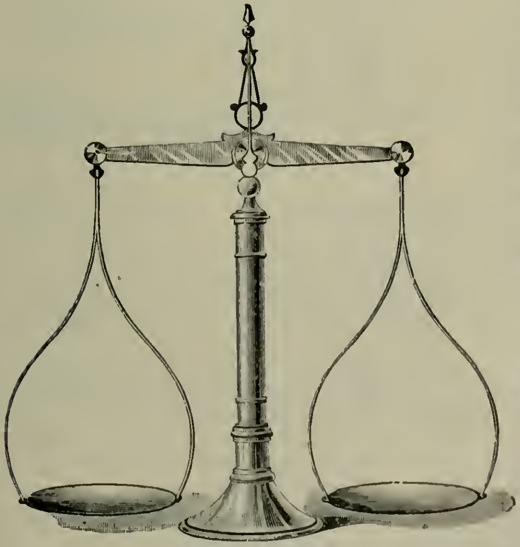
Fig. 10



Enlarged view of the end of beam

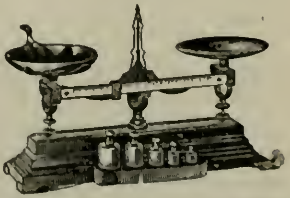
Counter Scales.— For counter and dispensing purposes, the single beam, equal arm principle was formerly exclusively used (see Fig. 11). These scales were usually made of polished brass, and answered most purposes if kept in good order, but were objectionable because the pan supports were frequently obstructive, as they only permitted the weighing of bodies having a limited surface, and the excessive amount of polished brass work about them required the expenditure of considerable labor to keep them bright, without any corresponding advantage. The form in which the pans are placed above the beam, thus getting rid of obstructive pan supports, is now greatly preferred (see Fig. 17). In these the objection to the polished brass is met by enclosing the working parts in a case; the copper or brass pan alone needs polishing. A very convenient form of dispensing scale for smaller weights, made by Troemner, is shown in Fig. 12. This beam is provided with a parallel, graduated, nickel plated bar, upon which a poise slides backward and forward; this is particularly useful for weighing small quantities of liquids. The tare of the bottle is easily taken by the use of the

Fig. 11



Old style counter scales

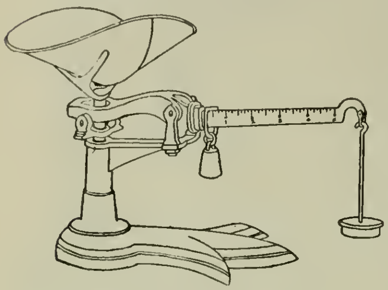
Fig. 12



Scale with graduated parallel beam and sliding weight sliding poise; the beam is graduated so that apothecaries' or metric weight may be used, and a projecting shelf attached to the base forms a convenient receptacle for the weights.

2. Forms of Single Beam, Unequal Arm Balances.—The principle upon which these very practical weighing machines are founded is best shown by referring to Fairbank's druggists' scale (see Fig. 13), and quoting the law in physics, "*The power is to the weight or resistance in the inverse ratio of the length of the arms of the lever.*" The inequality in the length of the arms of this beam permits of the convenient use of one movable weight upon the graduated longer arm of the beam, and thus dispensing with the use of small weights, which are liable to be lost; the scoop, which is useful in weighing bulky drugs, is sometimes replaced by a flat, circular disk when bottles, etc., are to be weighed.

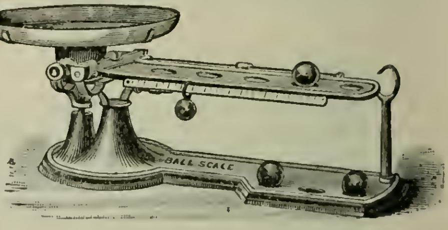
FIG. 13



Fairbank's druggists' scale

Troemner furnishes a convenient scale for pharmacists' use. It is termed the "Ball scale" (see Fig. 14). The beam is flat and perforated with five holes, which are about four inches apart; an iron ball is placed in one of these holes when a substance is to be weighed; the distance from the fulcrum of course determines the weight. It will weigh from $\frac{1}{4}$ oz. av. up to 16 pounds, and is furnished with an extra "sliding poise," to use in taring or balancing bottles when liquids are to be weighed. The purchaser of this scale need not buy a set of avoirdupois weights.

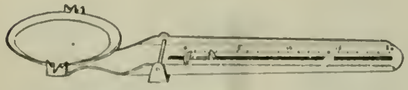
FIG. 14



Ball scale

A very simple vest pocket prescription scale is made by Shepard & Dudley, of New York; it is on the unequal arm principle, and is shown *half size* in Fig. 15. The principal parts are made in three pieces; the pan is detachable, the pan support being suspended on the short rod attached to the base; the graduated beam is more than double the length of the pan support; a slot runs nearly the length of this beam, and a sliding weight is pushed along in the slot. The scale is very cheap, and is intended for country physicians, who are often compelled to weigh medicines at the bedside of the patient.

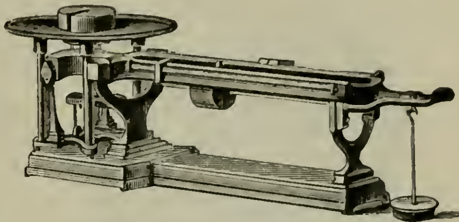
FIG. 15



Vest pocket prescription scale

3. Double Beam, Unequal Arm Balances.—It is preferable to have a double beam scale for constant use in the laboratory, and the most convenient form is upon the same principle as Fairbank's druggists' scale (Fig. 15), having, however, two parallel beams. This scale is particularly adapted for weighing liquids, the weight on the outside beam being used to tare the bottle or jar, while the other weight is left free so that it can be adjusted at once to the weight of the liquid desired. These are now to be had with the scale graduated into grammes, and are very useful in making preparations by the metric system, no loose weights being required when moderate quantities are to be weighed. (See Fig. 16.)

FIG. 16

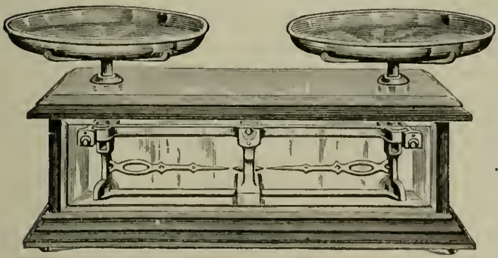


Troemner's scale for weighing liquids

4. **Compound Lever Balances.**—The principal of the compound lever was first applied in the construction of balances by Robervahl, of Paris, about A.D. 1660. It has only been recently adopted for delicate weighings in compounding prescriptions, although the general utility of counter and platform scales constructed upon this plan has long been recognized. The principal objection to them, when compared with equal beam balances, consists in the multiplicity of points of suspension, thus necessarily increasing friction and the liability to disarrangement; but their general convenience, and some recent improvements in their construction, have brought them into favor. The principle of the Robervahl compound lever balance, with the arrangement of the levers, is shown in Troemner's glass box scale in Fig. 17.

One of the practical advantages possessed by this form of balance is the small amount of polished metal to keep in order, and, as the working parts are enclosed in a tight box of glass, wood, or marble, dust and corrosive vapors are largely excluded; as they are made to occupy as little space as possible, the pans are conveniently low and unobstructed.

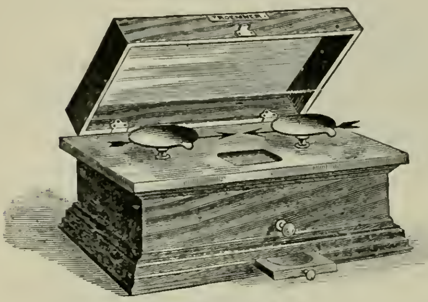
FIG. 17



Counter scales in "glass box"

Box prescription scales, on the compound lever principle, have come into extensive use, and they are the most convenient scales for weighing moderately small quantities (see Fig. 18). Although sensitive to $\frac{1}{30}$ of a grain when new, they do not retain this delicacy long. Their strongest recommendation is the ease with which they may be cleaned and kept in order; the only polished metal liable to be affected by corrosive vapors is found in the pans, and these are of solid nickel; the marble or plate glass top has a countersunk basin to keep weights in, and a hinged glass cover effectually excludes dust and vapors when the balance is not in use. If a pharmacist has a delicate, equal beam balance for weighing alkaloids and powerful poisons (see Fig. 8), and a box prescription scale for weighing ordinary quantities, he is well equipped for compounding prescriptions.

Fig. 18

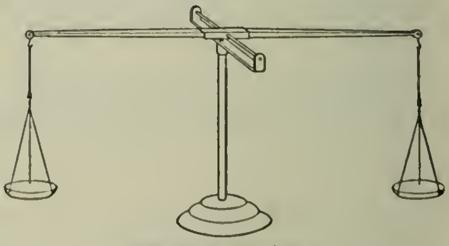


Box prescription scales

By far the most extensive application of the compound lever and unequal arm principles has been made in the universally known platform scales, which are manufactured largely by Fairbank and others; these are employed in weighing comparatively large quantities, and are most useful in the laboratory and warehouse. In these a platform or table is suspended by four short legs upon the ends of four levers, which are joined to a central nearly horizontal lever, which in turn is connected with a perpendicular iron rod attached to the graduated bar, suspended so that one of the arms is much longer than the other. This combination of levers is so nicely adjusted that one hundred pounds placed upon the platform may be balanced by a one pound weight placed upon the end of the graduated bar.

Torsion Balances.—A simple illustration of the principle of torsion is afforded by tying a stout piece of cord to a firm support and inserting a lead pencil in the middle of the cord between the strands, at right angles to it. If the free end of the cord is tightly stretched, and the effort is made to turn the lead pencil over, it will be at once noticed that resistance is offered, and if the pencil is released, it at once flies back to its original position.

Fig. 19



Ritchie torsion balance

Torsion is the term applied to this method of twisting. The principle of supporting the beam of a balance upon a tightly stretched wire, with the view of doing away with knife edges and diminishing friction, has occupied the attention of inventors for years. One of the earliest and simplest forms in which this principle was used was that devised by Ritchie, shown in Fig. 19. A very light beam is supported exactly in the middle (at its centre of gravity) upon a wire stretched upon a horizontal bar, having its ends slightly turned up; to these the ends of the wire are fastened, the beam is firmly secured to the wire, and when it is caused to oscillate the wire is twisted according to the extent of the force applied. This balance was very delicate and impracticable, because the torsional resistance was not overcome; this had to be neutralized before the wire could be used solely as a means of supporting the beam. In 1882 Prof. Roeder and Dr. Springer contrived an ingenious torsion balance which gave promise of valuable results. Two illustrations of this original balance are shown on page 54 of the first edition of the "Practice of Pharmacy." Recent improvements have greatly increased its efficiency; the most important difficulty in applying the principle—that of torsional resistance—was overcome by the device of placing a weight just above the centre of gravity, torsional resistance having the tendency to keep the beam in a horizontal position, while the elevation of a weight above the centre of gravity, by its tendency to produce unstable equilibrium (see page 56), exercises an opposite effect—that of inclining the beam to be top heavy, and therefore to tip on either side. If now the weight be made adjustable, by mounting it upon a perpendicular screw, so that it can be raised or lowered, it is possible to arrange these opposite forces so that one exactly neutralizes the other. In this manner sensitiveness is obtained.

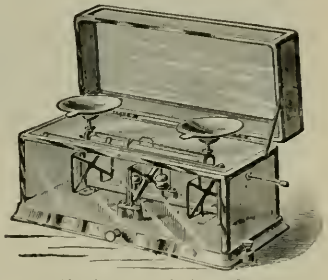
Fig. 20

Frame

Fig. 21

Frame with wire

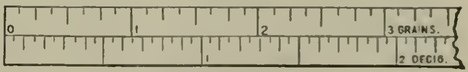
Fig. 22



Torsion prescription balance

In the torsion prescription balance (see Fig. 22) two beams are used, supported upon three frames, each of the latter having a flattened metallic band stretched tightly over its edge. Fig. 20 shows one of these frames, and Fig. 21 shows a frame with the wire stretched upon it. The form of the prescription balance is that of the box scale, enclosed in a glass case; a rider beam graduated upon the upper edge from $\frac{1}{8}$ of a grain to 8 grains and on its lower edge from 0.5 centigramme to 5 decigrammes (see Fig. 23) furnishes a very convenient means of weighing minute quantities without having to use the small weights. The single ball elevated over the central point of support has in the later patterns been replaced by two smaller weights, one on either side of the central frame. These serve the same purpose as the single weight, and do not have the objection that the latter has, of sometimes interfering with the convenient use of the scales when large pieces of paper are placed upon the scale pans to receive a substance to be weighed (see Fig. 24). A base upon which the torsion balance may be placed, containing a drawer, is very convenient for holding weights, powder papers, etc.

Fig. 23

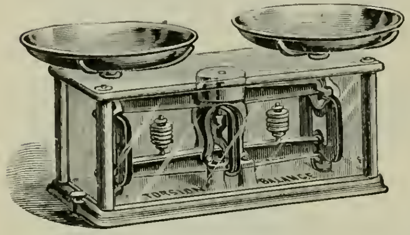


Part of the rider beam

The torsion principle has also been applied to analytical balances with short arms and scales designed to carry heavier loads, as well as counter scales constructed upon the compound lever principle; balances with unequal beams and those having sliding weights upon graduated beams are now manufactured in many different patterns.

Care of the Balance.—The necessity for protecting the delicate mechanism of a balance is frequently overlooked, notwithstanding the possibility of having a fine apparatus irretrievably ruined by want of care in using or cleaning it or in protecting it while at rest. The position chosen for the balance or scales should be upon a level and firm counter, desk, or table, where it will be subjected to little risk of injury from dampness, dust, or corrosive vapors, and where the knife edges will not be liable to become blunted by the jarring produced by heavy mortar practice or other vibration.

FIG. 24



Torsion counter scale

In the finer class of balances protection is afforded by enclosing them in glass cases having sash doors in the front or at the side, and providing against injury from vibration by the use of a lever for elevating or locking the beam, so that the knife edges are not in contact with any surface whatever. To prevent injury from jarring while the balance is in use, by a weight falling on the pan, or other accident, the finest balances are provided with pan supports, which break the fall and serve the additional purpose of quickly arresting the beam, thus saving time while weighing.

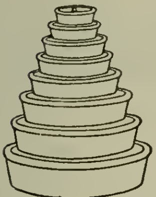
Substances which act on metals, like iodine, corrosive sublimate, etc., and those which are adhesive, like the extracts, should not be weighed directly upon the scale pans, but upon the glass pans which are furnished by the manufacturers, or, if these are not at hand, upon highly glazed paper, care being taken to balance the papers before weighing the substance. In cleaning the scales, great care should be exercised; polishing powders should be used sparingly; a portion is very apt to find its way into crevices and elude detection until an attempt is made to adjust the scales, when the increased weight of one of the sides of the beam leads to its discovery. Frequent cleaning with soft leather is generally sufficient to keep a balance in good order; but if through neglect it becomes necessary to use more active measures, some simple polishing powder for the silver and brass work, with soapsuds for nickel plate, and simple brushing for the lacquered brass, is all that is necessary.

Metallic Weights used in Pharmacy

The weights used by the pharmacist are a very important part of his outfit, and care in their selection and examination is necessary. Economy of the cheese paring order is particularly to be avoided, as the use of cheap, inaccurate weights must lead ultimately to serious consequences. Prescription weights are sometimes seen so worn that the characters on their faces have disappeared, and, *per contra*, weights are to be found with bits of hardened extract and dirt obscuring their characters. A set of standard weights should be kept on hand, so that at least once a year the weights in daily use can be tested

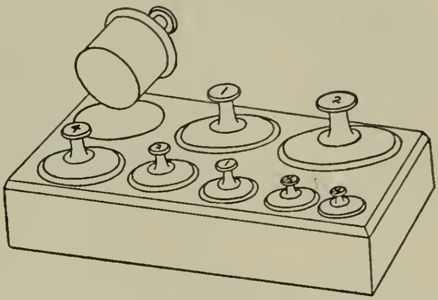
Common avoirdupois weights are usually made of iron, and are of the flat, circular form (see Fig. 25), japanned to prevent rusting; these form a pyramidal pile, and range from half an ounce to four pounds; they may be adjusted by adding to or diminishing the amount of lead which is hammered into a depression in the base of each. These weights are sometimes made of brass in this form, and sometimes of zinc; the latter, however, are brittle and unserviceable. When used for dispensing purposes, the cylindrical weights, known technically as "block weights," are preferable. If the block is made of two kinds of wood glued together, so as to avoid shrinkage, they are very desirable, particularly if each cylindrical hole in the block has been made large enough to hold easily each weight. The advantages of block weights are, that the gaps left by missing weights are readily noticed, and the greater surface of the weight is protected from the action of corrosive vapors when not in use. When the weights are nickel plated, a more imposing appearance is produced by arranging them on an ebonized block in recesses. The disadvantage of this form is that the surfaces are not protected from oxidation, and they need cleaning more frequently. J. M. Maris & Co., of Philadelphia, supply brass avoirdupois weights having a shoulder near the top, these fit into circular openings in a hollow cast iron frame (see Fig. 26), and by this expedient the annoyance common to ordinary blocks, caused by the shrinkage of the wood, is avoided.

Fig. 25



Common avoirdupois weights

Fig. 26



Avoirdupois weights in metal frame

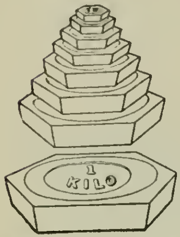
Troy weights may be had either as "block weights" or "cup weights;" the latter are to be preferred, particularly if the block avoirdupois weights have already been procured, for they are then easily distinguished from each other. The cup troy weights range from a quarter of an ounce to thirty two ounces, and have many conveniences (see Fig. 27). When the outside weight is separated, it will be found to have the exact weight of all the rest; if one of the weights is missing, its absence is at once noticed in the incomplete nest; and their compact form is a great recommendation. Weights cannot well be made to occupy less space, while all the inside weights are protected from abrasion and corrosion.

Fig. 27

Cup troy weights

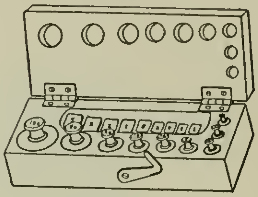
Metric weights may be procured of iron (japanned) for coarse weighing, when they are preferably hexagonal and flat in shape, to distinguish them from the ordinary round avoirdupois weights (see Fig. 28). The most useful for the pharmacist's purposes are undoubtedly the brass weights. Those made by Becker, and contained in a solid block, ranging from one centigramme to one hectogramme, as shown in Fig. 29, are very reliable and convenient.

FIG. 28



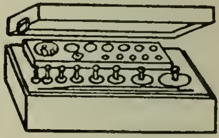
Metric weights (iron)

FIG. 29



Metric weights (block)

FIG. 30

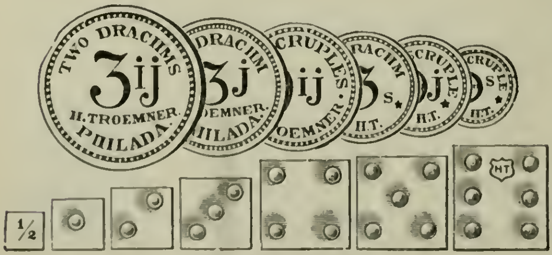


Metric weights (analytical)

For prescription purposes, a very inexpensive yet accurate set is made by Troemner, by which as high as forty grammes may be weighed by using all the brass weights, while ample provision is made for weighing the fractional parts of a gramme.

For analytical purposes, metric weights are almost exclusively used; in the most complete sets the highest weight is one kilogramme, the lowest one-tenth of a milligramme; three riders for use on the graduated scale beam are provided. The weights, from one gramme upward are of brass, finely lacquered; the smaller weights are made of squares of platinum foil, curved so as to permit of being easily handled with the forceps.

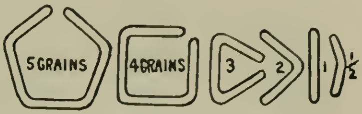
FIG. 31



Prescription weights

Prescription weights.—Too much care can hardly be exercised in the selection of weights to be used in compounding prescriptions. The cost of accurate weights is trifling, yet the market is flooded with weights which are disgracefully inaccurate, and it is greatly to be regretted that the latter find a ready sale. The round, flat, brass "drachm" weights, which have the denomination stamped distinctly on their face in raised characters, are most largely used (see Fig. 31). These range from ten grains to one hundred and twenty grains in weight. The old fashioned square brass "drachm" weights are rapidly passing out of use. The brass foil grain weights are usually inaccurate, and should not be employed, because of their liability to corrosion. Undoubtedly the best grain weights are the aluminum wire weights. These are more easily and quickly distinguished from one another than any other form, and there is less likelihood of dangerous mistakes than from the flat weights, where the denomination is stamped upon the face, often faintly, and is liable to be obliterated by constant use or corrosive contact. The number of sides in the wire weights at once gives the denomination (see Fig. 32). There is such a difference in the shape of these weights, and they are so simply handled practically, that they should be invariably used. The aluminum grain weights, cut out of aluminum plates, are to be preferred to the flat, brass grain weights, because less liable to corrosive action. They are usually more accurately adjusted ; the corners of the weights are clipped, and each weight is pressed into a curved form, so that it may be easily picked up (see Fig. 33).

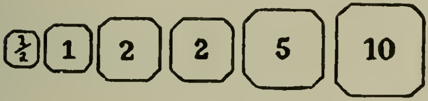
Fig. 32



Aluminum wire weights

Measuring Liquids.—Tinned iron measures nearly cylindrical in shape, but slightly wider at the bottom, are generally used for measuring liquids when the quantity is over a pint. A set of these measures usually consists of four (gallon, half-gallon, quart, and pint). Those made of tinned iron, or of the enamelled sheet iron called agate or marbleized, are greatly inferior to those made of *tinned copper.* Tinned iron measures soon become rusty ; and although a protection is afforded if enamelled, particles of the enamel become chipped off, and the exposed iron soon contaminates the liquids measured in them. Tinned copper measures cost more at first, but they are more economical, because more durable. Care must be taken to protect them from blows which will cause dents, as these may be serious enough to detract from the accuracy of the measures. Fig. 34 shows a copper gallon measure of the usual form. Cylindrical metric measures having a diameter just half their height, of tinned copper or brass, in sets of ten, including dekaliter, half-dekaliter, double liter, liter, half-liter, double deciliter, deciliter, half-deciliter, double centiliter, and centiliter are obtainable. An excellent measure for the laboratory, particularly where liquids are to be carried any distance, is shown in Fig. 35. It was designed by Dr. E. R. Squibb, and has the merit of being less liable to error in measuring than those of ordinary shape, because of the contracted surface at the top.

Fig. 33



Aluminum grain weights

Fig. 34

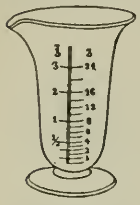
Tinned copper gallon measure

Fig. 35

Laboratory measure

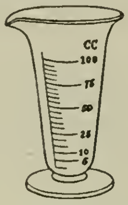
Glass measures are preferred for relatively small quantities of liquids, for, although always subject to loss by fracture, they can be more accurately adjusted to indicate the measure. On account of the transparency of glass, the level of the liquid at any height may be seen through the measure, while porcelain or metallic measures have to be full, or nearly so, to be used.

FIG. 36



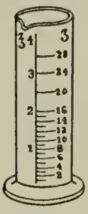
Tumbler-shaped graduate

FIG. 37



Metric graduate

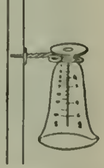
FIG. 38



Cylindrical graduate

Glass graduated measures are almost exclusively used for quantities of one pint or less, and these are of two forms,—*conical* and *cylindrical.* The conical graduate is preferred in practical work because of the greater ease with which it can be cleansed, but cylindrical measures are likely to be more accurate because of their smaller diameter. Thus, if a conical graduated measure has at the f℥ 3 mark a diameter of 3 inches (see Figs. 36 and 37), and the cylindrical graduate (see Fig. 38) a diameter at the same mark of 1 inch, it follows that a trifling error in reading off in the cylindrical graduate, either slightly above or below the line, would be increased if similarly made in the conical graduate by exactly the number of times that the surface of the liquid in the conical graduate exceeds that in the cylindrical graduate at the given point. Formerly it was usual to use exclusively glass measures which had been graduated by hand; but, owing to the large quantities of imperfect graduates found in the market, moulded measures came into use. These, while deficient in the attractive brilliancy of surface characteristic of blown glass, have the substantial merit of greater accuracy. Hodgson's moulded graduated measures were the first to appear, and were largely used for a while, but they have been supplanted by Hobb's graduated measures. In Hodgson's measure the graduations are upon the outside surface of the glass, and their accuracy largely depends upon whether the plunger, which forces the melted glass into the mould, is driven down to exactly the standard depth to secure the proper thickness of glass to indicate the correct capacity. This practical point could not always be attained, owing to the wear of the mould, and occasionally the measures were imperfect. In Hobb's graduated measures this difficulty is overcome by *graduating the plunger*, and when this is done it makes no difference about the thickness of the glass, because if the plunger is correctly graduated, if the proper allowance has been made for contraction in cooling, and if a correct impression can be made upon the inside of the glass, the measure itself must be accurate, and the same result can be indefinitely repeated. An objection arises, however, to this form of graduate in measuring thick or dark colored liquids, for then the graduations upon the inside are often completely obscured. This is sometimes remedied by correspondingly marking them upon the outside with an engraver's wheel. The introduction of the moulded graduates has had the natural effect of improving the accuracy of the blown, hand graduated measures, and it is now unusual to see a measure like one formerly in the possession of the author, which registered 25 percent. too much when filled to the highest graduation. If the custom of returning to the

FIG. 39



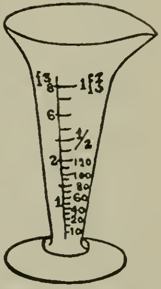
Graduate hook

maker all graduates which prove inaccurate were universal, it would soon be impossible to find an inaccurate one. As it is, reliable graduates can always be had by paying a fair price for them.

Fig. 39 shows a simple method of supporting a graduate after cleaning it. A brass hook is screwed into an upright, preferably over the sink; the prongs are so adjusted that they easily catch the graduate base.

An improvement has been made recently by graduating measures *doubly;* upon one side metric measures are marked, and upon the other ordinary fluid measures, and in addition they sometimes have two lips opposite to each other, for pouring either to the right or left, or for permitting the use of either scale. The testing of the graduation of a glass measure is effected most accurately by placing it upon a perfectly level surface and then pouring into it the proper weight of distilled water at the temperature of 25° C. (77° F.); the fluidounce, weighing 454.6 grains, is preferably taken as the basis. A sufficiently accurate and more ready method is to measure into the graduate from a standard burette or pipette 30 Cc. of water for a fluidounce (29.57 Cc. is the exact equivalent). The extension of the graduating mark into a circle which passes entirely around the graduate is an improvement which obviates the necessity of placing the graduate upon a level place, as the corresponding mark upon the opposite side may be seen through the glass, and the graduate easily levelled even when held in the hand. For measuring smaller quantities of liquids graduated glass tubes of much less diameter should be used, and minim pipettes are more accurate, cleanly, and convenient than the conical minim graduates which are often used, and which possess several radical faults. By referring to Fig. 40 it will be seen that the graduations on the minim measure are necessarily in the narrowest and lowest portion of a comparatively tall measure. Now, if it is desired to measure ten minims of a volatile oil, to add to a pill mass, the surface which the oil must traverse when this measure is inverted over the mortar is so great that probably 20 percent. of the oil will be left adhering to the measure. In those instances of liquid preparations where the smaller liquid is miscible with the larger quantity of diluting liquid, the minim graduate may be rinsed and this loss recovered, but inconveniences are largely overcome and greater accuracy secured by the use of the minim pipette suggested by Dr. E. R. Squibb (see Fig. 41). This in its simplest form consists of a glass tube of small caliber, with its lower extremity somewhat contracted, and having minim graduations upon its side. The pipette is used by dipping the contracted end into the liquid to be measured, and upon applying suction by the mouth at the opposite end the liquid is drawn into the pipette; the moistened tip of the right forefinger is now tightly applied to the upper end of the tube to regulate the flow of the liquid, and a sufficient quantity is allowed

Fig. 40



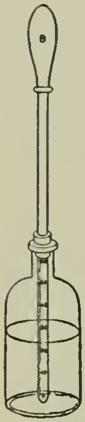
Minim measure

Fig. 41

Minim pipette

to flow out by slightly raising the finger until the height of the liquid corresponds to the measure desired; pressure with the forefinger at once stops the flow, and the accurately measured quantity can be transferred to the bottle, mortar, or graduate by raising the finger and allowing the liquid to flow out. These pipettes may be had of four different capacities, holding 15, 20, 30, and 60 minims, and a reference to the cut will show that a sufficient length of tube above the graduations is left to secure the operator from any risk of getting a poisonous liquid into the mouth, except through extraordinary carelessness. One of the best methods of keeping the pipette ready for use is to have it pass through a perforated cork which fits into a half-pint bottle containing alcohol or water (see Fig. 42), the liquid being renewed when it ceases to be clean. A rubber unperforated tube nipple, inserted on the top of the pipette, has also been suggested to obviate the necessity of using suction with the mouth; it is used by first pushing it down over the top of the pipette until it will go no farther, then compressing the bulb and inserting the tip of the pipette into the fluid, when upon gradually relieving the pressure on the bulb the pipette commences to fill, and if not filled to the mark desired the bulb is pushed upward gently until the end is attained. In the use of tubes or glass measures of small diameter, it will be noticed that two distinct lines are visible on the surface of the liquid. This is due to the capillary attraction of the glass, which causes the edge of the liquid to creep up the sides, and the surface becomes concave and a *meniscus* is formed; the lowest point of the lower zone is usually selected by analytical chemists as the reading point, but it is manifest that a line drawn between the upper and lower zones slightly below the middle would give the most correct reading. Fortunately, the occasions are very rare in pharmaceutical operations where a difference in the method of reading need cause concern.

FIG. 42



Minim pipette with bottle

In administering small quantities of liquids the very convenient *drop* is almost always used. The impression that a drop is equivalent to a minim, and that sixty drops of any fluid are equivalent to a fluidrachm, is widespread. This impression doubtless arose from the fact that sixty ordinary drops of *water* are about equal to a fluidrachm; but many circumstances cause variations in the relative size of drops. Thick viscous liquids, like the mucilages and the syrups, necessarily produce large drops, because the drop adheres to the surface of the glass so long as its weight does not overcome its power of adhesion, while bromine and chloroform, heavy, mobile liquids, having very little adhesion to the dropping surface, produce very small drops, only one-fifth the size of the drop of syrup of acacia. The shape and surface of the vessel from which the liquid is dropped also have an influence in determining the size of the drop. The greater the extent of surface for the drop to adhere to, the larger, proportionally, will be the drop. In order that this subject should have an investigation of a rather wide range, the late Stephen L. Talbot, at the author's suggestion, constructed, after many laborious trials, the following table:

Table exhibiting the Number of Drops in a Fluidrachm of Different Liquids, with the Weight in Grains and Grammes

Name	Drops in f℥i (60 m.)	Weight of f℥i	
		in gr.	in Gm.
Acetum Opii	90	61	3.95
Sanguinariæ	78	55½	3.59
Scillæ	68	57	3.69
Acidum Aceticum	108	58	3.75
Aceticum Dilutum	68	55	3.56
Carbolicum	111	59	3.82
Hydrochloricum	70	65	4.21
Hydrochlor. Dilutum	60	56	3.62
Hydrocyanicum Dil.	60	54	3.49
Lacticum	111	66	4.27
Nitricum	102	77	4.98
Nitricum Dilutum	60	58	3.62
Nitrohydrochloricum	76	66	4.27
Phosphoricum Dil.	59	57	3.69
Sulphuricum	128	101	6.54
Sulphuricum Aromat.	146	53	3.43
Sulphuricum Dilutum	60	58½	3.79
Sulphurosum	59	55	3.56
Æther	176	39	2.52
Alcohol	146	44	2.85
Dilutum	137	49	3.17
Aqua	60	55	3.56
Ammoniæ Fortior	66	50	3.24
Destillata	60	53½	3.46
Balsamum Peruvianum	101	60	3.88
Bromum	250	165	10.69
Chloroformum	250	80	5.18
Copaiba	110	51	3.30
Creosotum	122	56½	3.66
Fluidextract Belladon.	156	57	3.69
Buchu	150	47½	3.07
Cimicifugæ	147	48	3.11
Cinchonæ	138	58	3.75
Colchici Radicis	160	57	3.69
Colchici Seminis	158	55	3.56
Conii	137	61	3.95
Digitalis	134	62	4.01
Ergotæ	133	60	3.88
Gelsemii	149	49	3.14
Glycyrrhizæ	133	61	3.95
Hyoscyami	160	59	3.82
Ipecacuanhæ	120	60	3.88
Pareiræ	140	57	3.72
Rhei	158	61	3.95
Sarsaparillæ Comp.	134	60	3.88
Senegæ	137	62	4.01
Serpentariæ	148	47	3.07
Uvæ Ursi	137	60	3.88
Valerianæ	150	49	3.17
Veratri Viridis	150	50	3.24
Zingiberis	142	48	3.11
Glycerinum	67	68	4.40
Hydrargyrum	150	760	49.24
Liquor Acidi Arsenosi	75	56	3.62
Ammonii Acetatis	57	55	3.56
Arseni et Hydrargyri Iodidi	58	55	3.56
Ferri Chloridi	71	72	4.66
Ferri Citratis	71	72	4.66
Ferri Nitratis	59	59	3.82
Ferri Subsulphatis	73	83	5.37
Ferri Tersulphatis	83	72	4.66
Liquor Hydrarg. Nit.	131	123	7.97
Iodi Compositus	63	59	3.82
Plumbi Subacetatis	74	70	4.53
Potass. Hydroxidi	62	58	3.75
Potassii Arsenitis	57	55	3.56
Sodæ Chlorinatæ	63	62	4.01
Zinci Chloridi	89	88	5.70
Oleoresina Aspidii	130	52	3.36
Capsici	120	51	3.30
Cubebæ	123	52	3.36
Oleum Æthereum	125	50	3.24
Amygdalæ Amaræ	115	55	3.56
Amygdalæ Expres.	108	48½	3.14
Anisi	119	54	3.49
Bergamottæ	130	46	2.98
Cari	132	50	3.24
Caryophylli	130	57	3.69
Cinnamomi	126	53½	3.46
Copaibæ	123	49½	3.20
Cubebæ	125	51	3.30
Fœniculi	125	53	3.43
Gaultheriæ	125	62	4.01
Juniperi	148	49	3.17
Lavandulæ	138	52	3.36
Limonis	129	47	3.04
Menthæ Piperitæ	129	50	3.24
Ricini	77	51½	3.33
Rosæ	132	47	3.04
Rosmarini	143	50	3.24
Sassafras	133	58	3.75
Terebinthinæ	136	45½	2.94
Tiglii	104	50	3.24
Spiritus Æther. Comp.	148	45	2.91
Ætheris Nitrosi	146	47	3.04
Ammoniæ Aromat.	142	48	3.11
Camphoræ	143	47	3.04
Chloroformi	150	48	3.11
Menthæ Piperitæ	142	47	3.04
Syrupus	65	72	4.66
Acaciæ	44	73	4.73
Ferri Iodidi	65	77	4.98
Scillæ	75	74	4.79
Scillæ Compositus	102	70	4.53
Senegæ	106	70	4.53
Tinctura Aconiti	146	46	2.98
Belladonnæ	137	53	3.43
Benzoini Composita	148	48	3.11
Cantharidis	131	51	3.33
Cinchonæ Comp.	140	49	3.17
Digitalis	128	53	3.43
Ferri Chloridi	150	53	3.43
Iodi	148	47	3.04
Nucis Vomicæ	140	44	2.85
Opii	130	53	3.43
Opii Camphorata	130	52	3.36
Opii Deodorati	110	54	3.49
Valerianæ	130	52	3.36
Veratri Viridis	145	46	2.98
Zingiberis	144	46	2.98
Vin. Colchici Radicis	107	55	3.56
Colchici Seminis	111	54	3.49
Opii	100	55	3.56

Specific Gravity

A knowledge of the subject of specific gravity is necessary to the pharmacist, to enable him to identify substances or to judge of their purity, while the physician frequently depends upon it as an aid in diagnosing certain diseases. *Specific gravity is the weight of one body compared with the weight of an equal bulk or volume of another body selected as the standard, both bodies having the same temperature.* In ascertaining the ordinary weight of a body it is simply compared with an arbitrary standard selected by governmental authority, while in determining specific gravity, the body, if solid or liquid, is compared with a standard which is universal,—*i.e.*, an equal bulk of pure water expressed as 1 and taken at a given temperature[1] and atmospheric pressure. In all the methods hereafter detailed, it must be borne in mind that the main object sought for *is the weight of a bulk or volume of water equal to that of the body of which we wish to take the specific gravity.* Archimedes proved experimentally that *a body immersed in a liquid lost as much weight as its own bulk of that liquid weighed;* hence is derived the general rule for taking specific gravity:

Rule.—Divide the weight of the body by the weight of water displaced (loss of weight in water); the quotient will be the specific gravity.

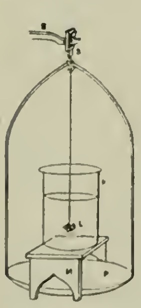
The taking of specific gravity will be considered as follows:

1. Solids insoluble in, but heavier than water.
2. Solids soluble in, but heavier than water.
3. Solids insoluble in, but lighter than water.
4. Solids soluble in, but lighter than water.

1. To take the specific gravity of a solid insoluble in, but heavier than water.

a. With the Balance.—It is customary to recommend a special balance for taking the specific gravity of solids, known technically as the hydrostatic balance; but a good prescription or analytical balance will answer perfectly for practical purposes. The substance, preferably in one piece, is first weighed accurately and the weight noted; a horse hair is then tied around it with a slip knot, and a tight loop at the other end is made, which is attached to the hook at the end of the scale beam; a small wooden bench made for the purpose, or extemporized by taking out the bottom and one of the sides of a small wooden or stiff pasteboard box, is now arranged over the scale pan so that it does not touch it or interfere with its free movement; upon this a small beaker or wide mouthed jar is placed, and two-thirds filled with pure water (see Fig. 43). The horse hair must be adjusted to such length that it will permit of the complete immersion of the substance in the water. Upon weighing the immersed substance, after freeing it from attached air bubbles, it will be at once noticed that it has lost weight, and all that remains to

Fig. 43



Taking the specific gravity of a solid

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[1] The temperature directed in the U. S. P. (8th Rev.) is 25° C. (77° F.). When not specified, it is understood to mean 25° C. (77° F.); but in many investigations, particularly those conducted in Europe, the temperature selected is that of the maximum density of water, 4° C. (39.2° F.). For practical purposes the temperature adopted by the Pharmacopœia is most useful in the latitude of the United States.

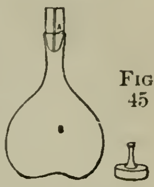
be done is to apply the rule,—divide the weight of the body by its loss of weight in water.

For example, 805.5 grains of copper lose by immersion in water 90 grains; then 805.5 divided by 90 gives 8.95, the specific gravity of the copper. See also Nicholson's hydrometer, page 84.

b. With the Specific Gravity Bottle.—This instrument in its most usual form is a bottle having an elongated, narrow neck, fitted with a ground glass stopper, and holding, when filled, exactly 1000 grains of pure water at a given temperature (see Fig. 44).[1] The reason for selecting 1000 grains for the contents is to avoid the necessity of making a calculation to obtain the specific gravity of a liquid.[2] To use the instrument for a solid substance, the previously weighed body is dropped into the bottle, which is then filled with water at the temperature of 25° C. (77° F.), the bottle carefully dried, and, after the counterpoise (the exact weight of the empty bottle, see Fig. 45) has been placed upon the opposite scale pan, it is weighed. To obtain the *loss of weight* in water of the substance, it is only necessary to deduct the weight of the contents of the bottle (*i.e.*, that of the water and the immersed body) from the weight of the body in air, plus that of the water which the bottle holds when full,—*i.e.*, 1000 grains; the rule is then to be applied,—divide the weight of the body by its loss of weight in water.

FIG. 44

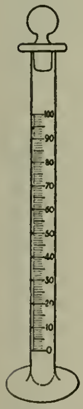
FIG. 45



1000 grain bottle with counterpoise

Example.—A piece of aluminum wire weighs 100 grains; when dropped into a 1000 grain bottle, and the bottle filled with water at the proper temperature, the weight of both is 1062 grains. As the bottle when filled with water alone held 1000 grains, and as the weight of the aluminum in air is 100 grains, both together weigh 1100 grains; hence 1100 grains, less 1062 grains, gives 38 grains, the loss of weight of the aluminum in water. *Apply the rule*, $\frac{100}{38} = 2.63$, sp. gr. The specific gravity of any insoluble powder, like calomel, litharge, etc., may be taken in exactly the same way, but care must be observed to agitate the powder with a small quantity of water in the bottle, before adding the rest, to cause the bubbles of air to escape.

FIG. 46



Graduated specific gravity tube

c. With the Graduated Tube.—A graduated tube is provided in which each space indicates a grain or a gramme (Cc.) of water (or better if graduated in smaller subdivisions); the zero mark should be somewhat above the bottom of the tube, as shown in Fig. 46. Now, if water be poured into the tube exactly up to the zero mark, and a weighed solid body dropped into it, the water will rise in the tube and indicate the weight of a bulk of water equal to that of the substance; this is equivalent to the loss in water. *Then apply the rule*,—divide the weight of the body by its loss of weight in water. It is evident that this method cannot be as accurate as either of those above mentioned, as small differences are more clearly indicated by a good balance than by tube reading.

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[1] 50 Gramme Specific Gravity bottles are supplied by apparatus dealers for those who prefer metric bottles.

[2] See Specific Gravity of Liquids, page 77.

d. By immersing the Solid in a Transparent Liquid of the Same Density.—This method may be applied where the body is small, is not very heavy specifically, and is insoluble in the liquid. A heavy liquid is chosen, like solution of mercuric nitrate; the solid is found to float on the surface of the liquid, and water is added until the solid neither rises nor sinks, but swims indifferently. The specific gravity of the solid will of course be that of the liquid, which may be ascertained by the specific gravity bottle (see page 77).

2. To take the specific gravity of a solid soluble in, but heavier than water.

A liquid must be selected in which the solid is insoluble, like olive oil, almond oil, petroleum benzin, or oil of turpentine. The specific gravity of the oil having been ascertained, it is used just as if it were water, the object being to find out the loss of weight that the substance suffers when immersed in the oil; this having been obtained, a simple proportion must be made as follows: as the specific gravity of the oil is to the specific gravity of water, so is the loss of weight in the oil to the loss of weight in water. *Then apply the rule,*—divide the weight of the body by its loss of weight in water.

Example.—200 grains of citric acid lose by immersion in oil 115 grains; then, as

Sp. gr. of oil		Sp. gr. of water		Loss of weight in oil		Loss of weight in water	
0.920	:	1.000	: :	115	:	125	$\frac{200}{125}=1.6$, sp. gr. of citric acid.

It is obvious that either the balance, specific gravity bottle, or graduated tube can be used in this case; but it is possible in some cases to coat the soluble substance with varnish and treat it then as an insoluble substance, and thus avoid the use of an oily liquid. A pill of blue mass may be coated with shellac varnish, and then treated as an insoluble substance as in 1, *b*. The practical difficulty, however, is to secure a thin coating which shall be impervious to water.

3. To take the specific gravity of a solid insoluble in, but lighter than water.

The solution of this problem requires the aid of a heavy insoluble body, which is to be attached to the light body, so as to secure the immersion of both. It is plain that if the loss of weight in water of the heavy substance is deducted from the loss of weight in water of both the heavy and the light body, the result must give the loss of weight in water of the light body alone. *Then the rule must be applied,*—divide the weight of the body by its loss of weight in water.

Example.—A piece of paraffin weighs 174 grains, a piece of brass loses by immersion in water 6 grains; when the brass is attached to the paraffin, both together lose by immersion in water 206 grains; by deducting 6 grains (the loss in water of the brass) from 206 grains (the loss in water of both) the loss in water of the paraffin alone is found,—*i. e.*, 200 grains; then $\frac{174}{200}=0.870$, sp. gr. of paraffin. See also Nicholson's hydrometer, Fig. 57.

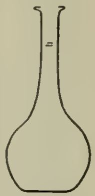
4. To take the specific gravity of a solid soluble in, but lighter than water.

The use of the specific gravity bottle is recommended in cases of this kind, and the process is the same as in 2. The selection of a suitable liquid lighter than the body, and in which it is insoluble, is, however, usually attended with difficulty. The proportion would be, as the specific gravity of the light liquid is to the specific gravity of water, so is the loss of weight in the light liquid to the loss of weight in water. *Then the rule must be applied,*—divide the weight of the body by the loss of weight in water.

Specific Gravity of Liquids

The *specific gravity bottle* (*pycnometer* or pyknometer) is the most accurate instrument for taking the specific gravity of liquids. Fig. 47 shows a practical form; it is used as follows. The liquid to be tested is first brought to the proper temperature, 4° C. (39.2° F.), 15.6° C. (60° F.), or 25° C. (77° F.), according to the standard selected for the bottle; the bottle is filled with the liquid to the mark on the neck, dried carefully, and weighed accurately, using the counterpoise on the opposite pan. If the 1000 grain or 100 gramme bottle has been used, the weight of the liquid at once indicates the specific gravity. Thus, the bottles would hold at 25° C. (77° F.) 1158 grains or 115.8 grammes of hydrochloric acid, 1246 grains or 124.6 grammes of glycerin, 716 grains or 71.6 grammes of ether, and 13535 grains or 1353.5 grammes of mercury, and the specific gravity of each would be respectively 1.158, 1.246, 0.716, and 13.535, thus directly showing the relation to the specific gravity of water, 1. To show the use of an ordinary prescription vial in this process, one containing about a fluidounce may be taken; if it holds 454.6 grains of pure water to a mark upon the neck it will be convenient, because it will at the same time give the weight of a fluidounce of the liquid. It is evident that a bottle holding any moderate quantity may be used in the same way.

Fig. 47



Specific gravity bottle

A fluidounce bottle at 25° C. (77° F.) would hold 526.4 grains of hydrochloric acid, 566.5 grains of glycerin, 325.5 grains of ether, and 6153.0 grains of mercury, and the specific gravity would be obtained by the following proportion:

Example.—As 454.6, the number of grains of pure water that the bottle holds, is to 1.000, the specific gravity of water, so is 526.4, the number of grains of hydrochloric acid that it holds, to 1.158, the specific gravity of hydrochloric acid. 454.6 : 1.000 : : 526.4 : 1.158.

In practice, it is simply necessary to divide the number of grains of liquid that the bottle holds by 454.6 and adjust the decimal point. The accuracy of these bottles depends entirely upon the care with which they are made and used, and it is better to scratch, with a file, two marks upon the neck of a long necked flask, one showing the upper edge of the meniscus and the other marking the lowest point (see Fig. 47). In filling, it is a good practice, after bringing the liquid to the proper temperature, to exceed slightly the quantity indicated by the mark on the neck, and then to make a small roll of filtering paper and neatly absorb the excess by inserting the roll in the neck so that it shall just touch the surface. The more expensive specific gravity bottles have an accurately fitted stopper made of thermometer tube, and hold exactly 100 grammes, or 1000 grains, when the bottle, including the capillary tube of the stopper, is entirely full (see Fig. 44). They are not so convenient as a correctly marked, narrow necked bottle (see Figs. 47 and 49), nor are they practically more accurate. They have to be filled to the brim and the stopper then inserted; this causes an overflow, and the necessary wiping and the natural warmth of the hands usually expand the liquid by raising the temperature, and prevent accurate results.

Fig. 49

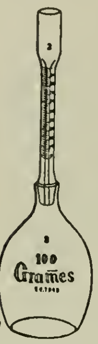


Fig. 48

Squibb's pycnometer with leaden collar

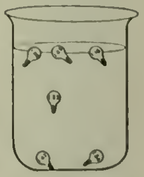
A more elaborate form of apparatus for taking specific gravity is needed for some purposes; for instance, where standards are required for the liquid preparations of the Pharmacopœia or in investigations where great accuracy is necessary. Dr. Squibb has devised the pycnometer shown in Fig. 49, which is admirably adapted for taking specific gravity with the objects above mentioned.

One of these bottles is shown in the illustration; the stopper is a tube lengthened out so that the central channel will permit the bottle to hold the volume of water at any temperature between 4° C. (39.2° F.) and 25° C. (77° F.), thus permitting any of the standards of temperature to be used, the tube being graduated to half-millimeters, and at the top it is enlarged so as to allow room for the expansion of light liquids and to permit the bottle to be loosely closed with a cork while adjusting the temperature, the cork being removed during the weighing. These bottles are all used in a bath of water containing ice when the lower standard temperatures are used; Fig. 48 shows a leaden collar to keep the bottle in position in the bath.

It is necessary to verify the marks of the contents of the bottles from time to time, as the glass flask contracts for a year or two after it has been made. The liquid that it is designed to test is weighed into the bottle, as in the ordinary cases of taking specific gravity; the bottle is loosely corked, loaded with the leaden collar, and set in a bath of water which has been brought to the desired temperature. When the liquid in the bottle has reached the same temperature (and this is indicated by the liquid in the tube remaining stationary, a careful watching of the rise or fall of the liquid in the graduated tube being necessary in order to determine this), the final adjustment is made and the bottle weighed.

Lovi's beads, or *specific gravity beads*, are sometimes used for taking the specific gravity of liquids; they are especially useful in cases where a boiling liquid is to be evaporated until it has a given specific gravity, and in mixing liquids of different densities. They are balloon shaped, hollow globes of glass, of different sizes and weights, having specific gravity figures scratched upon their sides. These figures indicate the specific gravity of a liquid in which the beads swim indifferently; they neither rise nor sink, when not disturbed at the given temperature, if the specific gravities of the bead and liquid are the same. The illustration, Fig. 50, shows their method of use, those heavier than the liquid sinking, those lighter floating,

Fig. 50

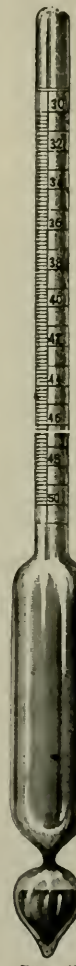


Lovi's beads

while the one supported indifferently (1.25) indicates the specific gravity of the liquid. Lovi's beads may be defined as hydrometers which indicate but one specific gravity.

Hydrometers

Fig. 51



Baumé's hydrometer

Hydrometers, sometimes called *areometers*, are floating instruments which are used to indicate the specific gravities of liquids by sinking to a depth corresponding to the densities of the liquids. Their principle of action was probably first made known by Archimedes, and depends upon the fact that when a solid body is placed in a liquid in which it is capable of floating, it sinks to a certain point, and this floating point is reached when the body has displaced a volume of liquid exactly equal to its own weight. Thus, if an hydrometer has a specific gravity exactly three-fourths that of water, it will sink in water until exactly three-fourths of its volume is immersed ; the same hydrometer would swim indifferently, like a Lovi's bead, in ether having the specific gravity of 0.750, for the obvious reason that the specific gravities of the solid and liquid are identical. Hydrometers may be divided into two classes for convenience of study : 1. Those in which the weight is constant, but the depth of immersion subject to change. 2. Those in which the depth of immersion is constant, but the weight subject to change. To the first class belong nearly all the hydrometers specially useful to pharmacists, and of these, two kinds are generally used, one for liquids heavier than water, the other for those lighter. They are known as Baumé's, Cartier's, Gay-Lussac's, Zanetti's, Twaddell's, but the best of all is the specific gravity scale hydrometer. To the second class belong the hydrometers which are intended to sink, by the addition of weights, to a given mark on the stem, and thus displace a constant volume, like Fahrenheit's, Nicholson's, Guyton de Morveau's, etc.

1. Hydrometers in which the weight is constant, but the depth of immersion subject to change.

Baumé's Hydrometers.—This form is treated first in detail because it was the first one of its class to come into general use, having been originally described by Baumé in his "Éléments de Pharmacie." Two instruments were used by Baumé, one termed *Pèse-Acide* or *Pèse-Sirop*, for liquids heavier than water, the other *Pèse-Esprit*, for liquids lighter than water. This hydrometer, as now made, consists of a glass tube loaded at the bottom with mercury or small shot, having a bulb blown in it just above the loaded end. (See Fig. 51.) A simple cylindrical tube, loaded so as to cause it to assume an upright position in a liquid, may be used as an hydrometer. The only advantage gained in expanding the lower portion into bulbs is one of convenience, that of increasing the volume of the hydrometer, and thus permitting the use of shorter instruments. The graduations upon the stem of Baumé's hydrometer are entirely arbitrary, and were made in the following manner :

For the hydrometer to be used for *liquids heavier than water*, sufficient mercury was added to the lower bulb to cause it to sink in water to a convenient point near the top of the stem ; this was marked 0. The instrument was then placed in a solution containing 15 percent. by weight of common salt, and the point at which it rested was marked 15. The space between these two points was divided into fifteen *equal* parts, and the scale below was extended by marking off similar spaces. *For liquids lighter than water,* the instrument was placed in a 10 percent. by weight solution of common salt, and loaded so that it floated at a point just above the bulb ; this was marked 0. The hydrometer was then transferred to water, the point at which it rested was marked 10, the space between was divided into ten equal parts, and the scale above was extended by marking off similar spaces. The illustrations, Figs. 52, 53, were drawn from Pile's hydrometers, and show the manner of graduating the Baumé scale for both hydrometers, and, in addition, the corresponding specific gravity figures. The Baumé hydrometer is rapidly going out of use, being replaced by an hydrometer having a graduated scale, in which the graduations represent the specific gravities.

Fig. 52

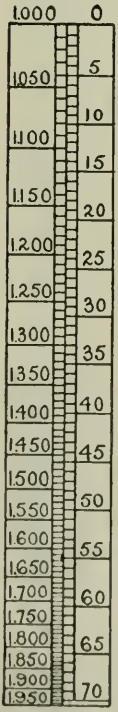
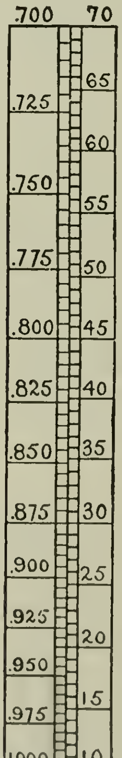


Fig. 53



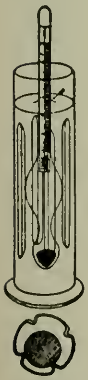
Scales of specific gravity hydrometer

The specific gravity scale hydrometer, which should be used exclusively, is more convenient and useful to the pharmacist. The graduations upon the stem are not arbitrarily chosen, but indicate at once the specific gravity of a liquid when floated in it. Two hydrometers are necessary, one for liquids heavier than water, and one for liquids lighter than water ; for special purposes it is often desirable to have five or six hydrometers, beginning with one for very light liquids and ending with one for very heavy liquids, and if the diameter of the stem is narrow the divisions in the scale are not so close together, and thus a more accurate reading of the graduations is possible and the delicacy of the hydrometer increased. It must be borne in mind, however, that the hydrometer cannot be as accurate an instrument for taking specific gravity as the specific gravity bottle. The adhesion of air bubbles when in use, the liability to variation in the diameter of the stem, the inaccuracies in the scale and the difficulties of adjusting it so as to give correct readings, and the want of uniformity among the makers in fixing the reading point, render it necessary for the pharmacist to verify each instrument and note its error before accepting it for practical use. In selecting an hydrometer with a specific gravity scale, it should be at once noticed whether the graduated spaces are equal. If they are, it is useless to attempt to verify it, as it cannot be accurate, for the degree of the immersion varies with the specific gravity of the liquid, and "equal differences of specific gravity cannot be indicated by equal spaces on the scale, but by the differences of the reciprocals of those specific gravities, or by proportionate quantities." In the illustration shown in Fig. 52, the arbitrary scale of Baumé, made up of equal spaces, is shown immediately in contact with a specific gravity scale. The spaces of the latter gradually increase in size from below upward, and the highest space is nearly four times the size of the lowest. The method of graduating this scale differs with different makers, but by the use of Clarke and Ackland's process it is possible to make a scale without using any other liquid than water if a correct table of reciprocals is employed (see Watts's Dictionary, vol. iii. p. 207). Before any hydrometer is accepted for use, it should be tested by floating it in water at the temperature indicated on the hydrometer, and, the specific gravity of several liquids having been ascertained carefully by the specific gravity bottle, the hydrometer should be floated in the same liquids, and any deviation carefully noted. An hydrometer which registers uniformly one or two points too low or too high need not be rejected, because the error can be added or subtracted each time and the constant error marked on the box for a memorandum; but if an error of any magnitude has to be added to one part of the scale, and another subtracted from another part, it is economy to reject the instrument at once. Hydrometers are usually floated in tall, cylindrical glass jars (see Fig. 54), and it is frequently necessary to cool the liquid by placing the jar in ice water after inserting a thermometer, and, after the temperature has been lowered to the desired degree, observing the point to which the hydrometer sinks in the liquid. It is to be regretted that there is no fixed rule for a reading point; some makers adjust their instruments so as to read from a reflection in the upper part of the meniscus, others (probably the majority) prefer to take the exact level of the liquid, disregarding the meniscus altogether; this may be easily done in all cases where the liquid is transparent, or nearly so, by holding the jar containing the hydrometer at first exactly on a level with the eye, and then glancing slightly below, when a line can be traced which will exactly join the divided surface of the liquid upon either side of the stem. In case of opaque liquids an allowance can be made for the meniscus. The pharmacist should choose one or the other method and adhere to his choice, so that his verification of his own hydrometer may not vary (see Fig. 55, in which the arrow shows the point to read). It is usually best to cool the liquid below the standard temperature adopted for the hydrometer, and then, after wiping the jar, the correct higher temperature may be gradually obtained by grasping the jar with the hands and passing them up and down to warm the liquid. An hydrometer having an elongated bulb with cylindrical sides, as shown in Fig. 56, is more likely to give a false indication if permitted to touch the sides of the

Fig. 54

Hydrometer jar

Fig. 55



Urinometer and jar (Squibb)

jar than one having an oval or globular bulb (see Fig. 55); the latter can touch the jar at only one point, and hence can move freely up and down, while the former may have one side touching the side of the jar for its entire length. To obviate this, Dr. Squibb suggests the use of a jar with four perpendicular indentations in it, and an hydrometer having an oval bulb (see Fig. 55). The points of contact between the urinometer bulb and the indentations in the jar are best shown in the transverse sectional view immediately below the cut of the urinometer.

FIG. 56

Alcoholmeter

The *urinometer* is one of the most useful special applications of the hydrometer; as its name indicates, it is used to take the specific gravity of urine; a special scale, which is easily understood, is sometimes used. The very delicate stem, which hardly permits of the use of specific gravity figures, is divided into sixty spaces, numbered from 0 to 60; by adding 1000 to each of these numbers, and pointing off three decimal places from the right, the true specific gravity is shown. In Dr. Squibb's urinometer the specific gravity is indicated without abbreviation, the number highest on the scale being 1.000, the lowest 1.060, the intervening figures being 1.010, 1.020, 1.030, 1.040, and 1.050.

The specific gravity of urine from healthy subjects ranges from 1.010 to 1.020; that from diabetic patients has a specific gravity varying from 1.030 to 1.060.

The *saccharometer* is intended to take the specific gravity of syrups. The scale is sometimes graduated so as to indicate the percentage of sugar in solution, rarely the actual specific gravity; usually Baumé's scale (*pèse-sirop*) is used. The *elæometer*, a very delicate instrument, is used to take the specific gravity of fixed oil. The *lactometer* is employed in detecting the adulteration of milk with water; it has a limited range, and the scale usually shows the points at which it floats in milk mixed with different proportions of water. Hydrometers are often made for taking the specific gravity of liquids, like petroleum benzin, ether, petroleum, vinegar, wine, beer, solutions of silver nitrate, sea water, etc.; probably the most useful to the pharmacist of all those having special applications is the one made for testing alcohol.

Alcoholmeters may be purchased which combine the thermometer with the hydrometer, as shown in Fig. 56, and the scale frequently has the percentage by volume of absolute alcohol marked opposite the corresponding specific gravity; when graduated so as to show the percentage by weight, they were formerly more useful, on account of the adoption of the principle of parts by weight in the U. S. Pharmacopœia of 1880, thus obviating the necessity of using an alcoholmetrical table or making a calculation.

Tralles's hydrometer is an alcoholmeter having a centesimal scale. It is used by the United States government in gauging spirits, and is in general use by distillers and others. Each division of the scale corresponds to a given percentage of pure alcohol by volume in the liquor. In the United States Dispensatory, 18th edition, page 1881, a table is given showing the value of Tralles's degrees in specific gravity and Baumé's degrees.

Cartier's hydrometer, largely used in France, is merely a modification of Baumé's *pèse-esprit*, or hydrometer for liquids lighter than water; the zero of the scale is the same as Baumé's (10°), but the degrees are not of the same value, 32° of Baumé's scale being equal to 30° Cartier. Dorvault gives the following approximate rule for conversion: Cartier's degrees may be converted into Baumé's by subtracting 10, multiplying the remainder by 0.08, and adding the product to Cartier's degree.

Baumé's degrees may be converted into Cartier's by subtracting 10, multiplying the remainder by 0.08, and subtracting the product from Baumé's degree.

Gay-Lussac's centesimal alcoholmeter has a scale divided into 100 unequal degrees. The zero corresponds to pure water at 15° C. (59° F.) and the 100 mark to absolute alcohol. The advantage of this method is that every intermediate degree expresses the percentage of pure alcohol by measure contained in the spirit. Thus, when the instrument stands at the 50 mark in an alcoholic liquid, it indicates that 100 measures of the liquid contain 50 of pure alcohol.

Sikes's hydrometer is used in Great Britain in the collection of the excise revenue. It is a brass instrument having a spherical bulb, with a weight at the bottom to make it float upright; the stem is divided into 20 parts, and every other division numbered, from 0 to 10. A series of nine weights are furnished with the instrument, numbered from 10 to 90; these are to be added to the weight at the bottom to cause the hydrometer to sink, so that a reading may be had on the graduated scale; this reading added to the number on the weight employed, gives a figure which indicates the strength of the spirit by referring to a table which accompanies the instrument.

Jones's hydrometer is similar to Sikes's, but by many is regarded as an improvement on it.

Dica's hydrometer belongs to the same class.

Twaddell's hydrometer is frequently employed in England, and technical works often quote the degrees of this scale. It is used for liquids heavier than water, and is graduated so that the number of the degree, multiplied by 5 and added to 1000, gives the specific gravity. Thus, 20° Twaddell indicates the specific gravity of 1100 or 1.100; 50° Twaddell, 1250 or 1.250.

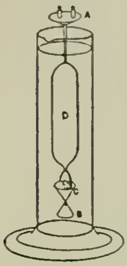
Beck's hydrometer is rarely used or referred to. In this scale 0 corresponds to the specific gravity 1.00, and 30 to that of 0.850; the scale is extended equally above and below 0. For tables, see Bayley's Chemist's Pocket Book, p. 178.

Zanetti's hydrometers have a scale which requires the addition of a cipher to the number of the degree to show the specific gravity.

2. Hydrometers in which the depth of the immersion is constant, but the weight subject to change.

Fahrenheit's hydrometer was one of the first instruments of this class to come into general use. Robert Boyle described, however, in 1675, his "New Essay Instrument," and Fahrenheit's hydrometer was very similar to it in principle; it had but a single mark on the stem, which was surmounted by a small scale pan; weights were placed in the pan to cause the hydrometer to sink to the mark. Now, as this mark indicated the point at which the instrument would float in water at a given temperature when certain weights were placed on the pan, it follows that when it was immersed in a liquid of different specific gravity the weights would have to be changed to float the instrument to the fixed mark; the ratio which this weight bore to the weight used for water gave the specific gravity.

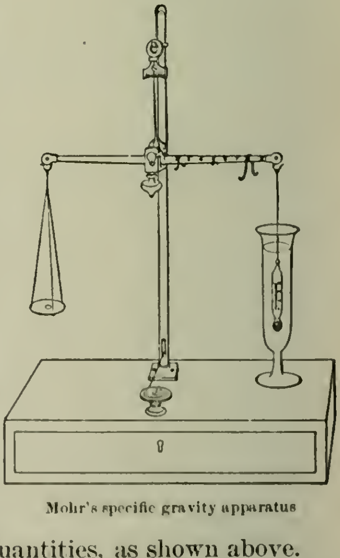
Fig. 57



Nicholson's hydrometer

Nicholson's hydrometer is similar in principle to Fahrenheit's, but is modified so that it can be used for taking the specific gravity of heavy or light solids. Fig. 57 is an illustration of one of the most convenient forms of the instrument; it is usually made of brass; there is a single mark on the stem and a scale pan on the summit. To the lower extremity of the hydrometer two conical cups are attached; their apexes are joined so as to resemble an hour glass; the lowest cone has several apertures at the top, to permit of the escape of air when the instrument is immersed. The weight of the hydrometer is usually so adjusted that a 1000 grain weight is needed on the scale pan to float it to the mark on the stem. Now, to take the specific gravity of a piece of zinc weighing less than 1000 grains, the 1000 grain weight is removed from the pan and the piece of zinc substituted for it, weights are added until the instrument floats at the mark on the stem, and it is found that an addition of 655 grains has been necessary. It is evident that the difference between 1000 and 655 gives the weight in air of the zinc, 345 grains. The zinc is now placed in the upper conical cup and weights are again placed upon the scale pan, and it is found that the zinc has lost in weight 50 grains by immersion in water; the specific gravity is obtained by applying the well known rule,—divide the weight of the body by the loss of weight in water: $\frac{345}{50} = 6.9$, sp. gr. of zinc. The lower cup is used for taking the specific gravity of bodies lighter than water, and is very convenient, the weight of the hydrometer keeping the light body submerged when the lower cup is placed over it. The specific gravity is obtained in the same manner as in the case of bodies heavier than water. One of the advantages of Nicholson's hydrometer is that it can be used in place of a balance for weighing small quantities, as shown above.

Fig. 58



Mohr's specific gravity apparatus

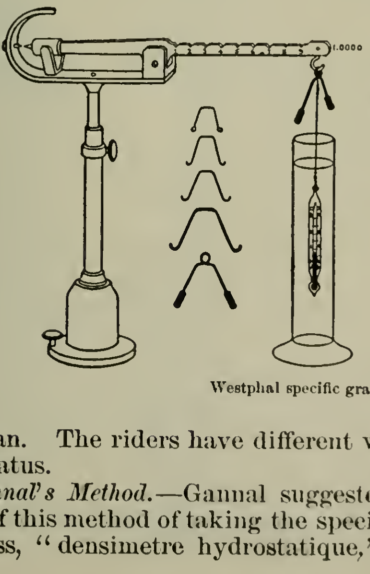
Methods of taking the Specific Gravity of Small Quantities of Liquids.

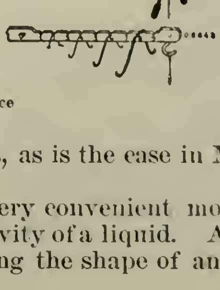
Mohr's Apparatus.—The illustration of this apparatus (see Fig. 58) represents an improved form, yet it is quite possible for a pharmacist to construct one for himself that will answer practical purposes. It will be noticed that one end of the beam is divided into ten equal spaces, and a small glass thermometer is suspended from the extremity by a slender platinum wire, while the opposite scale pan is so adjusted that it exactly counterbalances the thermometer. When the thermometer is immersed in pure water at 25° C. (77° F.), a brass wire weight is placed upon the hook at the end of the beam, and this restores the equilibrium. Now, it is apparent that if a lighter liquid, like alcohol at 25° C. (77 F.), is substituted for the water, the equilibrium cannot be maintained, and the thermometer will sink. The brass wire weight is then to be moved along the beam toward the central knife edge until the balance is nearly restored, and this point will be found at 8, which gives the first decimal figure; still further to approach the equilibrium, a wire weight, one-tenth the weight of the larger one, is pushed along the beam until it rests at the 2 mark, which gives the second decimal figure; while thoroughly to restore the balance the smallest weight (one-tenth of the second) is placed at 5, and thus the third decimal figure is obtained, and the specific gravity of the alcohol is shown to be 0.825. Specific gravities of liquids heavier than water are obtained in the same way, except that the large brass wire weight is left hanging on the hook at the end of the beam and additional weights are placed upon the beam until equilibrium is restored.

A prescription balance could be easily converted into a Mohr's apparatus, and the thermometer replaced by a glass stopper suspended by a horsehair. The thermometer in the improved form of apparatus merely serves to indicate the temperature and act as a convenient weight. In the home made apparatus especial care must be exercised in adjusting the wire hook weight so as exactly to immerse the stopper in water at the proper temperature.

Westphal Specific Gravity Balance.—This balance is more convenient than the Mohr's apparatus because a sliding weight (see Fig. 59) is used on the beam at the left, instead of ordinary weights in the pan. The riders have different weights, as is the case in Mohr's apparatus.

FIG. 59



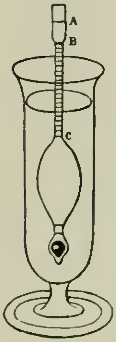


Westphal specific gravity balance

Gannal's Method.—Gannal suggested a very convenient modification of this method of taking the specific gravity of a liquid. A piece of glass, "densimetre hydrostatique," having the shape of an olive, has a volume of 10 cubic centimeters. This is suspended from the hook at the end of the beam of a balance by a horsehair (see Fig. 43), and weights are added to the opposite scale pan until the balance is restored ; it is then immersed in the liquid, and the metric weight required to restore the equilibrium gives the specific gravity without a calculation.

Specific Gravity Pipette.—Grauer recommends the use of a small pipette having a fine orifice at the lower end, and at the upper end a short piece of rubber tube closed by a pinchcock; a mark is scratched on the pipette to show a point to which a convenient weight of water rises (1 Gm.) ; enough of the liquid to be tested is drawn by the mouth through the tube to rise to the mark, and it is then closed ; the weight of the liquid indicates its specific gravity.

Fig. 60



Rousseau's densimeter

Rosseau's Densimeter.—This ingenious instrument is constructed upon the plan of an hydrometer (see Fig. 60). The stem from B to C is divided into 20 equal parts ; the cup shaped tube upon the summit of the stem holds exactly 1 cubic centimeter. When the densimeter is floated in water at the proper temperature, it sinks to the point C at the bottom of the stem ; when the cup is filled with water to the cubic centimeter mark, it causes the instrument to sink to the point B ; this space, B C, being then divided into 20 equal parts, it follows that each division corresponds to $\frac{1}{20}$ of a gramme, or 0.05 Gm. If one cubic centimeter of oil of rose were placed in the cup, it would sink the densimeter to 17.2 divisions of the scale ; then 17.2 × 0.05 = 0.860, the specific gravity of oil of rose.

Table giving the Specific Gravities of Official Substances arranged in the Order of their Densities at 25° C. (77° F.)

Official Name	Specific Gravity	Weight of one Fluidounce in grains
Benzinum	0.638–0.660	290.0–300.0
Æther	0.716–0.717	325.5–325.9
Acetonum . . . about	0.790	359.1
Alcohol Absolutum (15.6° C.; 60° F.)	0.797	362.3
Spiritus Ammoniæ	0.808	367.3
Spiritus Glycerylis Nitratis	0.814–0.820	370.0–372.7
Alcohol (15.6° C.; 60° F.)	0.816	370.9
Petrolatum (60° C. ; 140° F.)	0.820–0.850	372.7–386.4
Spiritus Ætheris Nitrosi	0.823	374.1
Oleum Aurantii Corticis	0.842–0.846	382.7–384.6
Erigerontis	0.845–0.865	384.1–393.2
Limonis	0.851–0.855	386.8–388.7
Rosæ	0.855–0.865	388.7–393.2
Terebenum	0.860–0.865	390.9–393.2
Oleum Terebinthinæ Rectificatum	0.860–0.865	390.9–393.2
Terebinthinæ	0.860–0.870	390.9–395.5
Juniperi	0.860–0.880	390.9–400.0
Coriandri	0.863–0.878	392.3–399.1
Amylis Nitris	0.865–0.875	393.2–397.7
Petrolatum Liquidum	0.870–0.940	395.5–427.2
Oleum Lavandulæ Florum	0.875–0.910	397.8–413.7
Æther Aceticus	0.883–0.895	401.4–406.8
Oleum Myristicæ	0.884–0.924	401.8–420.0
Paraffinum	0.890–0.905	404.6–411.4

Table giving the Specific Gravities of Official Substances arranged in the Order of their Densities at 25° C. (77° F.)—*Continued*

Official Name	Specific Gravity	Weight of one Fluidounce in grains
Oleum Picis Liquidæ about	0.892	405.5
Rosmarini	0.894–0.912	406.4–414.6
Menthæ Piperitæ	0.894–0.914	406.4–415.5
Acidum Oleicum	0.895	406.8
Oleum Copaibæ	0.895–0.905	406.8–411.4
Aqua Ammoniæ Fortior	0.897	407.7
Spiritus Ammoniæ Aromaticus	0.900	409.1
Oleum Thymi	0.900–0.930	409.1–422.7
Cari	0.900–0.910	409.1–413.7
Sabinæ	0.903–0.923	410.5–419.6
Æthereum	0.905	411.4
Adipis	0.905–0.915	411.4–415.9
Eucalypti	0.905–0.925	411.4–420.5
Cubebæ	0.905–0.925	411.4–420.5
Amygdalæ Expressum	0.910–0.915	413.7–415.9
Olivæ	0.910–0.915	413.7–415.9
Æthylis Chloridum (8° C.; 46.4° F.)	0.911–0.916	414.1–416.4
Oleum Menthæ Viridis	0.914–0.934	415.5–424.6
Gossypii Seminis	0.915–0.921	415.9–418.7
Cajuputi	0.915–0.925	415.9–420.5
Adeps	0.917	
Oleum Morrhuæ	0.918–0.922	417.3–419.1
Chrysarobinum	0.920–0.922	
Oleum Hedeomæ	0.920–0.935	418.2–425
Eucalyptol	0.921–0.923	418.7–419.6
Spiritus Frumenti (15.6° C.; 60° F.)	0.924–0.945	420.0–429.6
Spiritus Vini Gallici (15.6° C.; 60° F.)	0.925–0.941	420.5–427.7
Oleum Lini	0.925–0.935	420.5–425.0
Acidum Sulphuricum Aromaticum	0.933	424.1
Oleum Tiglii	0.935–0.950	425.0–431.8
Cetaceum	0.935–0.944	
Alcohol Dilutum (15.6° C.; 60° F.)	0.936	425.5
Oleum Ricini	0.945–0.965	429.6–438.7
Cera Alba	0.950–0.960	
Copaiba	0.950–0.995	431.8–452.3
Cera Flava	0.951–0.960	
Oleum Fœniculi	0.953–0.973	433.2–442.3
Aqua Ammoniæ	0.958	435.5
Oleum Santali	0.965–0.980	438.7–445.5
Theobromatis	0.970–0.976	
Anisi	0.975–0.988	443.2–449.1
Vinum Rubrum (15.6° C.; 60° F.)	0.989–1.010	449.6–459.1
Camphora	0.990	
Paraldehydum	0.990	450.0
Vinum Album (15.6° C.; 60° F.)	0.990–1.010	450.0–459.1
Aqua Destillata	**1.000**	**454.6**
Tinctura Ferri Chloridi	1.005	456.8
Acidum Aceticum Dilutum	1.009	458.7
Oleum Sinapis Volatile	1.013–1.020	460.5–463.7
Fel Bovis	1.015–1.025	
Serum Antidiphthericum	1.025–1.040	466.0–472.8
Acidum Sulphurosum	1.028	467.3
Oleum Pimentæ	1.028–1.048	467.3–476.4
Thymol	1.030	
Limonis Succus	1.030–1.040	468.2–472.8
Cresol	1.036–1.038	470.9–471.9
Oleum Caryophylli	1.040–1.060	472.8–481.8
Acidum Hypophosphorosum Dilutum	1.042	473.7
Aceticum	1.045	475.0

Table giving the Specific Gravities of Official Substances arranged in the Order of their Densities at 25° C. (77° F.)—*Continued*

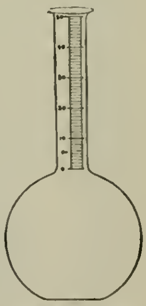
Official Name	Specific Gravity	Weight of one Fluidounce in grains
Benzaldehydum	1.045	475.0
Oleum Cinnamomi	1.045–1.055	475.0–479.6
Oleum Amygdalæ Amaræ	1.045–1.060	475.0–481.8
Liquor Potassii Hydroxidi	1.046	475.5
Cinnaldehydum	1.047	475.9
Acidum Hydrochloricum Dilutum	1.049	476.8
Aceticum Glaciale	1.049	476.8
Liquor Sodæ Chlorinatæ	1.050	477.3
Acidum Nitricum Dilutum	1.054	479.1
Liquor Sodii Hydroxidi	1.056	480.0
Acidum Phosphoricum Dilutum	1.057	480.5
Phenol Liquefactum	1.065	484.1
Oleum Sassafras	1.065–1.075	484.1–488.7
Eugenol	1.066–1.068	484.6–485.5
Acidum Sulphuricum Dilutum	1.067	485.0
Liquor Formaldehydi	1.075–1.081	488.7–491.4
Acidum Hydrobromicum Dilutum	1.076	489.1
Creosotum	1.078	490.0
Safrolum	1.098–1.100	499.1–500.0
Mel (diluted with 2 parts of water)	1.099	499.6
Acidum Hydriodicum Dilutum	1.106	502.8
Guaiacol	1.110–1.114	504.6–506.4
Acidum Hypophosphorosum	1.130	513.7
Balsamum Peruvianum	1.140–1.150	518.2–522.8
Syrupus Calcis	1.145	520.5
Acidum Hydrochloricum	1.158	526.4
Oleum Gaultheriæ	1.172–1.180	532.8–536.4
Methylis Salicylas	1.180–1.185	536.4–538.7
Syrupus Acidi Hydriodici	1.190	540.9
Acidum Lacticum	1.206	548.2
Liquor Plumbi Subacetatis	1.235	561.4
Glycerinum	1.246	566.4
Carbonei Disulphidum	1.256–1.257	570.9–571.4
Liquor Ferri Chloridi	1.280–1.290	581.8–586.4
Syrupus Ferri Iodidi	1.349	613.2
Acidum Nitricum	1.403	637.8
Liquor Ferri Tersulphatis	1.430–1.450	650.0–659.1
Chloroformum	1.476	670.9
Liquor Zinci Chloridi	1.548	703.7
Ferri Subsulphatis	1.548	703.7
Chloralum Hydratum (at melting point, 58° C.; 134.4° F.)	1.575	
Acidum Phosphoricum	1.707	776.0
Phosphorus	1.820	
Acidum Sulphuricum	1.826	830.0
Liquor Hydrargyri Nitratis	2.086	948.2
Talcum	2.200–2.800	
Bromoformum	2.808	1276.5
Bromum (15° C.; 59° F.) about	3.016	1371.0
Iodum (17° C.; 62.6° F.)	4.948	
Hydrargyrum	13.535	6153.0

Specific Volume

Specific volume in pharmacy may be defined *as the volume of one body compared with the volume of an equal weight of another body selected as the standard, both bodies having the same temperature.* It is directly the opposite of specific gravity. The temperature chosen is usually 25° C. (77° F.). 1. *To obtain the specific volume of a liquid.*—**Rule,** Divide the volume of the given weight of the liquid by the volume of an equal weight of water, or divide the specific gravity of water (1.000) by the specific gravity of the liquid. Ex. 1403 Gm. of nitric acid measure 1000 Cc., and 1403 Gm. of water measure 1403 Cc.; then $\frac{1000}{1403} = 0.7127$, sp. vol. of nitric acid. 2. *To obtain the volume of a given weight of a liquid.*—**Rule,** Multiply the volume of an equal weight of water by the specific volume of the liquid. Ex. How many fl. oz. are there in 100 oz. av. of nitric acid? 100 oz. av. of water measure 96.21 fl. oz.; then $96.21 \times 0.7127 = 68.56+$ fl. oz. of nitric acid.

Very early in the tyro's experience the fact is recognized that pound bottles designed for different liquids vary in size, a pint bottle, for instance, of water (which may be regarded as a rough standard) holding about a pound avoirdupois; the same bottle, however, would only be four-fifths full if a pound of glycerin were poured into it, and two-thirds full if chloroform were used, while a pound of petroleum benzin would fill the pint bottle, and there would be almost enough to spare to fill another pint bottle. A bottle which would hold a pound of ether would hold two pounds of chloroform, and a pint bottle holding one pound of water holds fourteen pounds of mercury. These facts are, of course, capable of the explanation that the specific volumes of liquids lighter than water are greater than that of water, while those of liquids heavier than water are less. An instructive and useful bottle may be made by selecting a flask with a long and not very narrow neck (see Fig. 61), the bulb of which would hold about 100 Cc. of water at 4° C.; if the neck would hold about 50 Cc. of the same liquid at the same temperature, and a mark was made at the 100 Cc. point and the tube graduated from 100 Cc. to 150 Cc., it would follow that in order to find the specific volume of any lighter liquid within the capacity of the bottle, all that would be necessary would be to pour into the flask 100 Gm. of such liquid at the proper temperature and read off the point to which the liquid rises. A bottle to be used for heavy liquids would have the 100 Cc. mark at the top of the neck and the Cc. graduations below decrease in value. A bottle of limited range may be constructed having the 100 Cc. mark half way between the top of the bulb and the top of the neck. That specific volume is the antithesis of specific gravity is shown by the fact that in order to obtain the specific volume of a liquid the measure of a given weight of the liquid is divided by the measure of an equal weight of water, and (as has been shown heretofore) specific gravity is obtained by dividing the weight of a given measure of the liquid by the weight of an equal measure of water; therefore it follows that when the specific volume of a liquid is multiplied by its specific gravity the product must be 1, or the specific gravity of water.

FIG. 61



Specific volume bottle

Table of Weight and Volume Relations. U. S. P. (8th Rev.)

Specific gravity apparent 25° C. / 25° C.	Specific volume (volume of 1 kilogramme in liters)[1]	Weight of 1 U. S. gallon in pounds avoirdupois[2]	Weight of 100 fluidounces in ounces avoirdupois	Weight of 1 fluidounce in grains	Volume in U. S. gallons of 100 pounds avoirdupois[3]	Volume in fluidounces of 100 ounces avoirdupois	Volume in fluidounces of 1000 grains
0.700	1.4286	5.819	72.74	318.2	17.185	137.48	3.143
0.710	1.4085	5.902	73.78	322.8	16.943	135.54	3.099
0.720	1.3889	5.985	74.82	327.3	16.707	133.66	3.056
0.730	1.3699	6.068	75.85	331.9	16.479	131.83	3.014
0.740	1.3514	6.151	76.89	336.4	16.256	130.05	2.973
0.750	1.3333	6.235	77.93	341.0	16.039	128.31	2.933
0.760	1.3158	6.318	78.97	345.5	15.828	126.62	2.894
0.770	1.2987	6.401	80.01	350.0	15.623	124.98	2.857
0.780	1.2821	6.484	81.05	354.6	15.422	123.38	2.820
0.790	1.2658	6.567	82.09	359.1	15.227	121.82	2.784
0.800	1.2500	6.650	83.13	363.7	15.037	120.30	2.750
0.810	1.2346	6.733	84.17	368.2	14.851	118.81	2.716
0.820	1.2195	6.817	85.21	372.8	14.670	117.36	2.683
0.830	1.2049	6.900	86.25	377.3	14.494	115.95	2.651
0.840	1.1905	6.983	87.28	381.9	14.321	114.57	2.619
0.850	1.1765	7.066	88.32	386.4	14.152	113.22	2.588
0.860	1.1628	7.149	89.36	391.0	13.988	111.90	2.558
0.870	1.1494	7.232	90.40	395.5	13.827	110.62	2.528
0.880	1.1364	7.315	91.44	400.1	13.670	109.36	2.500
0.890	1.1236	7.398	92.48	404.6	13.516	108.13	2.472
0.900	1.1111	7.481	93.52	409.1	13.366	106.93	2.444
0.910	1.0989	7.565	94.56	413.7	13.219	105.75	2.417
0.920	1.0870	7.648	95.60	418.2	13.075	104.60	2.391
0.930	1.0753	7.731	96.64	422.8	12.935	103.48	2.365
0.940	1.0638	7.814	97.68	427.3	12.797	102.38	2.340
0.950	1.0526	7.897	98.71	431.9	12.663	101.30	2.315
0.960	1.0417	7.980	99.75	436.4	12.531	100.25	2.291
0.970	1.0309	8.063	100.79	441.0	12.401	99.21	2.268
0.980	1.0204	8.147	101.83	445.5	12.275	98.20	2.245
0.990	1.0101	8.230	102.87	450.1	12.151	97.21	2.222
1.00	1.0000	8.313	103.91	454.6	12.029	96.23	2.200
1.02	0.9804	8.479	105.99	463.7	11.794	94.35	2.157
1.04	0.9615	8.645	108.07	472.8	11.567	92.54	2.115
1.06	0.9434	8.812	110.15	481.9	11.348	90.78	2.075
1.08	0.9259	8.978	112.22	491.0	11.138	89.10	2.037
1.10	0.9091	9.144	114.30	500.1	10.936	87.49	2.000
1.12	0.8929	9.310	116.38	509.2	10.741	85.93	1.964
1.14	0.8772	9.477	118.46	518.3	10.552	84.42	1.930
1.16	0.8621	9.643	120.54	527.4	10.370	82.96	1.897
1.18	0.8475	9.809	122.61	536.4	10.194	81.55	1.865
1.20	0.8333	9.975	124.69	545.5	10.025	80.20	1.833
1.22	0.8197	10.142	126.77	554.6	9.860	78.88	1.803
1.24	0.8065	10.308	128.85	563.7	9.701	77.61	1.774
1.26	0.7937	10.474	130.93	572.8	9.547	76.38	1.746
1.28	0.7813	10.640	133.01	581.9	9.398	75.18	1.719

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[1] Or of one gramme in cubic centimeters; strictly true only at 0° C. in vacuo.

[2] Multiply these figures by 2 for weight of one U. S. pint in ounces avoirdupois.

[3] Divide these figures by 2 for volume in pints of 100 ounces avoirdupois.

Table of Weight and Volume Relations—*Continued*

Specific gravity apparent 25° C./25° C.	Specific volume (volume of 1 kilogramme in liters)	Weight of 1 U. S. gallon in pounds avoirdupois	Weight of 100 fluidounces in ounces avoirdupois	Weight of 1 fluidounce in grains	Volume in U. S. gallons of 100 pounds avoirdupois	Volume in fluidounces of 100 ounces avoirdupois	Volume in fluidounces of 1000 grains
1.30	0.7692	10.807	135.08	591.0	9.253	74.02	1.692
1.32	0.7576	10.973	137.16	600.1	9.113	72.90	1.667
1.34	0.7463	11.139	139.24	609.2	8.977	71.82	1.642
1.36	0.7353	11.305	141.32	618.3	8.845	70.76	1.618
1.38	0.7246	11.472	143.40	627.4	8.717	69.74	1.594
1.40	0.7143	11.638	145.47	636.4	8.592	68.74	1.571
1.42	0.7042	11.804	147.55	645.5	8.471	67.77	1.549
1.44	0.6944	11.970	149.63	654.6	8.354	66.83	1.528
1.46	0.6849	12.137	151.71	663.7	8.239	65.91	1.507
1.48	0.6757	12.303	153.79	672.8	8.128	65.02	1.486
1.50	0.6667	12.469	155.87	681.9	8.020	64.16	1.466
1.52	0.6579	12.635	157.94	691.0	7.914	63.31	1.447
1.54	0.6494	12.802	160.02	700.1	7.811	62.49	1.428
1.56	0.6410	12.968	162.10	709.2	7.711	61.59	1.410
1.58	0.6329	13.134	164.18	718.3	7.614	60.91	1.392
1.60	0.6250	13.300	166.26	727.4	7.519	60.14	1.375
1.62	0.6173	13.467	168.33	736.5	7.426	59.41	1.358
1.64	0.6098	13.633	170.41	745.6	7.335	58.69	1.341
1.66	0.6025	13.799	172.49	754.6	7.247	57.98	1.325
1.68	0.5952	13.966	174.57	763.7	7.160	57.28	1.309
1.70	0.5882	14.132	176.65	772.8	7.076	56.61	1.294
1.72	0.5814	14.298	178.73	781.9	6.994	55.95	1.279
1.74	0.5747	14.464	180.80	791.0	6.913	55.31	1.264
1.76	0.5682	14.631	182.88	800.1	6.835	54.68	1.250
1.78	0.5618	14.797	184.96	809.2	6.758	54.06	1.236
1.80	0.5556	14.963	187.04	818.3	6.683	53.46	1.222
1.82	0.5495	15.129	189.12	827.4	6.610	52.88	1.209
1.84	0.5435	15.296	191.19	836.5	6.538	52.31	1.196
1.86	0.5376	15.462	193.27	845.6	6.467	51.74	1.183
1.88	0.5319	15.628	195.35	854.7	6.399	51.19	1.170
1.90	0.5263	15.794	197.43	863.8	6.331	50.65	1.158
1.92	0.5208	15.961	199.51	872.8	6.265	50.12	1.146
1.94	0.5155	16.127	201.59	881.9	6.201	49.61	1.134
1.96	0.5102	16.293	203.66	891.0	6.137	49.10	1.122
1.98	0.5051	16.459	205.74	900.1	6.075	48.60	1.111
2.00	0.5000	16.626	207.82	909.2	6.015	48.12	1.100

PRACTICAL PROBLEMS AND EXERCISES

(Chapter I.—Metrology)

Illustrating the Uses of Weights, Measures, Specific Gravity, and Specific Volume

(The answers to these questions will be found on page 1347)

1. If Dover's powder contains one grain of powdered ipecac, one grain of powdered opium, and eight grains of powdered sugar of milk, how much of each ingredient will be needed to make one pound (av.) ?
2. What is the percentage of each ingredient in Dover's powder?
3. Add the following together, giving the answer in grains: ℥iv, ℈ii, ʒvi, 2 oz.
4. Subtract ʒx from 10 oz.

5. How much postage would be required to send a book, weighing 4lb. 3 oz., to Brazil, the rate being one cent for each 2 oz. or fraction?

6. How many fluidounces are there in a wine gallon?

7. How many minims are there in a pint?

8. In an Imperial pint?

9. How many grains are there in 4 oz. of water?

10. In f℥iv?

11. In ℥iv?

12. How many wine gallons are there in 40 Imperial gallons?

13. How many avoirdupois pounds in 5 wine gallons of water?

14. How many fluidrachms in an Imperial half-pint of water?

15. A physician ordered, as an application to a burn, 4 tablespoonfuls of linseed oil to be mixed with a teacupful of lime water. What are the equivalent quantities in apothecaries' measure?

.16. A traveller was ordered by his physician to take with him on a journey enough of a quinine mixture to last five weeks, taking one teaspoonful three times a day for the first week, one twice a day for the second week, one once a day for the third week, one four times during the fourth week, and one twice during the fifth week. How many fluidounces of the mixture must the apothecary compound for him?

17. A physician wants a pharmacist to make him one fluidounce of a one percent. aqueous solution of cocaine hydrochloride. How will he do it?

18. How much quinine, strychnine, and ferric phosphate would be required to make a pint of elixir of iron, quinine, and strychnine phosphates, so that each teaspoonful of finished elixir should contain $\frac{1}{64}$ of a grain of strychnine, one grain of quinine, and two grains of ferric phosphate?

19. What would an Imperial gallon of rose water cost at the rate of 12 cents a pound (av.)?

20. A merchant offered to exchange 2 oz. of musk, valued at 4 cents per grain, for 20 Imperial gallons of orange flower water, valued at 17 cents per pound. How much would he gain or lose?

21. Express the following: 7.5 meters in millimeters. 22. 806.23 centimeters in meters. 23. Six meters and three decimeters. 24. Twelve meters, five decimeters, four centimeters, and three millimeters. 25. Twelve thousand five hundred and forty-three millimeters.

26. Write one meter and one millimeter.

27. Read 25 Dm.

28. Read 25 dm.

29. Is the equivalent number of centimeters usually read in practice instead of using the term decimeters?

30. Read 1.2 M.

31. How does this practice resemble that in daily use in relation to our decimal system of coinage? (See No. 30.)

32. Read 4263.678 M.

33. Add 816 cm., 732 dm., and 36 mm.

34. What is the difference in length between two roots, one being 5 cm. long, and the other 65 mm. long?

35. Divide 3784.128 M. by 8.

36. How many square millimeters are there in 5 square centimeters?

Note.—In square measure length is multiplied by width ($10 \times 10 = 100$), hence each denomination is increased or decreased by 100 instead of by 10; two decimal places are therefore required to express square measure.

37. Write eight sq. meters, thirty-six sq. decimeters.

38. Write eight sq. meters, thirty-six sq. decimeters, eight sq. centimeters.

39. Write three sq. M., three sq. dm., three sq. cm., three sq. mm.

40. Express in figures twenty sq. millimeters, twenty sq. centimeters, twenty sq. decimeters, twenty sq. meters.

41. Express in figures five hundred sq. meters, five hundred sq. decimeters, five hundred sq. millimeters.

42. How many cubic centimeters in a cubic meter?

Note.—In cubic measure length is multiplied by width and this by thickness, $10 \times 10 \times 10 = 1000$; so that three decimal places are required to express cubic measure.

43. Express in figures sixty-three cubic meters, sixty-three cubic decimeters, sixty-three cubic centimeters, sixty-three cubic millimeters.

44. How many cubic centimeters in a liter?

45. What metric measure of capacity corresponds with a cubic decimeter?

46. How many 100 Cc. bottles will be required to hold five liters of water?

47. A drug merchant having purchased a cubic meter of olive oil, sold from it at different times 100 liters, 87 liters, 375 Cc., 638 liters. How much had he left?

48. In making one kilo. of U. S. 1880 compound spirit of juniper, how many grammes of each ingredient would be required, the formula being as follows: Oil of juniper 10 parts, oil of caraway 1 part, oil of fennel 1 part, alcohol 3000 parts, water 1988 parts?

49. How many grains of each ingredient would be required to make one pound avoir.? (See No. 48.)

50. What percentage of an avoirdupois pound is a troy pound?

51. How much water must be added to a pint of solution of ferric chloride (containing 37.8 percent. of anhydrous salt, specific gravity 1.387) to make the solution contain 10 percent. of anhydrous salt?

52. How much of the above solution of ferric chloride and how much water must be used to make a pint of solution containing 20 percent.? (See No. 51.)

53. If moist opium containing 10½ percent. morphine loses 30 percent. of its weight by drying, how much morphine percent. will it contain when dry?

54. If one pint of a solution contain 704 grains, how much is there in each fluidrachm?

55. If one fluidrachm of a solution contain 3¼ grains, how much is there in 14½ fluidounces?

56. If 8 fluidounces contain 240 doses, how much in each dose?

57. How many doses of 12½ minims in 12½ fluidounces?

58. If 96 minims of water will dissolve 7⅞ grains of salt, how much will one pint dissolve?

59. How much will one pound avoirdupois dissolve? (See No. 58.)

60. How much will one pound troy dissolve? (See No. 58.)

61. If Liquor Acidi Arsenosi contains 37 grains of arsenic trioxide in 8 fluidounces, what fraction of a grain (exactly) is there in a fluidrachm?

62. If Liquor Ferri Citratis (U. S. P. 1890) (specific gravity 1.250) contains 35.5 percent. of anhydrous salt, how much of the anhydrous salt is contained in 1 pint?

63. How much in one fluidrachm? (See No. 62.)

64. If Liquor Ferri Nitratis (U. S. P. 1890) contains 6 percent. of anhydrous salt (specific gravity 1.050), how much of the salt is there in each fluidounce?

65. If Liquor Ferri Subsulphatis (specific gravity 1.548) contains 43.7 percent. of basic ferric sulphate, how much of the salt is contained in one pound avoirdupois?

66. How much in one pint? (See No. 65.)

67. How much in one fluidrachm? (See No. 65.)

68. How many minims would contain 10 grains? (See No. 65.)

69. Liquor Ferri Tersulphatis (specific gravity 1.432) contains 36 percent. of normal ferric sulphate How much in Oi?

70. If Liquor Acidi Arsenosi contains 74 grains of arsenic trioxide in Oi, what quantity of the liquid contains one grain?

71. How many pills of 235 mgm. can be made from a mass weighing 423 grammes?

72. How many cubic inches are there in one liter (1 liter = 2.1134 pints)?

73. What part of a liter is a pint (to four decimal places)?

74. How many Cc. in a cubic foot (1 Cc. being equal to 0.061028 cubic inches)?

75. How many Cc. in a quart (1. L. = 33.815 fl. oz.)?

76. How many pints in one cubic meter (1 deciliter being equal to 3.3815 fluidounces)?

77. How many fluidrachms in a liter?

78. How many grammes in one pound avoirdupois?

79. How many grammes in a quart of a liquid of specific gravity 1.45 (1 gramme = 15.432 grains)?

80. How many milligrammes in one pound troy?

81. How many centimeters in one yard (1 mm. = 0.03937 inch)?

82. What is the weight in grammes of 14 cubic centimeters of mercury, its specific gravity being 13.5?

83. What is the weight in grammes of 555 cubic centimeters of sulphuric acid of specific gravity 1.84?

83a. What is its weight in kilogrammes? (See No. 83.)

83*b*. What is its weight in milligrammes? (See No. 83.)

84. How many meters are there in a mile (1 meter = 39.37043 inches)?

85. How many inches in 1833 centimeters?

86. How many grains of compound extract of colocynth are required to make 144 compound cathartic pills (there being 65 grs. in 50 pills)?

87. How much jalap is contained in one pound avoirdupois of compound powder of jalap (the official process ordering 35 parts in 100)?

88. What percentage must be added to 400 minims to bring the measure up to one fluidounce?

89. If 32.4 grammes be divided into 144 pills, what is the weight of each pill in grains?

90. If 46.656 grammes be divided into 144 pills, what is the weight of each pill in grammes? What in grains?

91. How much valerian must be used to make 4 pints of tincture, so that each fluidrachm shall represent 10¼ grains?

92. If a Seidlitz powder is composed of 35 grains of tartaric acid, 120 grains sodium bicarbonate, and 40 grains Rochelle salt, how much Rochelle salt must be used to make enough Seidlitz mixture to put up one gross of boxes of Seidlitz powders, each box to contain ten doses?

93. How much sodium bicarbonate? (See No. 92.)

94. How much tartaric acid? (See No. 92.)

95. How many deciliters of oil (specific gravity 0.905) will a bottle hold which weighs, when full of water, 1050.5 Gm., the weight of the bottle being 610.5 Gm.?

96. If a body weighs 2.31 kilogrammes in air and 1.76 kilogrammes in water, what is its specific gravity?

97. A piece of lead weighs 148.392 pounds, and measures 12 inches long, 6 inches wide, and 5 inches thick (cu. in. water = 252.+ gr.). What is its specific gravity?

98. A piece of zinc weighs in air 77.88 grains, in water 65.88 grains. What is its specific gravity?

99. What is its specific volume? (See No. 98.)

100. What is the weight of a piece of iron measuring 50 cm. long, 6 cm. wide, and 2 cm. thick, its specific gravity being 7.8?

101. What is the length of a bar of iron 8 cm. wide, 5 cm. thick, its specific gravity being 7.8 and its weight 195 kilogrammes?

102. What is the weight of a piece of iron measuring 4 decimeters long by 1 decimeter wide and 7 centimeters thick (specific gravity 7.8)?

103. One pound av. of lead shot is put into a bottle, and it is then filled with water and found to weigh 25566 grains (the bottle when filled with water alone weighs 19174 gr.). What is the specific gravity of the lead shot?

104. What is the specific gravity of a substance of which 9.7 Cc. equal 40.74 Gm?

105. What is the specific gravity of a liquid of which one pound avoirdupois will measure one pint?

106. If 52.98 Cc. of a liquid weigh 1207 grains, what is its specific gravity, and what is the liquid (Oi = 473.18 Cc.)?

107. If 65.008 Cc. of a liquid weigh 1250 grains, what is its specific gravity, and what is the liquid?

108. What is the weight in grammes of one pint of glycerin (Oi = 473.18 Cc.)?

109. What is the weight in grammes of one fluidounce of glycerin?

110. What is the weight of Oi chloroform in grammes (specific gravity 1.476)?

111. What is the weight of one fluidounce of chloroform in grammes?

112. What part of a liter is a pint (to four decimal places)?

113. What part of a gallon is a fluidrachm?

114. What part of a gallon are 32 minims?

115. What part of one pound avoirdupois are 1¼ ounces troy?

116. What is the specific gravity of a piece of wood which weighs in air 177.45 grains? A piece of brass weighs 68.25 grains when immersed in water. The wood and brass together immersed in water weigh 35.7 grains.

117. A piece of wood (specific gravity = 1.6), when weighed in oil of turpentine (specific gravity = 0.87), loses 217.5 grains in weight. What is its weight? (Its loss in weight (in oil) divided by the specific gravity of the oil is equal to its loss of weight in water. This multiplied by its specific gravity gives its weight.)

118. A bottle full of water weighs 31 ounces avoirdupois; the same bottle filled with oil (specific gravity 0.91) weighs 29 ounces, 245 grains avoirdupois. How many avoirdupois ounces of water will the bottle hold? What is the weight of the bottle?

NOTE.—To find the capacity divide the difference between the two weights by the difference between the two specific gravities.

119. How many Cc. would the same bottle hold? (See No. 118.)

120. What is the weight of a piece of iron 25 inches long, 4 inches wide, and 2 inches thick, its specific gravity being 7.8 (cu. in. water = 252.509 gr.)?

121. What is the capacity in Cc. of a vessel which will hold 2 pounds avoirdupois of glycerin?

122. If one pound avoirdupois of lead, when weighed in water, loses 611 grains, what is its specific gravity?

123. A bar of iron, when immersed in water, loses 13 percent. of its weight. What is its specific gravity?

124. A piece of copper, when immersed, loses $\frac{1}{9}$ of its weight. What is its specific gravity?

125. A troyounce of silver, when weighed in water, weighs 434.72 grains. What is its specific gravity?

126. A druggist proposes exchanging 5 pints of phenol (specific gravity 1.065), valued at 40 cents per pound (avoirdupois), for 5 pints of glycerin (specific gravity 1.25), valued at 32 cents per pound. Does he gain or lose by the exchange, and how much?

To find the specific gravity of a liquid by immersing a solid in it: *Immerse in it a solid of known specific gravity and weight; carefully note its loss of weight when thus immersed; then use the proportion: As its weight in air is to its specific gravity, so is its loss of weight when immersed in the liquid to the specific gravity of that liquid.* If the weight of the solid is made the same number in grains as its specific gravity, its loss of weight, when immersed in the liquid, is equal to the specific gravity of the liquid.

127. A piece of iron weighs 1560 grains; its specific gravity is 7.8. When immersed in syrup it loses 262 grains weight. What is the specific gravity of the syrup?

128. A piece of aluminum weighing 256 grains, having the specific gravity 2.56, loses 82 grains when immersed in a liquid. What is the specific gravity of the liquid? What is the liquid?

129. What is the volume of a block of ice 12 feet long, 8 feet wide, and 2 feet thick? What is its weight, and how many cubic feet of water will it yield when melted, supposing that water upon freezing increases in volume $\frac{1}{15}$? (See No. 120.)

130. How many gallons and parts and how many pounds and parts of water will it take to fill a vessel 14 inches wide, 21 inches long, and 9 inches deep (cu. in. water = 252.509 gr.)?

131. What is the specific volume of mercury?

132. What is the specific volume of diluted sulphuric acid?

133. What is the specific volume of glycerin?

134. What is the specific volume of iodoform (specific gravity 4)?

135. How much (wine measure) will one pound (avoirdupois) tincture of chloride of iron measure (specific gravity = 1.005)?

136. If 65.1 Gm. of Rochelle salt be divided into seven powders, what would be the volume of water equal to the weight of one powder?

137. How much silver nitrate must be used to make 2 fluidounces of a 4 percent. solution of the nitrate? (See No. 17.)

138. A bottle when filled with syrup (specific gravity 1.31) contains 23.58 ounces (av.). How much nitric acid (specific gravity 1.42) will it contain?

139. A bottle when filled with syrup (specific gravity 1.31) weighs 36 ounces, 285 grains (av.), when filled with oil (specific gravity 0.9) it weighs 30 ounces, 219 grains. What is the weight of the bottle? Of the syrup? Of the oil? (See No. 118.)

140. A bottle when filled with syrup (specific gravity 1.31) weighs 34.96 ounces (av.), when filled with nitric acid (specific gravity 1.42) it weighs 36.72 ounces. What is the weight of the bottle, and how much water will it hold? (See No. 118.)

141. A bottle filled with water weighs 32 ounces (av.); when filled with chloroform (specific gravity 1.47) it weighs 39.755 ounces (av.); when filled with acid it weighs 34.64 ounces. What acid does it contain? (See No. 118.)

142. In a mixture of lard 2 pounds, wax 4 pounds, and spermaceti 1 pound, what is the percent. of each constituent in the whole amount?

143. How many grammes of each of the foregoing ingredients would be required to make one kilogramme of the mixture?

144. If I purchase 500 grammes of ether for 75 cents, and sell 4 fluidounces for 50 cents, what percent. profit do I make?

145. If a druggist's pound weight is 65 grains lighter than it should be, what percent. increase of profit does he make upon goods sold by it as compared with a correct weight?

146. What will be the value of 2405.365 grammes of opium at $13.50 per kilogramme?

147. How many fluidounces of creosote are required to fill 4 gross of 5 minim capsules?

148. How much of each ingredient will be required to make 60 grammes of compound morphine powder according to the following formula:

Morphine sulphate	1.5 Gm.
Camphor	32.0 Gm.
Glycyrrhiza	33.0 Gm.
Precipitated calcium carbonate	33.5 Gm.

149. What will be the value of 125 grammes of lactucarium at $12.50 per kilogramme?

150. How many ounces avoirdupois in one pound troy?

151. How many troy ounces in one pound avoirdupois?

152. How many pounds avoirdupois in one gallon of water?

153. How many pounds troy? (See No. 152.)

154. How many pounds avoirdupois in one gallon of honey (specific gravity 1.370)?

155. What percent. of an avoirdupois ounce is a grain?

156. What percent. of an avoirdupois pound is a grain?

157. What factor would you use in converting fluidounces into avoirdupois ounces?

158. What factor would you use in converting avoirdupois ounces into fluidounces?

159. If I sell two-fifths of an ounce of oil of rose for three-sevenths of the cost of the entire ounce, what percent. do I gain or lose?

160. From a one pound can of opium the following quantities have been removed: 3 ounces, 1¾ ounces, 1.64 ounces, 175 grains, 2 grammes. How much opium remains in the can?

161. How many fluidounces will be contained in a box 5 cm. long, 5 cm. wide, and 5 cm. deep?

162. If you received an order to spread a plaster 8 by 12 cm., what size in inches would you give?

163. A druggist orders a five inch funnel, but receives one measuring 12 cm. Is the one sent larger or smaller than the one desired, and how much?

164. If a pint of water weighs 7291.2 grains, how many grains of solid matter are present in a gallon of water containing 58 parts of solid matter in the million?

165. If a prescription calls for 75 pills each to contain 200 mgm. of quinine sulphate, how many grains of quinine sulphate would be required to make the whole number of pills?

166. If I pay $1.00 a kilogramme for a substance which I sell for 10 cents an ounce retail, what percent. profit do I make?

167. If 500 Cc. of official alcohol be mixed with 500 Cc. of water, and the contraction in volume amounts to 30 Cc., what will be the percent., by volume, of official alcohol in the resulting mixture?

168. What will be the cost of the mixture, per pint, with alcohol costing $2.40 per gallon. (See No. 167.)

169. How many Cc. of camphorated tincture of opium represent 1 gramme of morphine, if 1000 Cc. represent 4 grammes of powdered opium (12 percent.)?

170. If tincture of opium is found to contain 1.45 grammes of crystallized morphine in each 100 Cc., how much diluted alcohol must be added to each pint to reduce it to the official minimum strength (1.2 Gm. in 100 Cc.)?

171. How many Cc. of official minimum strength tincture of opium can be made from 123 grammes of granulated opium, assaying 13.25 percent. morphine? (See No. 170.)

172. If 10 avoirdupois pounds of a solution contain 8 avoirdupois ounces of sodium chloride, what is the percentage strength of the solution?

173. How much salt and how much water would be required to make 15 avoirdupois pounds of a 5 percent. solution?

174. If 3 grammes of potassium nitrate are dissolved in 27 grammes of water, what is the percentage strength of the solution?

175. If $\frac{1}{8}$ ounce of cocaine hydrochloride be dissolved in 1 fluidounce of water, what will be the percentage strength of the solution?

176. What will be the percentage strength of $\frac{1}{8}$ ounce troy if dissolved in the same amount of water?

177. How much corrosive sublimate must be used to make 1 pint of a 1-2000 solution?

178. How much must be used to make a liter of a 1-3000 solution?

179. If 1 troyounce of sodium chloride be dissolved in 1 pint of water, what is the percentage strength of the resulting solution?

180. Boric acid is souble in 18 parts of water. What is the percentage strength of a saturated solution?

181. What percent. of sugar is there in a syrup made by dissolving 1 avoirdupois pound of sugar in 1 pint of water?

182. What will be the percent. if 1 pound troy of sugar is used?

183. How much physostigmine salicylate will be required to make approximately 1 fluidounce of a 2 percent. solution?

184. Potassium iodide is soluble in about three-fourths of its own weight of water. What is the percentage strength of a saturated solution?

185. How many grammes of mercuric chloride will be required to make 100 Cc. of a solution, 10 Cc. of which when added to 990 Cc. of water will make a solution containing the equivalent of 1 gramme in 2000 Cc.?

186. If the specific gravity of acetone is 0.79, what will 2 fluidounces weigh in grammes?

187. What is the value of 4 pints of glycerin, specific gravity, approximately, 1.25, at 18 cents per pound avoirdupois?

188. Which is heavier and how much, 1 fluidounce of mercury, specific gravity, approximately, 13.50, or 1 pint oil of turpentine, specific gravity, approximately, 0.850?

189. What is the value of 5 avoirdupois pounds of spirit of nitrous ether, specific gravity 0.820, at 40 cents per pint?

190. What will be the cost of a gallon of extract of witchhazel, if the distillate costs 35 cents a gallon, and 12 percent., by volume, of alcohol, costing $2.75 a gallon, is added to it for preservation?

191. A formula calls for 246 grammes of nitric acid, specific gravity 1.414. On account of the corrosive nature of the acid it is advisable to measure it. How many Cc. will be required?

192. If 1 pint of syrup, specific gravity 1.313, be mixed with 500 Cc. of glycerin, specific gravity 1.246, how many troyounces will the mixture weigh?

193. What size bottle in fluidounces, approximately, will be required to hold 1 avoirdupois pound of ether?

194. Five hundred grammes of chloroform? (See No. 193.)

195. One troy pound of olive oil? (See No. 193.)

196. One avoirdupois pound of bromoform? (See No. 193.)

197. One avoirdupois pound of mercury? (See No. 193.)

198. How much salicylic acid, and how much monohydrated sodium carbonate would you use to make 240 grains of sodium salicylate, when, by referring to the saturation tables of the Pharmacopœia, it will be found that 100 parts of salicylic acid require 45.18 parts of monohydrated sodium carbonate to combine to form 115.97 parts of sodium salicylate?

199. How much of each will be required to make 100 grammes of the salt?

200. What will it cost to make a pound of sodium salicylate, if the salicylic acid costs 50 cents a pound, and the monohydrated sodium carbonate costs 15 cents a pound, allowing 10 cents for labor?

Alligation Applied to Pharmacy

(The answers to these questions will be found in the Appendix)

Rules for ascertaining the quantities of drugs of different percentages of strength, to be used in making a mixture of definite strength; also of liquids where no change of volume takes place when mixed.

Percentages

Rule.— *Write the percentages of the different ingredients in a horizontal row; connect with a line each percentage which is greater than that of the mixture sought with one that is less, and each one that is less than that of the mixture sought with one that is greater; then write the difference between the percentage of the mixture sought and that of each of the ingredients under the percentage of the other ingredient or ingredients with which it is connected by the line. The figures thus placed under each percentage will be found to indicate the proportionate parts (by weight) of each ingredient to be used.*

It is apparent that where there are more than two ingredients there will be an indefinite number of ratios. Either one of the ingredients of less strength than the mixture may vary, and therefore one or more of the other ingredients must vary correspondingly.

The same rules are applicable to liquids of different specific gravities (where no change of volume takes place when they are mixed), writing "specific gravities" in places of "percentages."[1]

Specific Gravities

Rule.— *Write the specific gravities of the different ingredients in a horizontal row; connect with a line each specific gravity which is greater than that of the mixture sought with one that is less, and each one that is less than that of the mixture sought with one that is greater; then write the difference between the specific gravity of the mixture sought and that of each of the ingredients under the specific gravity of the other ingredient or ingredients with which it is connected by the line. The figures thus placed under each specific gravity will be found to indicate the proportionate parts (by measure) of each ingredient to be used.*

1. In what proportion must two quantities of powdered opium, containing respectively 7 and 18 percent. of morphine, be mixed so that the mixture shall contain 16 percent.?

16		*Answer*	*Proof*
7	18	2 parts of 7 percent.	$2 \times 7 = 14$
2	9	9 parts of 18 percent.	$9 \times 18 = 162$
		11 parts	11)176
			16

2. In what proportions to yield a mixture of 12 percent.? (See No. 1.)

3. In what proportions may three quantities, containing respectively 7, 16, and 18 percent., be mixed so that the mixture shall contain 14 percent.?

14			*Answer*		
			6 parts of 7 percent.	=	42
7	16	18	7 parts of 16 percent.	=	112
2	7	7	7 parts of 18 percent.	=	126
4			20 parts		2.0)28.0
6					14

When there are three or more ingredients the proportion of these may be varied indefinitely, as will appear from the following:

In the preceding example suppose that only 1 part of that containing 16 percent., and the same number of parts containing 7 percent. as before be used, it will then require more than 7 parts of that containing 18 percent. to make the mixture contain 14 percent.

When the quantities of more than one ingredient are given, each quantity may be multiplied by its percentage and the sum of the products divided by the sum of the quantities; this will give the mean percentage of the quantities.

Thus 6 parts of 7 percent. } = 7 parts of $8\frac{2}{7}$ percent.
1 part of 16 percent. }

$6 \times 7 = 42$
$1 \times 16 = 16$
7)58
$8\frac{2}{7}$ percent.

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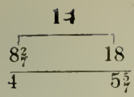
[1] Of course, mixed liquids which contract may be allowed to stand until contraction ceases, and sufficient liquid can then be added to make up the intended measure.

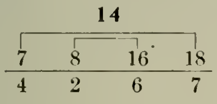


and it will require 4 parts of $8\frac{2}{7}$ percent. and $5\frac{5}{7}$ parts of 18 percent. to make a mixture containing 14 percent. Now if 4 parts of $8\frac{2}{7}$ percent. require $5\frac{5}{7}$ parts of 18 percent., then 7 parts of $8\frac{2}{7}$ percent. will require 10 parts of 18 percent., or 4 : $5\frac{5}{7}$: : 7 : 10; therefore the mixture will be—

6 parts of 7 percent. $6 \times 7 = 42$
1 part of 16 percent. $1 \times 16 = 16$
10 parts of 18 percent. $10 \times 18 = 180$
17)238(14
17
68
68

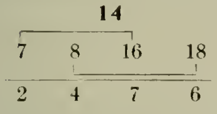
The different percentages may be connected in various ways, care being taken that in every case one larger than the required mixture shall be connected with one smaller, but every one must be connected with some other.

4. In what proportions may four quantities, containing respectively 7, 8, 16, and 18 percent., be mixed so that the mixture shall contain 14 percent.?



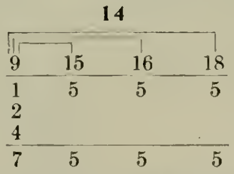
Answer
4 parts of 7 percent. = 28
2 parts of 8 percent. = 16
6 parts of 16 percent. = 96
7 parts of 18 percent. = 126
19 parts 19)266(14

Or,



Answer
2 parts of 7 percent. = 14
4 parts of 8 percent. = 32
7 parts of 16 percent. = 112
6 parts of 18 percent. = 108
19 parts 19)266(14

5. In what proportions may four quantities, containing respectively 9, 15, 16, and 18 percent., be mixed, so that the mixture shall contain 14 percent.?



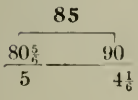
6. In what proportions may five quantities, containing respectively 7, 8, 9, 11, and 16 percent., be mixed, so that the mixture shall contain 12 percent.?

7. How much of each kind of scammony, containing respectively 77 percent., 83 percent., and 92 percent. of resin, may be used to make a mixture containing 85 percent.?

8. How much scammony of 90 percent. must be mixed with 7 ounces of 80 percent. and 5 ounces of 82 percent. to make the mixture contain 85 percent. of resin?

$$\left.\begin{array}{l} 7 \text{ oz.} \times 80 \text{ percent.} = 560 \\ 5 \text{ oz.} \times 82 \text{ percent.} = 410 \end{array}\right\} = 12 \text{ oz. of } 80\tfrac{5}{6} \text{ percent.}$$

12)970
$80\frac{5}{6}$



Then if 5 ounces of the mixture require $4\frac{1}{6}$ ounces of 90 percent., 12 ounces of mixture will require 10 ounces of 90 percent. 5 : $4\frac{1}{6}$: : 12 : 10

7 oz. × 80 percent. = 560
5 oz. × 82 percent. = 410
10 oz. × 90 percent. = 900
22 22) 1870(85
176
110
110

9. What quantities (by measure) of glycerin (specific gravity 1.246) and alcohol (specific gravity 0.816) must be mixed to have the specific gravity 1.000?

1.000

1.246 0.816

184 246

184 glycerin
246 alcohol
430

184 × 1.246 = 229.264
246 × 0.816 = 200.736
430.000

430 ÷ 430 = 1.000

10. What quantities (by measure) of glycerin (specific gravity 1.250) and diluted alcohol (specific gravity 0.928) must be mixed to have the specific gravity 1.000?

11. How much each of alcohol 94 percent. and 60 percent. must be used to make 100 ounces (by weight) of 80 percent.?

80

94 60

20 14

Or, 10 7

17 : 10 : : 100 : 58.82

100.00
58.82 of 94 percent.
41.18 of 60 percent.

When the quantity of one of the ingredients is given, to find the quantities of the other ingredients:

Proceed as before to find the ratios of the ingredients; then by proportion: As the ratio of that ingredient of which the quantity is given is to its quantity, so is the ratio of each ingredient to its quantity.

12. How much alcohol (specific gravity 0.820) and how much glycerin (specific gravity 1.25) must be mixed with 24 Cc. of syrup (specific gravity 1.31) to make 250 Cc. of mixture having the specific gravity 1.000 (no allowance for contraction)?

24
1.31
24
72
24
31.44

250
24
226

250.00
31.44
226)218.56(0.967
2034
1516
1356
1600
1582
18

24 parts specific gravity 1.310
226 parts specific gravity 0.967

0.967

0.820 1.25

283 147

283 alcohol, × 0.820 = 232.0
147 glycerin, × 1.250 = 183.5
430 415.5

430)415.5(0.966+
3870
2850
2580
2700

If 430 parts of mixture require 283 alcohol, how much will 226 require?

430 : 283 : : 226 : 148.7 ; then 226 — 148.7 = 77.3

148.7 Cc. alcohol, 77.3 Cc. glycerin, 24 Cc. syrup

When the quantity of more than one ingredient is given, each quantity may be multiplied by its specific gravity and the sum of the product divided by the sum of the quantities; this will give the mean specific gravity of the quantities.

13. In what proportions must 3 pints each of alcohol (specific gravity 0.935 and 0.865) be mixed with alcohol of specific gravity 0.820 so that the mixture shall have the specific gravity 0.835?

3 × 0.935 = 2805
3 × 0.865 = 2595
6 6)5400
900

3 pints of 0.935 and 3 pints of 0.865 are equal to 6 pints of 0.900 (mean specific gravity).

Then,

0.835

0.820 0.900

65 15

13 3

as 3 pints of specific gravity 0.900 are required to be mixed with 13 pints of 0.820 to make the specific gravity 0.835, so 6 pints will require twice 13 pints, or 26 pints of alcohol (specific gravity 0.820), to be added to 3 pints each of 0.865 and 0.935 to bring the whole to specific gravity 0.835.

14. How much opium containing 8 percent. of morphine must be mixed with 10 troy ounces of opium containing 17 percent. to make the mixture contain 12 percent.?

15. How much opium of 16 percent. must be mixed with 1 troy ounce of opium of 12 percent. to make the mixture 13 percent.?

16. How much scammony containing 92 percent. of resin must be mixed with 1 troy ounce of 75 percent. to make the mixture contain 85 percent. of resin?

17. How much alcohol of 35 percent. (by weight) will 1 quart of alcohol of 92.3 percent. (by weight) make on dilution with water?

18. How much opium of $16\frac{1}{2}$ percent. must be mixed with 4 ounces (10 percent.) and 5 ounces (11 percent.) to make the mixture 14 percent.?

19. How much opium of $15\frac{1}{2}$ percent. must be mixed with 3 ounces (9 percent.), $3\frac{1}{2}$ ounces (10 percent.), and $3\frac{1}{2}$ ounces (12 percent.) to make the mixture contain 14 percent.

When the quantity of the mixture and the percentages of the ingredients are given, to find the quantity of each of the ingredients:

Proceed as before to find the ratio of the ingredients, and then by proportion: As the whole amount of difference is to any one difference, so is the amount of the required mixture to the required amount of that particular difference.

20. An apothecary has opium of the following percentages of morphine,—viz.: 8, 11, 16, and 18. How much of each kind may be used to make 10 troy ounces of 12 percent.?

$$\begin{array}{cccc} & \mathbf{12} & & \\ 8 & 11 & 16 & 18 \\ \hline 4 & 6 & 4 & 1. \end{array} \qquad \begin{array}{rcl} 4 \times 8 & = & 32 \\ 6 \times 11 & = & 66 \\ 4 \times 16 & = & 64 \\ \underline{1} \times 18 & = & \underline{18} \\ 15 & & 15)180(12 \\ & & \underline{15} \\ & & 30 \\ & & \underline{30} \end{array}$$

15 : 4 : : 10 : to the required amount of 8 percent.

4 ounces = 1920 grains 15 : 1920 : : 10 : 1280 grains

If 4 parts correspond to 1280 grains, 6 parts will correspond to 1920 grains, 4 parts to 1280 grains, and 1 part to 320 grains; thus,

1280 grains,	8 percent.	15 : 1920 : : 10 : 1280
1920 grains,	11 percent.	15 : 2880 : : 10 : 1920
1280 grains,	16 percent.	15 : 480 : : 10 : 320
320 grains,	18 percent.	
4800 grains = 10 troy ounces.		

21. How many parts by weight of official alcohol (92.3 percent.) must be added to diluted alcohol (41.5 percent.) to make it the strength of 60 percent. by weight?

$$\begin{array}{cc} \multicolumn{2}{c}{\mathbf{60}} \\ 41.5 & 92.3 \\ \hline 32.3 & 18.5 \end{array} \qquad \begin{array}{lcccr} 32.3 \text{ parts}, & \times & 41.5 & = & 1340.45 \\ \underline{18.5} \text{ parts}, & \times & 92.3 & = & 1707.55 \\ 50.8 & & & & 3048.00 \end{array}$$

3048 ÷ 50.8 = 60

22. How much of each to make 1 pound (av.) of 60 percent.? (See No. 21.)

23. An apothecary has two kinds of opium, one $13\frac{1}{2}$ percent., the other 16 percent.; he desires to make 8 troy ounces of 14 percent. How much of the weaker kind must he use?

24. I have two qualities of cinchona, containing respectively $1\frac{3}{5}$ and $3\frac{7}{8}$ percent. of quinine. How much of each shall I take to make the mixture contain 2 percent.?

$$\begin{array}{cc} \multicolumn{2}{c}{\mathbf{2}} \\ 1\frac{3}{5} & 3\frac{7}{8} \\ \hline 1\frac{7}{8} & \frac{2}{5} \end{array} \qquad \begin{array}{lclr} 1\frac{7}{8} \text{ oz.} & = & 900 \text{ grains}, & 75 \\ \frac{2}{5} \text{ oz.} & = & 192 \text{ grains}, & 16 \end{array}$$

25. Two qualities contain $\frac{15}{16}$ of 1 percent. and $3\frac{1}{4}$ percent. respectively. How much of each shall I take to make the mixture contain 2 percent.?

26. Two qualities contain 1.235 percent. and 2.345 percent. respectively. How much of each shall I take to make the mixture contain 2 percent.?

27. Two qualities contain 1.676 percent. and 3.188 percent. respectively. How much of each shall I take to make the mixture contain 2 percent.?

28. Three qualities contain 0.840 percent., 1.848 percent., and 2.688 percent. respectively. How much of each shall I take to make the mixture contain 2 percent.?

29. Having the three qualities, as before (see No. 28), and having 5 ounces of the percentage 0.840, how much of the mixture will it yield?

If	43 parts are equal to 5 oz.,	0.840
	82 parts are equal to 9 oz., 256¾ grains,	2.688
	43 parts are equal to 5 oz.,	1.848
oz.	19 + 256¾ grains	

30. Having the three qualities, as before (see No. 28), with 5 ounces of the percentage 0.840, and wishing to make 32 ounces of the mixture, how much of each of the others must be used?

In this case proceed to find by previous rules how much of percentage 2.688 will be required to mix with the 5 ounces, 0.840, to make the mixture 2 percent.

This amount of mixture subtracted from 32 ounces will give the amount remaining to be made up of the other two percentages,—1.848 and 2.688.

2

0.840	2.688
0.688	1160
86	145

86 : 5 : : 145 : 8.4302

5.0000 oz.	of	0.840
8.4302 oz.	of	2.688
13.4302 oz.	of	2 percent.

Subtracting this from 32 ounces leaves 18.5698 ounces to be made up.

2

1.848	2.688
0.688	152
86	19

86
19
105 : 18.5698 oz. : : 86 : 15.2095 oz. of 1.848

Or, subtracting this from 18.5698 ounces gives 3.3603 of 2.688; adding 8.4302 gives the whole amount used of 2.688 percent. = 11.7905.

31. A solution of ferric sulphate is found to have the specific gravity 1.6520. How much water must be added to make it of the official strength (1.432)?

1.432

	1.6520	1.000
	0.4320	0.2200
Or,	43.20	22.00

43.20 fl. oz. of solution
22.00 fl. oz. of water

32. How much water must be added to 5 pints of solution of ferric sulphate (specific gravity 1.6520) to make it of the official strength?

33. A solution of ferric sulphate is found to have the specific gravity 1.412. How can it be made of the official strength?

The easiest method is to evaporate a portion of it until its specific gravity is considerably above the official strength (1.432), and then mix the proper quantities of the two solutions.

Suppose a portion of it has been evaporated until it has the specific gravity 1.448. How much of each solution must be taken to make 36 fluidounces of specific gravity 1.432?

1.432

	1.412	1.448
	16	20
Or,	4	5

$$\left.\begin{array}{l}\text{16 fl. oz. of 1.412}\\ \text{20 fl. oz. of 1.448}\end{array}\right\} = \text{36 fl. oz. of 1.432}$$

34. How much water must be added to 2 pounds of stronger ammonia water (28 percent.) to reduce it to ammonia water (10 percent.)?

10

28	0
10	18

10 : 18 :: 32 : 57.6 oz. water

35. How much water must be used to make 2 pounds of 10 percent. ammonia water?

36. How much official alcohol (U. S. P. 8th Rev.) (94.9 percent. by volume) must be added to 2 pints of alcohol of 76 percent. (vol.) to make it 81 percent. (vol.) (no allowance for contraction)?

37. How much official alcohol (U. S. P. 8th Rev.) (94.9 percent. by volume) must be added to 2 pints of 70 percent. (by volume) to make the mixture 85 percent. by weight, 87.8 by volume (no allowance for contraction)?

38. In what proportion must powdered nux vomica, assaying 1.03, 1.10, 1.32, and 1.28 percent. strychnine, be mixed in order to obtain a product containing 1.25 percent. strychnine?

39. If 1000 grammes of the mixture are desired, how much of each must be used? (See No. 38.)

40. How much water must be added to 100 Cc. of 92.5 percent. sulphuric acid (specific gravity 1.826) to make the official 10 percent. acid?

41. How much water will be required for 100 grammes of the acid? (See No. 40.)

42. If 1000 Cc. of the diluted acid (specific gravity 1.067) are desired, how many grammes of the strong acid will be required?

43. How much menstruum must be added to 500 Cc. of the fluidextract of coca, assaying 0.58 grammes of alkaloids to 100 Cc., to reduce it to the official strength of 0.50 grammes of alkaloids to 100 Cc.?

44. How many pints of 10 percent. ammonia water (specific gravity 0.958) can be made from 500 Cc. of 28 percent. ammonia water (specific gravity 0.897)?

45. How many pints of the weaker can be made from 500 grammes of the stronger? (See No. 44.)

46. How much milk sugar must be added to 125 grammes of extract of belladonna, assaying 1.48 percent. of alkaloids, to reduce it to the official strength of 1.40 percent.?

47. How much 36 percent. acetic acid can be made from 127 grammes of 99 percent. acetic acid?

48. How many fluidounces of water will be required to dilute 1 pound av. of a 12 percent. solution of potassium hydroxide so as to make it 5 percent.?

49. What will be the total weight of the product in grammes? (See No. 48.)

50. If a druggist has two lots of fluidextract of cinchona, assaying 3.52 and 4.84 grammes of ether-soluble alkaloids to each 100 Cc., how can he mix them so as to obtain a product of official strength (U. S. P. 8th Rev.)?

CHAPTER II

OPERATIONS REQUIRING THE USE OF HEAT

Generation of Heat

THE consideration of the theories which have been advanced from time to time to explain the phenomenon of heat, although very interesting and instructive, cannot be treated of in a work of this character, and the reader is therefore referred to any of the recent works on physics, which are everywhere accessible. The view which is now almost universally accepted is that known as the dynamical theory of heat, in which it is assumed that heat is produced by the constant motion of the particles composing the body, and that heat varies in quantity according as the body is *solid*, *liquid*, or *gaseous*.

It will be convenient to consider the various practical operations and appliances for generating heat under four heads:

1. Operations and forms of apparatus in which *solids* are used in developing heat.
2. Those in which *liquids* are used in developing heat.
3. Those in which *gases* are used in developing heat.
4. Those in which *electricity* is used in developing heat.

Operations and Forms of Apparatus in which Solids are used in developing Heat

Kinds of Fuel.—Under this head is included the very well known employment of solid fuel, as wood, charcoal, anthracite coal, bituminous coal, coke, etc.

Wood is seldom relied upon as fuel in pharmaceutical operations where a regular, well sustained heat is desired, yet from its wide distribution, ready inflammability, and comparative cheapness it is indispensable in kindling a fire. The large quantity of unconsumed carbon which is either lost in smoke or deposited upon vessels that are being heated constitutes the chief objection to its use.

Charcoal is more convenient, although more costly, than wood. It ignites easily, burns readily, and leaves but little residue. On account of its ready combustibility, it is well fitted for operations requiring a quick, strong heat.

Anthracite coal is probably the best form of solid fuel for general use, being the most economical. Its hard, dense structure renders it difficult to kindle, but where a long continued, strong heat is desired it is to be preferred.

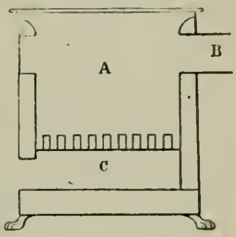
Bituminous or *semibituminous coal* affords a strong heat, but it is not equal to anthracite as fuel for pharmaceutical purposes. Unconsumed carbon is found in the smoke in large quantity, and this is apt to condense on the surfaces of kettles, vessels, etc., which are being heated, and the deposits of soot are uncleanly and often difficult to remove.

Coke, the residue obtained from the distillation of coal at gasworks, is an excellent fuel, and may be used either mixed with coal or by itself. It is more easily kindled than anthracite.

Pharmaceutical Furnaces, etc.—Much ingenuity has been used in the contrivance of various forms of furnaces, ranges, stoves, etc., to meet general or special applications, yet in all there are certain fundamental principles of construction which must be well understood if faults are to be avoided. The elements of a furnace are the *airflue, combustion chamber*, and *vent* or *chimney*, and the relative proportions of these must depend upon the special object sought in the construction of the furnace, and the character of the fuel that is to be used. Fig. 63 represents a sectional view of a pharmaceutical furnace,—C being the airflue, A the combustion chamber, and B the vent.

Coal being the principal solid fuel in use, it will be most appropriate to treat of those furnaces adapted for its combustion, and therefore the chemical constitution of coal and the theory of its combustion must be noticed. Hard anthracite, which is the best kind of coal for pharmaceutical furnaces, usually has a specific gravity of 1.550, and has been shown to consist of 94 percent. carbon, 0.40 percent. hydrogen, and 1.26 percent. oxygen; there are also apt to be present 2 percent. of water and about 2.3 percent. of incombustible impurities or ash, consisting of ferric oxide, silica, alumina, magnesia, lime, etc. The poorer grades of this kind of coal contain from 85 to 90 percent. of carbon. Anthracite may be distinguished from other varieties by its rich, glassy lustre, its peculiar conchoidal fracture, and its hard, dense structure. It burns freely, without black smoke, showing the absence of unconsumed carbon. Soft anthracite or *semi-bituminous* coal has a tendency, when broken into pieces, to assume the form of irregular cubes, and to crumble easily under pressure. It burns freely, but with the production of large quantities of black smoke. The heat produced by its combustion is very strong, and it is largely used in many parts of the United States.

FIG. 63

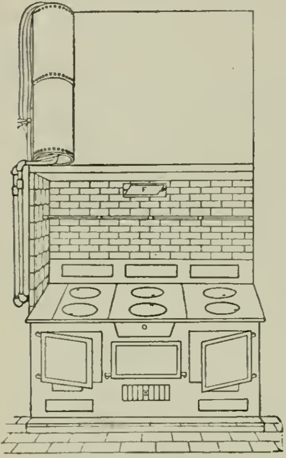


Pharmaceutical furnace, sectional view

The combustion or oxidation of coal requires the presence of a certain quantity of air in contact with the burning coal to furnish enough oxygen to combine properly with the carbon of the fuel. The result of the combination is carbon dioxide, CO_2, and carbon monoxide, CO, both of which are gases. It is very important to provide means of escape for these gaseous compounds, as they are both poisonous, and the former is a decided non-supporter of combustion. Theoretically, it has been calculated that one hundred and fifty cubic feet of air are necessary to consume perfectly one pound of coal in an ordinary furnace, but practically, because of the obstruction of the ashes, which prevents the thorough contact of the air with all parts of the glowing carbon, nearly double this amount is necessary.

Stoves and ranges are now so universally used that it would be needless to multiply illustrations of them. The proper selection of such as are suited to the special uses of the pharmacist must be left to individual decision, and will depend upon the space that can be spared and the character of the work that is to be done. One important feature should not be overlooked, however, in this connection,—*i.e.*, the addition of a boiler or waterback, whereby a constant supply of hot water can be had. Where stoves are used, this can generally be effected by having a circulating hot water boiler in a convenient corner, the pipes conveying the hot water being heated in the upper part of the combustion chamber of the stove. If sufficient space can be appropriated, a range is very useful, particularly if a sheet iron sliding door can be lowered over the front to enclose the space. Now, when a communicating flue, controlled by a damper, is made to enter the chimney from the top of this space, operations can be conducted here that would otherwise be impossible, noxious vapors being at once carried off by the flue. Fig. 64 represents an ordinary range which is well adapted for many pharmaceutical operations. The front has been removed, in order to show the construction more clearly. This front is of sheet iron, and is hinged to the shelf which supports the boiler; it extends half way over the top of the range, and when the damper is opened, the vapors arising from operations conducted on the top are carried up the chimney. The hot water boiler is connected by pipes with the cold water supply in such a manner that the cold water circulates through pipes which surround the combustion chamber, and, after becoming heated, ascends into the boiler.

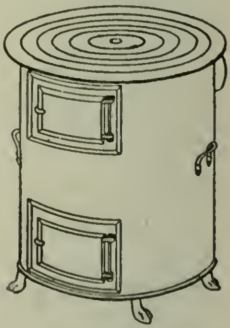
Fig. 64



Pharmaceutical range

Fig. 65 shows a durable pharmaceutical furnace made by Mershon's Sons, which has proved very useful in practical work. The body of the furnace is of wrought iron; it is lined with firebrick, and the top is composed of a series of rings, which permits of the use of various sized kettles, evaporating dishes, etc. It has two cast iron doors, the upper one being especially useful, as it permits the ready feeding of coal to the furnace while a kettle or dish is being heated, without disturbing the latter. Fig. 63 affords a sectional view of the same furnace, and it will be noticed that the combustion chamber, A, is sufficiently deep to contain a considerable body of ignited coal and permit the introduction of hot water pipes. The proportion of the airflue, C, is well arranged, while the vent, B, has sufficient capacity to serve all pharmaceutical purposes.

Fig. 65



Pharmaceutical furnace

The merits of this furnace are that the greater part of the heat rises and is available for heating the vessel placed on the rings, the heavy lining of firebrick preventing lateral radiation to a great extent, and, while it has all the advantages of a stationary furnace, its position can be changed repeatedly if desired, the relative proportion being so well adjusted that, while it is very sensitive to an increase or decrease of draught, a moderate heat may be as steadily maintained as the intensity of a strong fire.

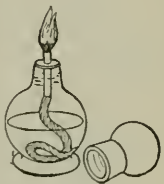
A drying closet can be adapted to this stove by which the waste heat may be utilized. This will be described in a chapter on Desiccation.

Operations and Forms of Apparatus in which Liquids are used in developing Heat

The liquids which are most used in pharmaceutical operations for heating are alcohol, methyl alcohol, petroleum, or coal oil, and petroleum benzin, or gasoline. All of these liquids contain carbon and hydrogen, while alcohol contains 34 percent. of oxygen in addition.

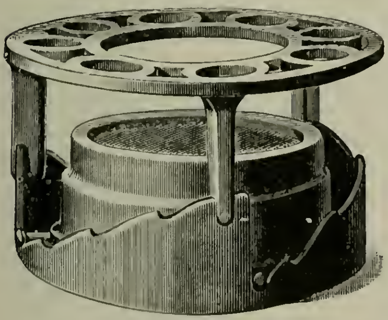
Alcohol burns with a blue flame, which does not deposit soot, and the heat produced is intense. It is in many respects the best liquid to use for generating heat in small operations, but the expense attending its use in this country is a serious objection. Refined *methyl alcohol* or *columbian spirit* has nearly all of the advantages of alcohol when used for burning in lamps, and it is much cheaper than ethyl alcohol. It should, however, never be used as a solvent in pharmaceutical preparations, as it is a dangerous liquid when taken internally, and too much caution cannot be exercised to guard against its improper use. In burning alcohol it is more economical to use a glass spirit lamp, which is provided with a ground glass cap (see Fig. 66), than an extemporaneous lamp made from an ordinary bottle. In the latter the loss by the evaporation of the alcohol from the wick, which is exposed when the lamp is not in use, is considerable. The older forms of alcohol lamps, such as Berzelius's, Mitchell's, etc., have almost gone out of use, being superseded by improved forms. Fig. 67 shows one of the simplest of these very convenient spirit lamps. Alcohol is poured upon the brass wire gauze, which sinks into and is absorbed by the asbestos, or mineral wool, with which the body of the brass lamp is filled ; a lighted match is now applied to the gauze, which retains sufficient spirit to ignite, and a strong heat is at once obtained, the large extent of surface of the gauze producing a solid blue flame. The great advantages of spirit lamps of this kind are that, all parts being of metal, accidents from breakage are avoided, while explosions cannot occur, as neither the alcohol nor its vapor is confined in a tight receptacle, and if the lamp is upset accidentally no spirit can be

FIG. 66



Spirit lamp

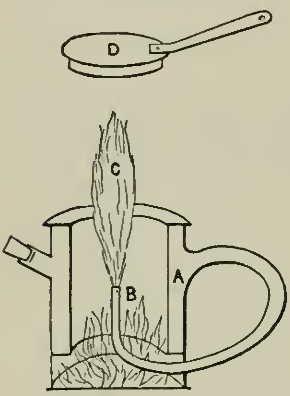
FIG. 67



Metal spirit lamp

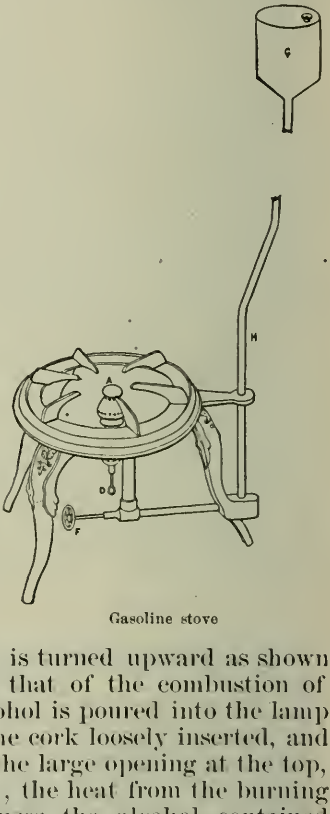
spilled, because it is absorbed by the asbestos. The lamp may be raised or lowered so as to increase or decrease the quantity of heat applied to the vessel. Many modifications of this simple contrivance have been introduced which are elaborate and useful.

Fig. 68



Russian blast lamp

Fig. 69

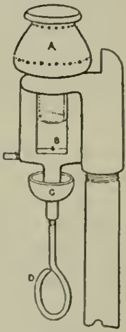


Gasoline stove

The so-called Russian blast lamp is one of the best contrivances for generating an intense heat. It is useful when glass tubes of large diameter are to be bent, or in crucible operations. A sectional illustration is seen in Fig. 68. It is made of sheet copper, and consists of a partially jacketed cylinder, A, with an opening on one side for introducing the alcohol, and on the opposite side a bent, tapering tube, B, which pierces the cylinder below the jacketed portion, and is turned upward as shown in the cut. The principle of action is that of the combustion of the *vapor* of the spirit. If sufficient alcohol is poured into the lamp through the side opening to half fill it, the cork loosely inserted, and half a fluidounce of alcohol poured into the large opening at the top, and then a lighted match dropped into it, the heat from the burning alcohol in the bottom of the lamp causes the alcohol contained between the jacketed sides to boil, and the vapor, having but one means of escape, rushes out by the tapering, bent tube, and at once ignites and produces a powerful upward blast. The flame, C, may be at once extinguished by putting the cover, D, over the central opening.

Petroleum benzin, or *gasoline*, is now used for heating purposes, and Fig. 69 shows one of the most convenient stoves for employing this cheap but very volatile hydrocarbon. The difficulties in the use of the very inflammable and often dangerous liquids of this class for heating have been here largely overcome. To avoid a smoky, luminous flame the *vapor is burned in contact with air*, while to prevent explosions the reservoir for the liquid is elevated and placed four or five feet away from the ignited vapor. Fig. 69 shows the stove, and Fig. 70 an enlarged view of the burner. The reservoir, G, is filled with gasoline, care being taken at the same time to see that the valve F is closed. When the burner is to be lighted, the valve F is opened slightly, and the valve D turned very carefully, so that a small quantity of gasoline shall flow from B over the sides and collect in the cup, C. When C is full, both valves, F and D, are turned off, and a lighted match applied to C. The burning gasoline will heat the burner, A, and when all of the liquid in C has been burned and the flame extinguished, the valve D is turned on slightly and a lighted match applied at A. The parts surrounding B being hot, the gasoline *is vaporized*, and passing upward through the burner, A, issues through the numerous circular openings and is ignited. The upward current of air caused by the heat mixes with the gasoline vapor and supplies the oxygen necessary to produce a perfectly blue and intensely hot flame, the size of which is regulated by the valves D and F. When fairly ignited, F is slightly opened, and D is used to control the flame by turning to the right or left.

Fig. 70



Gasoline stove burner

Although this stove is safe in careful hands, the volatile and very inflammable character of the hydrocarbon must be constantly borne in mind. In a large laboratory in the southern part of Philadelphia these burners were exclusively used, an elevated tank in the yard supplying the gasoline to the gaspipes, which are conveniently laid around the sides of the room and communicate with the burners on the tables.

Kerosene, or *coal oil*, is so widely known as a refined petroleum product used for illuminating and heating purposes that any extended notice of its properties in a practical work would be superfluous; as it is heavier in specific gravity and has a much higher flashing point[1] than gasoline, it is much safer for popular use. For many years the only kind of a coal oil stove available for druggists' use were wick-burners. In these, the oil is poured into a reservoir in the base of the stove; the upper part is surrounded with perforated tin, which admits air to the flame and acts as a protection; the wicks, which are flat and wide, have corresponding chimneys, by which the heat is conveyed to the vessel that is to be heated. The disadvantage common to all coal oil stoves using wicks is that the chimneys have to be high enough to secure perfect combustion and prevent smoking, and this removes the vessel that is to be heated so far from the flame that quick heating is almost impossible; in addi-

Fig. 71

Wickless blue flame coal oil stove

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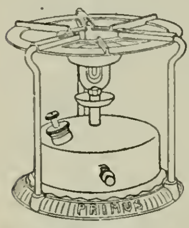
[1] By this term is meant the temperature at which coal oil begins to give off inflammable vapor which forms an explosive mixture with air. This temperature, fixed by the laws of different states, varies from 43.3° to 65.5° C., (110° to 150° F.).

tion to this, the wicks require constant attention, and imperfect combustion frequently results even when care is exercised.

The introduction of the "wickless blue flame oil stove" marked an era in practical methods of generating heat. Fig. 71 shows a good form. The stove must stand upon a level surface, for if it does not the coal oil will not flow properly. The cylindrical reservoirs on the side are supplied with an automatic feeder, whereby a uniform quantity of oil is furnished to the burner. The principle upon which this kind of a stove operates is that of *burning the vapor* of the oil (see gasoline stove, Fig. 69), and the control becomes an important factor. A lighting ring containing asbestos is first saturated with oil by turning one of the valves, and when a lighted match is applied sufficient heat is soon generated to cause the coal oil to burn with a blue flame without smoke or odor. Fig. 72 shows a smaller wickless coal oil stove which is very efficient.

Fig. 72



Wickless blue flame coal oil stove

Operations and Forms of Apparatus in which Gases are used in developing Heat

Gas.—The extensive employment of manufactured illuminating gas and the growing use of natural gas as sources of heat for pharmaceutical and other purposes render necessary a somewhat extended notice of gas in this connection. Illuminating gas was frequently called carburetted hydrogen, but it is really a mechanical mixture of various gases, some of which produce luminous flames and others do not; besides the hydrocarbon, CH_4 (carburetted hydrogen), which is the principal constituent, it contains condensible hydrocarbons, hydrogen, carbon dioxide, carbon monoxide, aqueous vapor, and traces of oxygen and nitrogen. Gas is usually produced by the destructive distillation of gas coal, while coal tar, gas liquor, and coke are the liquid and solid by-products, and these are now exceedingly useful as the sources of valuable manufactures in the arts. Gas which is fitted for illuminating purposes must have its composition modified by admixture with air before it is fit for heating purposes; this may be best illustrated by the examination of an ordinary fishtail gas flame. In Fig. 73 it will be noticed that three zones are visible,—the lower or dark central zone, which is not luminous and not at all hot, because the gas is not fairly ignited; A, the luminous zone, where the emission of light is due to the suspension of minute particles of incandescent carbon in the flame, caused by the incomplete combustion of the gas; and the outer non-luminous zone, or "mantle" which fringes the flame, and where the particles of carbon coming in direct contact with the air are entirely consumed, the commonly accepted theory being that the oxygen in the air unites chemically with the incandescent carbon particles, producing the invisible gases carbon monoxide and carbon dioxide.

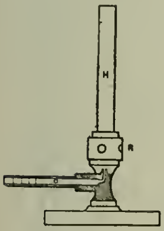
Fig. 73

Gas flame

Soon after gas came into use it was discovered that the properties which rendered it most valuable as an illuminator prevented its use as a source of heat, because of the deposition of the particles of soot from the luminous portion of the flame upon vessels that were to be heated. Dr. Duncan, of Edinburgh, showed that if gas properly mixed with air was made to enter at the bottom of a tall tinned iron cylinder, the upper end of which was covered with wire gauze, it would burn when ignited above the gauze with a blue, smokeless flame. The unnecessarily long cylinders (sometimes thirty inches) which were originally used were soon replaced by others of the length of five or six inches, for the sake of greater convenience. This discovery was at once utilized, and gas stoves and burners for various purposes came into use immediately.

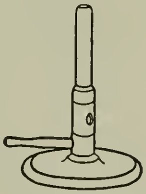
Bunsen burners are more frequently used in simple operations than any other form (see Fig 74). The coal gas issues from a small orifice, O, near the base, passes up through a brass tube, H, four inches high, and is ignited at the top of this tube; four large circular openings surround the small orifice at the base, and these may be closed either wholly or in part by a perforated brass ring, R; this permits the regulation of the supply of air, which mixes with the gas as it ascends the tube, and a blue, smokeless, intensely hot flame may be produced; if the perforated ring is turned so that the air openings are closed, a luminous, smoky flame results. One of the objections to the ordinary Bunsen burner is that, after being used for a time under a low gas pressure, when the tube becomes hot the flame will sometimes recede and the gas become ignited at the lower orifice. This may usually be avoided by gradually turning the brass perforated ring, so as to admit less air to suit the diminished pressure. Morton corrected this receding of the flame by contracting the orifice of escape at the top to about two-thirds of the area of the tube. That the length of the perpendicular tube does not materially affect the smokeless character of the flame may be proved by the use of the convenient little burners shown in Figs. 76 and 77. These are made by the Buffalo Dental Manufacturing Company, and have proved very useful at the prescription counter. Bunsen burners with the tube arranged horizontally have grown in favor because they are less likely to be overturned, and if they have a broad base they will easily support a large vessel. Fletcher's radial burner (see Fig. 78) has the merit of having no loose parts, and, as the casting is well annealed, it is well adapted for

Fig. 74



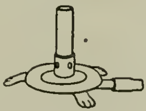
Bunsen burner

Fig. 75



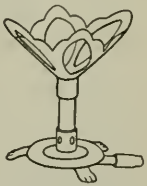
Bunsen burner (Morton's)

Fig. 76



Short burner

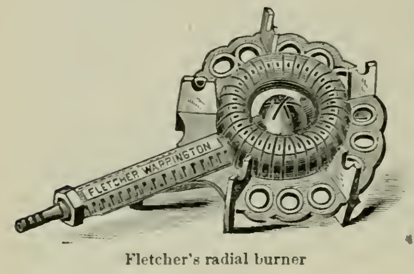
Fig. 77



Short burner with support

rough usage, the gas issuing from narrow slits cut radially in the raised circular burner; the flame is solid and non-luminous. No gauze is needed to distribute the heat. In Fig. 79 is shown a very compact and useful gas burner, well adapted for the dispensing counter, it is of the horizontal Bunsen type, and is furnished with an attachment for distributing the flame, and three short legs for supporting the vessel that is to be heated.

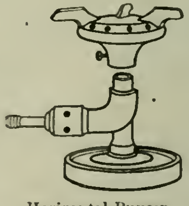
Fig. 78



Fletcher's radial burner

In many localities outside of cities and towns, gas made by vaporizing gasoline and mixing air with it is used for illuminating purposes. It is made by gas machines, as they are termed, the air pump, operated by weights and pulleys or by a water wheel, being usually located in the cellar of the residence or building, while the gasometer is buried underground at a safe distance. This gas is very satisfactory, but it has been only within a few years that it has been utilized for heating purposes. Special burners are required when this gas is used as an illuminant, and they require some adjustment at first to secure the proper proportion of air. Fig. 80 shows the Springfield laboratory burner, which gives a very hot, blue flame with this kind of gas, and it may also be used with ordinary gas. The milled head at the base of the burner is used to control the quantity of the gas passing through, while by revolving the burner itself upon the thread of the screw by which it is connected with the base, the quality of the gas is determined,—*i.e.*, the proper proportion of air is admitted.

Fig. 79



Horizontal Bunsen burner

Fig. 80

Springfield laboratory burner

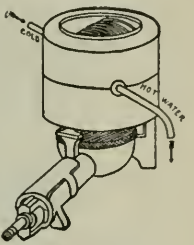
Fig. 81

Economy gas stove

Gas stoves are now made in such variety that it seems difficult to make a judicious selection for general pharmaceutical work. The error most frequently made is in the choice of those which are intended to produce only very high temperatures. It is very seldom that a heat of great intensity is desired in pharmaceutical operations. The chief points to be secured in a good gas stove are—1, a smokeless flame; 2, a strong, firm, indestructible frame that will easily support a large or small vessel and is not easily overturned; 3, an easy and quick adjustment, whereby either a strong, well sustained heat or a low, diffused heat may be obtained. Prof. Parrish devised a pharmaceutical stove which had these qualifications, but it is not made at present. Fig. 81 shows one which is known in commerce as the Economy gas stove. It is made by the American Meter Company, and of all of the gas stoves that have been used by the author, this is the one which is in every way most suited for pharmaceutical operations. It has a broad, low, strong base, and cannot be easily overturned, and a double ring burner, so arranged that either the small ring or both the small and large rings may be used. As it is only about four inches high, when placed upon the laboratory counter a vessel which is upon it and being heated is not elevated so that it cannot be conveniently stirred. It is nine inches square, and its consumption of gas when both rings are lighted is about ten feet per hour.

One of the greatest conveniences that a pharmacist can have at a dispensing counter, where a large supply of hot water cannot be had from a boiler, is the water heater shown in Fig. 82. If hot water is desired, the pipe at the top is connected with a hydrant, the water turned on, and the gas burner lighted below; in a few seconds warm water, and in a minute or two hot water, will run from the lower pipe. Many kinds of hot water apparatus are now to be had based on this principle. Fig. 83 shows a convenient hot water generator, well adapted for furnishing a supply of hot water in pharmacies which have not access to the waterback of a range, but can use gas. In the illustration it is shown attached to an ordinary circulating boiler, and it can be depended upon to furnish a large quantity of warm water. It is made by the American Meter Company.

FIG. 82



Water heater

The advantages of the use of illuminating gas as a source of heat may be summed up as follows: 1. It may be made to furnish a clean, smokeless flame. 2. It is cheap when compared with alcohol and other sources of heat, and is particularly economical in large cities. 3. The supply is unremitting, and the inconvenience of continually supplying fuel, which is always present in other forms of stoves, is not experienced here. 4. The supply is under almost perfect control, and, after once regulating the flow suitable for a continuous operation, little apprehension need be felt, during the operator's enforced absence, of an injurious rise or fall in the temperature.

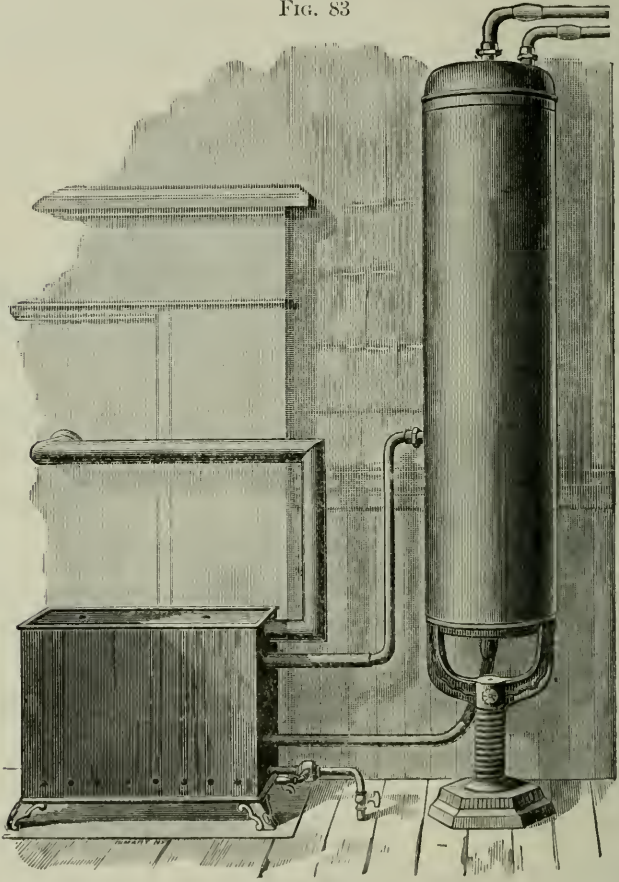
Operations and Forms of Apparatus in which Electricity is used in developing Heat

Electricity as a Source of Heat.—The enormous use of electricity as a source of light has naturally turned the minds of inventors to devising means of using it for heating purposes. Unless, however, there happens to be an electrical plant near by, this method cannot be used economically by the pharmacist, and, if illuminating gas is available, electric heating on a large scale is unprofitable. In many city stores lighted by electricity it will often be found that for convenience, cleanliness, and ease of application electrical stoves have an advantage. Fig. 84 shows a simple electrical stove which can be used for small operations. The current flows through fine wires of highly resisting metal embedded in fireproof insulating cement in the base, and the heat produced by the resistance warms the top plate of the stove.

Methods of measuring Heat

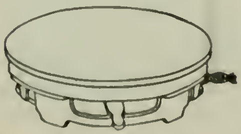
To measure degrees of temperature in pharmaceutical operations thermometers are used exclusively. A thermometer may be described as an instrument consisting of a glass tube having a capillary bore, with a cylindrical or globular bulb blown at the end, the bulb and a part of the stem containing a liquid (usually mercury), and the tube being mounted upon a graduated scale, or the tube itself graduated, in order to measure the degree of expansion of the liquid when subjected to the influence of heat. Unfortunately, the value of the degrees of thermometers in common use is not the same, there being no less than three arbitrary scales,—Centigrade, Fahrenheit, and Réaumur, the latter rarely used in English speaking countries.

FIG. 83



Hot water generator

FIG. 84



Electrical stove

The *Centigrade*, or Celsius, scale is best adapted for scientific work; it is given the first place in the U. S. P. (8th Rev.). The freezing point of water is zero, 0°, and the boiling point is 100°; the intervening space is divided into one hundred equal parts (see Fig. 85).

The *Fahrenheit* scale is much the most largely used in this country and Great Britain, and until the 1880 revision of the U. S. Pharmacopœia it was used exclusively in pharmacy. The Centigrade degrees in the Pharmacopœia are followed by those of Fahrenheit enclosed in parentheses, as 100° C. (212° F.). In Fahrenheit's thermometer the freezing point is 32°, and the boiling point is 212°, the intervening space being divided into one hundred and eighty equal parts (see Fig. 86). In Réaumur's thermometer the freezing point is 0°, and the boiling point is 80°.

Fig. 85

Centigrade thermometer

Fig. 86

Fahrenheit thermometer

Fig. 87 shows a convenient and cheap form of thermometer for pharmaceutical uses, but on account of its having a paper scale it should not be used for measuring temperatures above 300° F. as the paper will be charred.

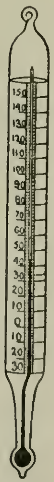
In Figs. 88, 89, and 90 the three thermometers are shown together to facilitate comparison. The lowest figures indicate the freezing points of each, the highest the boiling points.

RULES

1. *To convert Centigrade degrees into those of Fahrenheit*, multiply by 1.8 and add 32.

2. *To convert Fahrenheit degrees into those of Centigrade*, subtract 32 and divide by 1.8.

Fig. 87



Paper scale thermometer

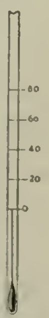
Fig. 88

Fahrenheit

Fig. 89

Centigrade

Fig. 90



Réaumur

Choice of Thermometers.—It is important that the practical pharmacist should possess a good thermometer. The best form is one in which the graduations are made on the surface of the tube. The diameter of the instrument should be the same throughout its entire length; this permits its convenient use through perforated corks in distillations and other operations where it is necessary to observe temperature, and it is not so easily broken (see Fig. 85). The thickness of the glass of the bulb is not a matter of indifference. If too thick, the thermometer will not respond quickly to changes of temperature, while if too thin, the risk of fracture is very great. The bore of the tube should be flat or elliptical, and perfectly uniform throughout. The absence of air in the tube may be known by the descent of the mercury to the lowest part of the tube when the thermometer is inverted. A strip of opaque, white enamelled glass behind the bore of the tube is of great assistance in reading the indication quickly. It is a good practice to send a thermometer to be officially tested,[1] and then to reserve it as a standard for correcting ordinary instruments. As glass usually reaches its limit of contraction in three years, such a thermometer should be at least this old before it is sent.

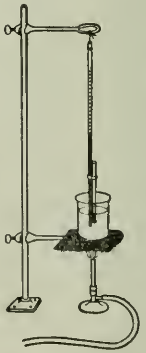
Fig. 91

Clinical thermometer

Fig. 91 illustrates one of the most valuable forms of the thermometer; it is called a *clinical* thermometer. The glass is triangular instead of cylindrical, and the capillary orifice is flattened so as to enlarge the diameter of the surface of the mercury, in order that it can be read easily. The normal temperature of the human body is 98.5° F., and the physician, by inserting the bulb of the thermometer under the patient's tongue and allowing it to rest there for a minute, can easily ascertain the presence or absence of symptoms of fever.

Melting Point.—By this is meant the temperature at which a substance melts or fuses. It is used as a means of identifying a body or of proving its purity. The U. S. P. (8th Rev.) cites the melting point of many bodies (see table below). Melting points may be taken with an apparatus like that shown in Fig. 92. The melted substance is drawn into the small tube and allowed to cool, or the end of the tube is sealed. The tube is attached by a rubber band to a thermometer, and both immersed in a bath of some convenient liquid. The whole is gradually heated, and the point at which the substance melts is noted. Figs. 93 and 94 show Bensemann's method of collecting a fusible body by holding the tube horizontally until the melted body cools. When heated carefully the exact point at which it melts can be seen by the liquid flowing down the side.

Fig. 92



Taking the melting point

Fig. 93

Fig. 94

Bensemann's method of collecting fusible body

Table of Melting Points of Official Substances

Acidum Aceticum Glaciale	15° C.	=	59° F.
Guaiacol (solid)	28.5° C.	=	83.3° F.
Oleum Theobromatis	30°–35° C.	=	86°–95° F.
Sodii Sulphas	33° C.	=	91.4° F.
Ferri Chloridum	35.5° C.	=	96° F.
Adeps	38°–40° C.	=	100.4°–104° F.
Adeps Lanæ	40° C.	=	104° F.
Adeps Lanæ Hydrosus	40° C.	=	104° F.

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[1] Thermometers are examined, and certificates are issued showing the corrections, by Winchester Observatory, of Yale College, New Haven, Conn., and by many others.

Phenol (crystals)	40° C.	=	104° F.
Sodii Phosphas	40° C.	=	104° F.
Phenylis Salicylas	42° C.	=	107.6° F.
Cetaceum	42°–50° C.	=	107.6°–122° F.
Menthol	43° C.	=	109.4° F.
Phosphorus	44° C.	=	111.2° F.
Petrolatum	45°–48° C.	=	113°–118.4° F.
Sevum Præparatum	45°–50° C.	=	113°–122° F.
Æthylis Carbamas	47.5°–50° C.	=	117.5°–122° F.
Sodii Thiosulphas	50° C.	=	122° F.
Thymol	50°–51° C.	=	122°–123.8° F.
Paraffinum	51.6°–57.2° C.	=	125°–135° F.
Acidum Trichloraceticum	52° C.	=	125.6° F.
Quinina	57° C.	=	134.6° F.
Chloralum Hydratum	58° C.	=	136.4° F.
Sodii Acetas	60° C.	=	140° F.
Cera Flava	62°–64° C.	=	143.6°–147.2° F.
Cera Alba	64°–65° C.	=	147.2°–149° F.
Acidum Stearicum	69.2° C.	=	156.6° F.
Potassii et Sodii Tartras	74° C.	=	165.2° F.
Plumbi Acetas	75° C.	=	167° F.
Camphora Monobromata	76° C.	=	168.8° F.
Sulphonethylmethanum	76° C.	=	168.8° F.
Naphthalenum	80° C.	=	176° F.
Vanillinum	80°–81°C.	=	176°–177.8° F.
Guaiacolis Carbonas	84°–87° C.	=	183.2°–188.6° F.
Alumen	92° C.	=	197.6° F.
Cocaina	98° C.	=	208.4° F.
Resorcinol	109°–111° C.	=	228.2°–231.8° F.
Hyoscinæ Hydrobromidum	110° C.	=	230° F.
Acetanilidum	113° C.	=	235.4° F.
Antipyrina	113° C.	=	235.4° F.
Atropina	113.8° C.	=	237° F.
Iodum	114° C.	=	237.2° F.
Chloralformamidum	114°–115° C.	=	237.2°–239° F.
Iodoformum	115° C.	=	239° F.
Sulphur Lotum	115° C.	=	239° F.
Sulphur Praecipitatum	115° C.	=	239° F.
Sulphur Sublimatum	115° C.	=	239° F.
Zinci Chloridum	115° C.	=	239° F.
Terpini Hydras	116°–117° C.	=	240.8°–242.6° F.
Acidum Benzoicum	120°–122° C.	=	248–251.6° F.
Betanaphthol	122° C.	=	251.6° F.
Elastica	125° C.	=	257° F.
Sulphonmethanum	125.5° C.	=	258° F.
Piperina	130° C.	=	266° F.
Hydrastina	131° C.	=	267.8° F.
Pyrogallol	132° C.	=	269.6° F.
Acetphenetidinum	134°–135° C.	=	273.2°–275° F.
Sparteinæ Sulphas (anhydrous)	136° C.	=	276.8° F.
Physostigminæ Sulphas	140° C.	=	284° F.
Colchicina	142.5° C.	=	288.5° F.
Aloin (from Curaçao Aloes)	147° C.	=	296.6° F.
Resina Jalapæ (anhydrous)	150° C.	=	302° F.
Hyoscyaminæ Hydrobromidum	151.8° C.	=	305.3° F.
Quininæ Hydrobromidum	152° C.	=	305.6° F.
Veratrina	152° C.	=	305.6° F.
Acidum Citricum	152°–153° C.	=	305.6°–307.4° F.
Codeina	154.9° C.	=	310.8° F.
Acidum Salicylicum	157° C.	=	314.6° F.
Chrysarobinum	157° C.	=	314.6° F.
Acidum Boricum	160° C.	=	320° F.
Quininæ Bisulphas	160° C.	=	320° F.
Acidum Tartaricum	168°–170° C.	=	334.4°–338° F.

Pilocarpinæ Nitras	170.9° C.	=	339.7° F.
Santoninum	170.3° C.	=	338.5° F.
Strophanthinum	170°–190° C.	=	338°–374° F.
Quinina (anhydrous)	174.9° C.	=	346.8° F.
Camphora	175° C.	=	347° F.
Physostigminæ Salicylas	178.9° C.	=	354° F.
Quininæ Salicylas	183°–187° C.	=	361.4°–368.6° F.
Acidum Camphoricum	187° C.	=	368.6° F.
Atropinæ Sulphas	189.9° C.	=	373.8° F.
Cocainæ Hydrochloridum	189.9° C.	=	373.8° F.
Quininæ Hydrochloridum	190° C.	=	374° F.
Hyoscine Hydrobromide	191°–192° C.	=	375.8°–377.6° F.
Chromii Trioxidum	192°–193° C.	=	377.6°–379.4° F.
Ammonii Benzoas	193°–194° C.	=	379.4°–381.2° F.
Aconitina	195° C.	=	383° F.
Pilocarpinæ Hydrochloridum	195.9° C.	=	384.5° F.
Cinchoninæ Sulphas	198.5° C.	=	389.5° F.
Hyoscyaminæ Sulphas	198.9° C.	=	390.1° F.
Acidum Gallicum	200° C.	=	392° F.
Argenti Nitras	200° C.	=	392° F.
Arseni Trioxidum (amorphous variety)	200° C.	=	392° F.
Morphinæ Acetas	200° C.	=	392° F.
Strychninæ Sulphas	200° C.	=	392° F.
Salicinum	201.4° C.	=	394.5° F.
Quininæ Sulphas	205° C.	=	401° F.
Cinchonidinæ Sulphas	205.3° C.	=	401.5° F.
Hydrastininæ Hydrochloridum	212° C.	=	413.6° F.
Homatropinæ Hydrobromidum	213.8° C.	=	417° F.
Elaterinum	216° C.	=	420.8° F.
Benzosulphinidum	219°–220° C.	=	426.2°–428° F.
Codeinæ Phosphas	235° C.	=	455° F.
Caffeina	236.8° C.	=	458.3° F.
Hydrargyri Iodidum Rubrum	253° C.	=	487.4° F.
Morphina	254° C.	=	489.2° F.
Hydrargyri Chloridum Corrosivum	265° C.	=	509° F.
Strychnina	268° C.	=	514.4° F.
Potassii Acetas	292° C.	=	557.6° F.
Sodii Nitras	312° C.	=	593.6° F.
Potassii Chloras	334° C.	=	633.2° F.
Potassii Nitras	353° C.	=	667.4° F.
Zinci Bromidum	394° C.	=	741.2° F.
Zincum	412°–415° C.	=	773.6°–779° F.
Zinci Iodidum	446° C.	=	834.8° F.
Sodii Hydroxidum	525° C.	=	977° F.
Potassii Hydroxidum	530° C.	=	986° F.
Potassii Bromidum	700° C.	=	1292° F.

CHAPTER III

USES OF HEAT

THE consideration of the uses of heat in pharmacy will follow naturally the preceding chapter upon its generation and measurement, and the subject may be properly treated of under two classes,—viz., 1, those operations in which comparatively high temperatures are required, and, 2, those which require moderate or low temperatures. It will be readily noticed that the latter class will embrace nearly all of the more important pharmaceutical operations in which heat is employed.

Operations in which comparatively High Temperatures are required.—In this class of operations must be placed some which seem to be in danger of becoming lost arts through the growth of special methods, which are now conducted on a large scale by manufacturers, who supply the products of their skill so cheaply that the home made apparatus is often produced at a pecuniary loss. It will, nevertheless, be found useful to refer briefly to these operations, for a certain amount of knowledge will frequently be of service to the practical worker in emergencies and on special occasions.

The Use of the Blowpipe.—A blowpipe in its simplest form is a metallic tube, usually of brass or copper, slightly conical, gradually tapering to a minute orifice, the narrowest portion being curved so that the axis of the orifice is at right angles to that of the principal portion of the tube. It is used by placing the widest end in the mouth, and inserting the other end into the edge of the flame, and forcing a current of air through the tube, with the effect of increasing the intensity of the flame by converting it into a miniature blast. Some skill and practice are required to produce an unremitting current of air, and this is effected by keeping the muscles of the cheeks distended and constantly supplying air from the lungs as it is needed. When the blowpipe is used with a luminous flame, the interior of the flame, owing to the carbon not being wholly oxidized, has the power of deoxidizing or reducing oxides, while the outer flame has opposite or oxidizing properties. A piece of lead glass tube held in the inner flame will be blackened through the reduction of the lead oxide to the metallic state; if this stain is held in the outer flame the metal is reoxidized, dissolves in the glass, and the glass again becomes transparent. The blowpipe is

FIG. 95

Plain blowpipe

FIG. 96

Bulb

FIG. 97

Black's

FIG. 98

Berzelius's

FIG. 99

Plattner's

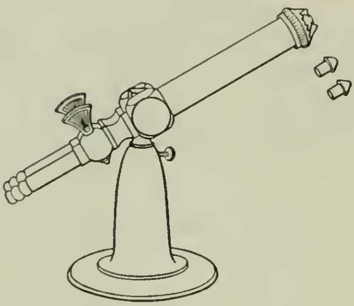
FIG. 100

Plattner's (dissected)

useful in pharmacy in working and bending glass, in testing fusible chemical substances, in soldering apparatus, etc. The various forms of blowpipes in common use are shown in Figs. 95 to 100.

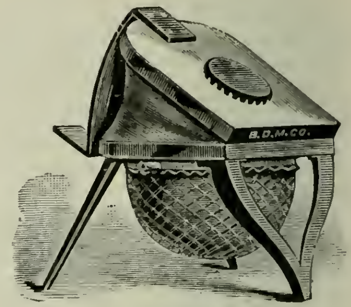
The gas blowpipe, shown in Fig. 101, furnishes an excellent and very powerful blast which is capable of delicate adjustment. It has a universal ball and socket joint, which enables it to be used in any position. The very convenient foot bellows, shown in Fig. 102, may be used in connection with it for producing the blast. The sides of this bellows are of stout leather, and the reservoir of air beneath is obtained by stretching and fastening a circular piece of thin rubber cloth over the lower orifice and preventing too great expansion and rupture by enclosing it in a net. This form, with the reservoir below, is preferable to that formerly in use, which had the rubber cloth above; the advantages are greater protection against injury from falling articles, and less obstruction to the valves through drawing in dust from the floor.

Fig. 101



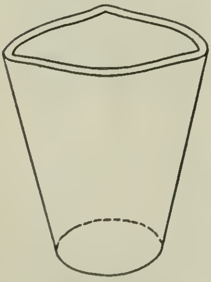
Gas blowpipe

Fig. 102



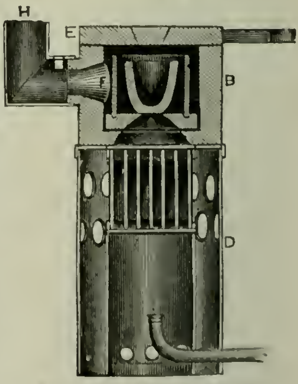
Foot bellows

Fig. 103



Hessian crucible

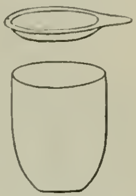
Fig. 104



Fletcher's gas crucible furnace

Crucible Operations.—A crucible is a cup-shaped vessel made of platinum, silver, black lead, iron, porcelain, wedgwoodware, or clay, and intended to withstand a very powerful heat. It is used for fusing metals or heating metallic oxides or organic substances, and is very useful in chemical analysis. The Hessian crucible (see Fig. 103) is the cheapest. It is unfitted for delicate operations, for, although capable of withstanding great heat, its porous character permits the ready absorption of many substances. The black lead crucible is more expensive. It is less porous, is infusible, and has the merit of bearing great changes in temperature without risk of fracture. Porcelain or wedgwood crucibles are fragile, and have to be very gradually cooled to prevent breakage. Fletcher's gas crucible furnace (see Fig. 104) is very useful in this connection. Of the metals used in making crucibles, platinum is superior to all. Its well known power of resisting fusion, its cleanliness, and its non-liability to be acted upon by most chemical substances render it invaluable to the chemist, notwithstanding its costliness (see Fig. 105). For lifting a hot crucible from the furnace, crucible tongs are employed (see Fig. 106).

Fig. 105



Platinum crucible

The following processes require the application of high heat:

1. *Ignition*, in the sense in which it is used in the Pharmacopœia and by chemists generally, is the process of strongly heating solid or semisolid substances, the residue left at the conclusion of the process being the object sought. The U. S. P. (8th Rev.) quantitative tests for potassium bitartrate, sodium benzoate, and sodium citrate afford examples of the use of this process.

2. *Fusion* is the process of liquefying solid bodies by the application of heat without the use of a solvent. The melting of wax, and the preparation of moulded silver nitrate, are familiar examples of this process.

3. *Calcination* is the process of separating volatile substances from fixed inorganic matter by the application of heat without fusion. Its principal application in pharmacy is in the expulsion of water and carbon dioxide from carbonates, as shown in the processes for making magnesia, lime, etc.

Fig. 106

Crucible tongs

4. *Deflagration* is the process of heating one inorganic substance with another capable of yielding oxygen (usually a nitrate or a chlorate); decomposition ensues accompanied by a violent, noisy, or sudden combustion. Deflagration is used in making some of the salts of antimony and arsenic, and in some qualitative analytical examinations.

5. *Carbonization* is the process of heating organic substances *without* exposure to air until the volatile products are driven off, and the residue assumes the black color characteristic of free carbon or charcoal. The manufacture of boneblack and wood charcoal afford good illustrations.

6. *Torrefaction* (known also as roasting) is the process whereby organic substances have some of their constituents modified by the application of a degree of heat somewhat less than that necessary to carbonize them. The most familiar example of this process is the roasting of coffee. Rhubarb in coarse, dry powder, when subjected to torrefaction, loses its cathartic properties, but retains its astringent qualities, and is known as *Torrefied Rhubarb.*

7. *Incineration* is the process of strongly heating organic substances *with* access of air until all the carbon is consumed, the ashes which remain being the object sought. The process is frequently used in

analysis to determine the amount of fixed matter in an organic substance.

8. *Sublimation* is the process of separating a volatile solid substance from one which is not volatile by the application of heat. A special chapter on this subject will be found in the succeeding pages.

Operations requiring Heat in which Lower Temperatures are used

In this class of operations will be found the most important of those requiring the application of heat; almost all medicinal substances have their properties altered by the action of heat, and many cases are met with where it is necessary to moderate the heat carefully in order to prevent the decomposition or destruction of the active agent; for the purpose of controlling heat various baths are used, as the sand bath, oil bath, solution bath, steam bath, water bath, etc.

Baths.—The *sand bath* is usually an iron vessel of hemispherical or other convenient shape, containing dry, clean sand (see Fig. 107); the vessel to be heated is embedded in the sand, and the bath is then heated to the required degree. The object of this form of bath is to equalize the temperature, and to prevent a too sudden rise or fall of heat whereby unequal expansion or contraction might cause fracture to a glass or porcelain vessel being heated. Iron wire clippings have sometimes been substituted for sand, with doubtful advantage, however.

Fig. 107

Sand bath

The practical error usually made by inexperienced operators in the use of the sand bath is in permitting too large a body of sand to rest between the bottom of the vessel to be heated and the flame; this results in an unnecessary waste of heat.

The *oil bath* is designed to furnish a regulated temperature below 260° C. (500° F.). A fixed oil is the medium usually employed for communicating the heat, but one of the best substitutes for oil is petrolatum. Most fixed oils, when heated above 177° C. (350.6° F.), evolve disagreeable fumes.

In fractional distillation on a large scale, oil baths are often used to control temperature, and the fumes arising from the heated oil are carried off by a pipe to the chimney.

The Glycerin Bath.—In order to avoid the disagreeable odors arising from hot oil, glycerin is sometimes substituted. Acrolein, an acrid, volatile product, however, is produced if glycerin is heated nearly to boiling. A temperature of 250° C. (482° F.) can be maintained in a glycerin bath without much inconvenience.

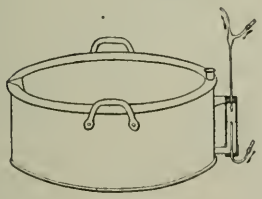
Salt water baths are sometimes used in special operations; their principle of action depends on the fact that the boiling point of a liquid is raised in proportion to the quantity of fixed salt dissolved in it. Water, as is well known, boils at 100° C. (212° F.), but if common salt is dissolved in water until it ceases to take up any more, and a saturated solution is produced, it is found that this solution does not boil until the temperature of 108.4° C. (227.1° F.) is reached. The following table shows the boiling point of certain saturated solutions as determined by Legrand and others:

Table of Boiling Points of Saturated Solutions of Various Salts

Salt	Boiling Point		Salt	Boiling Point	
	C.	F.		C.	F.
Sodium Chloride	108.4°	227.1°	Sodium Acetate	124.4°	256°
Ammonium Chloride	114.2°	237.6°	Potassium Carbonate	135°	275°
Potassium Tartrate	114.7°	238.5°	Calcium Nitrate	151°	303.8°
Potassium Nitrate	115.9°	240.2°	Potassium Acetate	169°	336.2°
Sodium Nitrate	121°	249.8°	Calcium Chloride	179°	354.2°

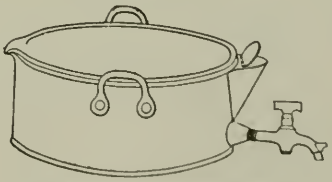
The *water bath* is one of the most useful of all the forms of pharmaceutical apparatus for regulating temperature, and the frequency with which it is directed to be used in works of authority indicates its importance as a necessary implement in the equipment of every pharmaceutical laboratory. Almost all the water baths used by pharmacists are extemporized, and these are generally crude and inconvenient; two dishes usually suffice, one of them somewhat larger in diameter than the other. Water is poured into the larger dish, and the other dish, containing the liquid to be heated, is placed in the water and the heat applied; the room is soon filled with the escaping steam, and in winter the condensation of the moisture upon the windows is alone a sufficient inconvenience to render it undesirable. Fig. 108 shows a tinned copper water bath in which this annoyance is overcome. The water level has at its lowest point a piece of block tin tube soldered in; this extends half way up the glass tube in the inside, while a perforated cork at the upper end of the glass tube permits the insertion of another piece of block tin tube; the upper tube connects with the cold water faucet and terminates in the smokeflue or with the outside air; the vapor arising from the boiling water either passes off into the chimney, as shown by the arrow, or is condensed, the loss being supplied by a small stream of water from the cold water faucet, shown by the arrow pointing downward; the lower block tin tube acts as an overflow, the excess of water being carried off by a rubber tube into the sink; all possibility of the water bath "boiling dry" is thus obviated. Vapors from the liquid in the water bath may be carried off by a hood (see Fig. 148). A simple water bath may be made by encasing a tinned copper round bottomed dish in one of larger diameter having a flat bottom. Water is poured in through a tubulure in the top, and it is replenished as required. Fig. 109 shows a similar water bath, a porcelain evaporating dish taking the place of the copper one. It is useful where a metallic

FIG. 108



Water bath

FIG. 109



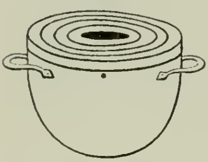
Water bath (porcelain dish)

dish would be acted on by the substance to be heated. A water bath intended for the smaller operations of analytical chemistry is shown in Fig. 110. The different sizes of the rings render it convenient for vessels of various shapes and sizes. It will be necessary to allude frequently hereafter to the uses and modifications of the water bath.

The Use of Steam in Pharmaceutical Operations

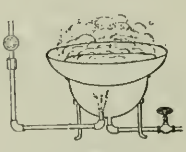
The scope of this work will not permit of any extended consideration of the use of steam in technical pharmacy, yet it is of vital interest to be acquainted not only with the theories underlying its employment, but also with the apparatus used in its practical application.

FIG. 110



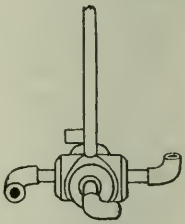
Copper water bath

FIG. 111



Open steam bath

FIG. 112



Steam distributor

When water is heated to the boiling point and steam is produced, a certain amount of heat is absorbed (or apparently lost). This has been termed *latent heat*. When steam comes in contact with surfaces having less heat than itself, it is condensed, water is produced, and the latent heat becomes *sensible* (or reappears), thus proving the well established physical law that *when a liquid assumes the gaseous state, a certain fixed and definite amount of heat disappears; and, conversely, when a gas or vapor becomes a liquid, heat to a corresponding extent is evolved.* Watts has illustrated this as follows: "When water at 0° C. is mixed with an equal weight of water at 100° C., the whole is found to have the mean of the two temperatures, or 50° C. On the other hand, 1 part by weight of *steam* at 100° C., when condensed in cold water, is found to be capable of raising 5.4 parts of the latter from the freezing point to the boiling point, or through a range of 100° C. Now, $100 \times 5.4 = 540$; that is to say, steam at 100° C. in becoming water at 100° C. parts with enough heat to raise a weight of water equal to its own (if it were possible) 540° of the Centigrade thermometer, or 540 times its own weight of water one degree of the same." When water passes into steam the same quantity of sensible heat becomes latent. A consideration of these facts in physics leads to the practical application of steam as a transmitter of heat, whereby heat from any source may be absorbed by steam and carried through suitable pipes to the vessel designed to be heated. If this vessel is filled with a cold liquid, the latent heat of the steam is rapidly communicated to the liquid, the steam is condensed, and the result is this most convenient and economical method of producing a temperature which is capable of being regulated with great exactness.

Steam Baths.—These may be divided into two classes: 1, those in which steam is used without pressure; 2, those in which steam is used under pressure.

1. *The Use of Steam without Pressure.*—In many cases open steam, as it is termed, is used (see Fig. 111). The pipe which conveys the steam from the boiler is conducted to the bottom of a hemispherical kettle, and the liquid to be heated is poured into a dish of larger diameter, which is placed upon the top; the steam is turned on, and as it condenses is carried off by the drip pipe. A temperature of about 100° C. (212° F.) can usually be maintained by this method.

Sometimes the steam pipe is conducted directly from the top into the liquid to be heated. A steam distributor, as shown in Fig. 112, may be used at the end of the pipe near the bottom of the kettle; it is made by screwing a cross upon the end of the pipe, and an elbow to each arm of the cross; the steam issues usually with some force from each elbow and effectually stirs up the liquid, and rapidly produces a uniform temperature in it. The principal disadvantages about using steam in this way are the noise at first produced by the contact of the hot steam with the cold liquid, and the increase in bulk of the liquid through the condensation of the steam.

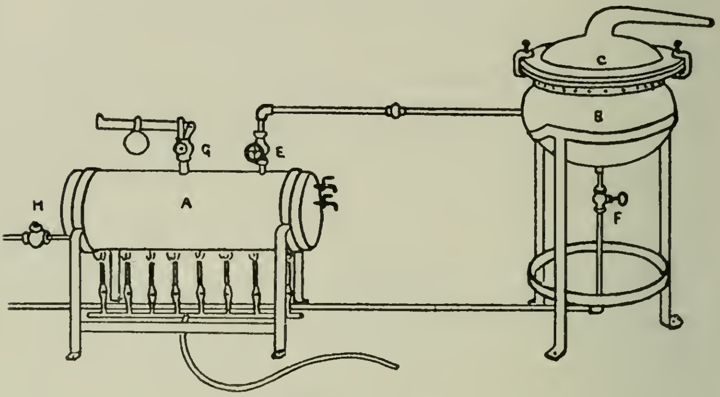
2. *The Use of Steam under Pressure.*—This is by far the most convenient method of using steam practically as a means of transmitting heat. It has been stated that steam produced in open and unconfined vessels, with the ordinary pressure of the atmosphere, has the temperature of 100° C. (212° F.). If water is heated continuously in a boiler capable of withstanding pressure, the water is prevented from boiling by the pressure of its own vapor, and the temperature of the steam rises in proportion as the pressure increases. It is usually stated that the pressure of the atmosphere is 14.7 pounds to the square inch. The following table shows the increase in temperature of steam when the pressure exceeds that of the atmosphere. Of course, the opposite effect is produced when the pressure is removed, and the water boils below the temperature of 100° C. (212° F.). (See vacuum apparatus.)

Table of the Temperatures of Superheated Steam

Pressure	Temperature of Steam		Pressure	Temperature of Steam	
Pounds per Square Inch	C.	F.	Pounds per Square Inch	C.	F
14.7	100°	212°	55	141.6°	287°
17	104.2°	219.6°	60	144.7°	292.7°
20	108.8°	228°	65	147.7°	298°
23	113°	235.4°	70	150.5°	302.9°
25	115.6°	240.1°	75	153°	307.4°
30	121.3°	250.4°	80	155.5°	312°
35	126.2°	259.3°	85	157.8°	316.1°
40	130.7°	267.3°	90	160°	320°
45	134.6°	274.4°	95	162.2°	324°
50	138.3°	281°	100	164.4°	327.9°

The principle of the use of steam under pressure is shown in the apparatus (see Fig. 113). It was designed by the author in 1872 to illustrate the subject practically upon the lecture table. A cylindrical copper boiler, A, supported by a stout iron stand, is heated by a row of six Bunsen burners; water is forced into the boiler from the hydrant through a rubber hose attached to the pipe connected with the check valve, H. The steam passes into the jacketed kettle, B, and is controlled by the steam valve, E, the exhaust steam and condensed water passing through the pipe controlled by the valve F. The safety valve, G, warns the operator by "blowing off" steam when the pressure has reached the highest point desired. C shows the dome which may be attached when a liquid is to be distilled.

Fig. 113

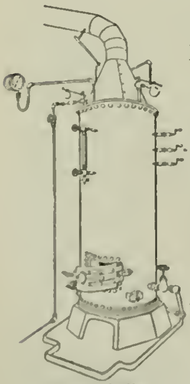


Use of steam under pressure

An upright tubular steam boiler, suited to operations in the pharmaceutical laboratory, and a sectional view of the same, are shown in Figs. 114 and 115.

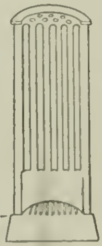
Prof. Patch contrived a very convenient upright tubular steel boiler. It is covered with asbestos composition, which acts as a non-conductor of heat, and the source of heat is a large coal oil stove; a conical coil of pipe serves to support a funnel when hot filtration is needed, while a safety valve and steam gauge assure safety. It is, of course, intended only for the laboratory of a retail druggist.

Fig. 114



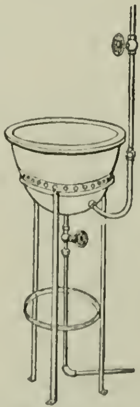
Steam boiler

Fig. 115



Sectional view

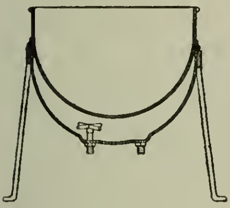
Fig. 116



Steam kettle

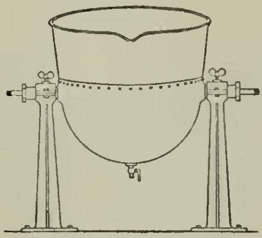
The usual form of steam kettle is shown in Fig. 116. A copper pan, tinned inside, having flaring sides to facilitate evaporation, is securely connected about midway from the bottom with another copper pan, both being riveted together. An opening for the steam pipe is made in the jacketed side to admit steam, and at the lowest point of the bottom another pipe is attached to carry off the water which is produced by the condensation of the steam. The upper edge of the kettle is protected by a flat brass ring, which is soldered and riveted to it, and which also serves to support the still top when the steam kettle is used for distillations. (See chapter on Distillation.) Care should be exercised to have the bottom of the kettle made of copper heavy enough to resist the greatest amount of steam pressure that will be likely to be used on it, as instances have been known of collapse when this was neglected. In using the steam kettle, the liquid that is to be heated is run into it by a syphon or other means; the drip or exhaust cock below is opened partially, and the steam slowly turned on. The habit of opening steam valves cautiously is one that should be sedulously cultivated, as accidents and strains to steam apparatus often arise from the sudden shocks due to want of care in this respect. While the liquid is becoming heated, the condensed water should be allowed to escape freely, and when the proper temperature is reached, the steam valve should be carefully adjusted and the exhaust valve turned so that, while all the condensed water may escape, no steam shall be allowed to go to waste by its being opened too widely. One of the greatest objections to the use of tinned copper kettles is that the coating of tin soon wears off, and the contamination of an evaporating liquid with copper is almost sure to result.

Fig. 117



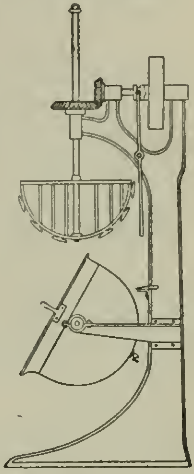
Steam kettle (sectional view)

Fig. 118



Steam kettle on trunnions

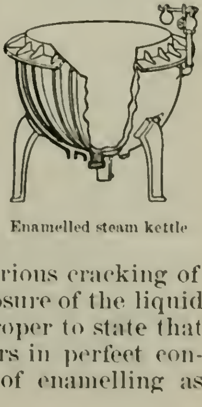
Fig. 119



Tilting steam kettle with stirrer

Fig. 117 represents a sectional view of a steam kettle, showing the space for steam and a four-arm, steam distributor with outlet. Fig. 118 shows a steam kettle mounted on trunnions. This form is very convenient when the operator wishes to pour out the contents. In the ordinary form of the kettle the contents have to be removed with a dipper. Fig. 119 shows a modern form of steam kettle with a stirring apparatus which is easily removed when not in use. The tilting kettle is very convenient.

Fig. 120

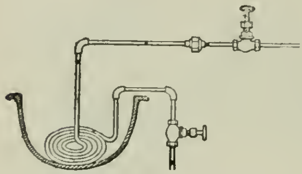


Enamelled steam kettle

The enamelled cast iron kettle shown in Fig. 120, is to be preferred on this account, although the injurious cracking of the enamel from overheating and the resulting exposure of the liquid to the iron surface beneath is an objection. It is proper to state that with care the enamel may often be retained for years in perfect condition. The great improvements in the process of enamelling as shown in modern bathtubs give promise of having pharmaceutical apparatus in the near future of excellent quality. Jacketed iron tanks lined with sheet block tin are very useful and durable, but their costliness is apt to prevent their extended use.

Pressure steam is frequently passed through coils of iron, block tin, or lead, which have been immersed in the liquid to be heated. Fig. 121 shows the usual form. It will be found very useful to the practical worker to use block tin pipe. Steam valves may be soldered to both ends of the pipe, and on account of the flexibility of the pipe it may be readily adjusted and coiled to suit available space, while the absence of danger from contamination when used for heating most medicinal liquids is an advantage which should not be overlooked. Steam, when passed through coils of various shapes, zigzag pipes, etc., is also largely used in heating liquids in special operations, in drying drugs, chemicals, etc. Figs. 122, 123, and 124 illustrate these forms. (See also chapter on Desiccation.)

Fig. 121



Kettle with steam coil

Fig. 122

Upright steam coil

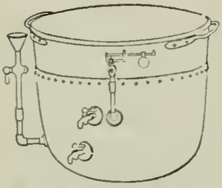
Fig. 123

Horizontal steam coil

Fig. 124

Zigzag steam coil

Fig. 125



Steam kettle for use over naked fire

Pressure Steam without the Use of a Boiler.—In Fig. 125 is shown a water bath jacketed kettle, which generates its own steam; it may be used over a gas burner, coal oil stove, or naked fire. Two gauge cocks indicate the quantity of water in the kettle, and the safety valve the amount of steam pressure; the funnel pipe is used for charging the kettle with water. The advantages of this kettle are apparent, the principal one being that it can be used by a pharmacist who desires to use steam heat without incurring the inconvenience and expense of installing a boiler in his store, laboratory, or cellar.

CHAPTER IV

VAPORIZATION

UNDER this head will be included those pharmaceutical operations in which volatile substances are separated from fixed bodies, or from others which are less volatile, by the action of heat at varying temperatures. Vaporization is frequently employed in pharmacy, and it will be most convenient to consider its applications in the order of their importance: 1. To Liquids. 2. To Solids.

1. When vaporization is used to separate a *volatile liquid* from a *less volatile* liquid, it is called *evaporation.*
2. When the object sought is the *volatile liquid,* it is called *distillation.*
3. When it is used to separate a *volatile liquid* from a *solid,* it is called *desiccation, exsiccation,* or *granulation.*
4. When it is used to separate a *volatile solid* from another body, it is called *sublimation.*

The following diagram may serve to impress the definitions on the memory:

Vaporization

Object Sought	Process
Liquids:	
Fixed or less volatile	Evaporation
Volatile	Distillation
Solids:	
Fixed	Desiccation Exsiccation Granulation
Volatile	Sublimation

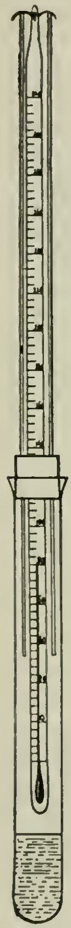
The subjects of Evaporation, Distillation, Sublimation, and Desiccation will be considered in the chapters which immediately follow. Vaporization, as applied to Granulation and Exsiccation, will be more appropriately considered after the chapters on Solution and Crystallization.

Evaporation

Although this term has in its more popular sense the signification of the separation of moisture from any body, whether solid or liquid, in pharmacy the word has a more restricted meaning, and signifies the driving off of the more volatile or less valuable portions of a liquid by the application of heat, with the object of purifying it or obtaining the less volatile portion. Illustrations are found in the concentration of syrups and liquids intended for crystallization, and in the treatment of weak tinctures in making fluidextracts and extracts.

As *ebullition,* or *boiling,* is an important form of evaporation, it will be necessary first to consider the essential points concerned therein. Ebullition in a heated liquid is caused by the formation of bubbles of vapor upon the surface of the vessel, which, rising to the surface of the liquid and bursting, permit the vapor to become diffused in the space above the boiling liquid. The *boiling point* of a liquid may be defined as the temperature at which the tension of its vapor is equal to the pressure of the atmosphere, this point being *definite,* while *evaporation* takes place in the same liquid at nearly all degrees of heat, and hence the *evaporating* point is an *indefinite* temperature. The point at which a liquid boils varies with the liquid.

Fig. 126



Boiling point test

The boiling point of a liquid is affected by the cohesion of the liquid and the degree of pressure upon its surface. Water under the ordinary pressure of the atmosphere boils at 100° C. (212° F.). When confined in a steam boiler it has been shown that water can have a temperature considerably over 200° C. (392° F.) without boiling, the bubbles being prevented from rising to the top on account of the pressure of the steam in the confined space above the liquid. On the other hand, the removal of pressure causes a liquid to boil below its normal boiling point.

Determination of Boiling Points.—One of the simplest methods of ascertaining the boiling point of a liquid is illustrated in the cut (see Fig. 126). The liquid is introduced into a test tube, and a glass tube is selected of such diameter as will permit a tube thermometer to pass easily through it and leave a small space between; the tube should be about one inch shorter than the thermometer. A short piece of wire should be passed through the glass ring of the thermometer, and slightly bent to hold it in position; a perforated cork should now be fitted tightly to the test tube, and the tube carrying the thermometer tube pushed through the perforation in the cork until the bulb of the thermometer is just above the liquid; heat should be applied cautiously by a sand bath or water bath. The vapor from the boiling liquid passes upward through the whole length of the thermometer, escaping at the top, and thus the error common to some methods, due to the difference in temperature between the portion of the thermometer in the test tube and that outside of the test tube, is measurably avoided. Boiling points are used as a means of determining the identity and purity of various substances, and the appended table gives the boiling points of substances according to the U. S. P. (8th Rev.).

Table of Boiling Points of Official Substances

Æthylis Chloridum	12.5°–13° C.	=	54.5°–55.4° F.
Æther	35.5° C.	=	96° F.
Benzinum	45°–60° C.	=	113°–140° F.
Carbonei Disulphidum	46°–47° C.	=	114.8°–116.6° F.
Acetonum	56°–57° C.	=	132.8°–134.6° F.
Chloroformum	60°–61° C.	=	140°–141.8° F.
Bromum . . . about	63° C.	=	145.4° F.
Spiritus Ætheris Nitrosi	65° C.	=	149° F.
Æther Aceticus	72°–77° C.	=	161.6°–170.6° F.
Alcohol	78° C.	=	172.4° F.
Aqua	**100° C.**	=	**212° F.**

Table of Boiling Points of Official Substances—*Continued*

Phenol Liquefactum	115°–188° C.	=	239°–370.4° F.
Acidum Aceticum Glaciale	117°–118° C.	=	242.6°–244° F.
Acidum Nitricum	120.5° C.	=	248.9° F.
Paraldehydum	121°–125° C.	=	249.8°–257° F.
Bromoformum	148° C.	=	298.4° F.
Oleum Sinapis Volatile	148°–152° C.	=	298.4°–305.6° F.
Oleum Terebinthinæ	155°–162° C.	=	311°–323.6° F.
Terebenum	160°–170° C.	=	320°–338° F.
Glycerinum (95 percent.)	165° C.	=	329° F.
Eucalyptol	176°–177° C.	=	348.8°–350.6° F.
Phenol	178°–182° C.	=	352.4°–359.6° F.
Benzaldehydum	179°–180° C.	=	354.2°–356° F.
Oleum Amygdalæ Amaræ	180° C.	=	356° F.
Acidum Trichloraceticum	195° C.	=	383° F.
Cresol (90 percent. should boil between)	195°–205° C.	=	383°–401° F.
Creosotum	200° C.	=	392° F.
Camphora	204° C.	=	399.2° F.
Guaiacol (liquid)	205° C.	=	401° F.
Menthol	212° C.	=	313.6° F.
Naphthalenum	218° C.	=	424.4° F.
Oleum Gaultheriæ	218°–221° C.	=	424.4°–429.8° F.
Methylis Salicylas	219°–221° C.	=	426.2°–429.8° F.
Safrolum	233° C.	=	451.4° F.
Cinnaldehydum	250° C.	=	482° F.
Eugenol	251°–253° C.	=	483.8°–487.4° F.
Camphora Monobromata	274° C.	=	525.2° F.
Resorcinol	276.5° C.	=	529.7° F.
Betanaphthol	286° C.	=	546.8° F.
Acetanilidum	295° C.	=	563° F.
Acidum Sulphuricum	338° C.	=	640.4° F.
Hydrargyrum	357.25° C.	=	675.05° F.
Sulphur Sublimatum	448° C.	=	838.4° F.
Zincum	940° C.	=	1724° F.

Tension of Vapors.—If a glass tube, thirty-six inches long, closed at one end, is filled with mercury, and the open end, after closing it with the finger, carefully inverted in a beaker containing mercury, it will be found that the mercury will run out from the tube into the beaker until a column of mercury about thirty inches in height is left. This column is sustained by the pressure of the atmosphere, and is, in fact, the well known mercurial barometer tube. The six inches of space in the tube above the level of the mercury is, of course, empty, or vacuous. Now, if a few drops of water are passed into the tube by a dropper, they immediately rise to the level of the mercury in the tube, and, although the temperature has not been increased, a portion of the water is vaporized, and the column of mercury is proportionately depressed. This depression is due to the elasticity or tension of the aqueous vapor. If the tube be forcibly pushed down into the mercury, the increased pressure will be found to have liquefied the vapor, and the original quantity of water is recovered; but the depression in the column of mercury may be increased by heat, and when a sufficient amount of heat has been applied to the tube to expel the mercury until none is left in the tube, it will be found that the temperature marks 100° C. (212° F.), which is exactly the boiling point of the liquid (water), showing that this point must be reached in order to overcome the pressure of the atmosphere. If alcohol or ether be substituted for water, it will be found that the mercury will be depressed in a far greater ratio,—this being due to the greater volatility and lower boiling point of these liquids. The *maximum density* of the vapor of a volatile liquid in a confined space in contact with the corresponding liquid is reached when its elastic force attains the limit beyond which pressure produces the liquefaction of the vapor. When this limit is reached, the vapor is said to be *saturated.* Maximum density varies with the temperature. If a saturated vapor in an enclosed tube is not in contact with an excess of liquid, increase of temperature lowers its density or expands it. On the other hand, when a saturated vapor is cooled, liquefaction gradually takes place, the vapor above the liquid remaining in the condition of maximum density until converted into the liquid. So that *cold* and *pressure* have the effect of *converting vapors into liquids*, while *heat* and the *removal of pressure* have the reverse effect,—*i.e.*, *the conversion of liquids into vapors.* The phenomena above described characterize evaporation into a space filled with air as well as evaporation into a vacuum, the only difference being that more time is required to produce the same effects when evaporating in contact with air, for volatile liquids are instantly converted into vapor in a vacuum, while the presence of air retards, but does not prevent, vaporization. A consideration of the foregoing facts leads to the following deductions :

1. The quantity of vapor that will form in a confined space depends upon the amount of pressure and heat to which the liquid is subjected, and when the point of maximum density of the vapor is reached, evaporation ceases if the pressure and temperature remain the same.

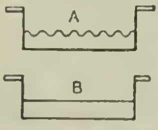
2. The rapidity of evaporation of an aqueous liquid in the open air is influenced by the condition of the aqueous vapor always present in the air. If it has the greatest density possible for the degree of heat, evaporation is retarded ; but if the aqueous vapor in the atmosphere is much below the state of maximum density, as is usually the case, evaporation is promoted.

3. Rapidity of evaporation is increased by removing the pressure of the atmosphere.

4. Increase of temperature obviously accelerates evaporation, by increasing the formation of vapor.

Evaporation of Liquids by Boiling.—In evaporating *by boiling*, temperature, pressure, etc., being equal, the rapidity of the process depends upon the *extent of surface exposed to the heat.* Fig. 127 represents a cross section of two evaporators, A and B. The corrugated bottom of A gives twice as much surface as the smooth bottom of B, and hence if the same quantity of a liquid is made to boil in each, at the same temperature, the bubbles of vapor given off from the corrugated bottom will be twice as numerous as those formed on the plain bottom. The superiority of tubular boilers over the ordinary plain or Cornish boiler also affords a good illustration of this fact (see Fig. 115).

Fig. 127



Evaporation by boiling

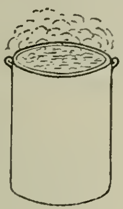
When a pure, volatile liquid is heated to the boiling point in the open air, its temperature remains the same until the whole of the liquid has evaporated. If, on the other hand, solid matter is dissolved in the liquid, the temperature of the solution is gradually increased until saturation is reached. This fact is well illustrated by considering boiling points of saturated solutions of various salts (see page 123), and it shows the importance of diminishing the heat in the evaporation of solutions of organic substances as evaporation progresses, as, for example, in the making of extracts, etc.

The cohesion of a liquid affects its boiling point, dense, thick, and sticky liquids offering more resistance to the escape of the bubbles of vapor than rare, mobile, or thin liquids.

The relative depth of liquid also influences the boiling point. Shallow vessels favor ebullition, because they afford proportionally less weight of liquid above the bottom of the dish for the bubbles to escape through than deep ones. Rough metallic surfaces favor evaporation by boiling, and are better than smooth surfaces, because they expose a greater amount of surface to the source of heat.

Fig. 128

Fig. 129



Evaporating below boiling point

Fig. 130

Porcelain evaporating dish

Fig. 131

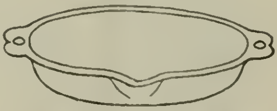
Glass evaporating dish

Evaporation below the Boiling Point.—In evaporating liquids *below their boiling point*, temperature, pressure, etc., being equal, rapidity of evaporation depends upon the *extent of surface exposed to the air*. Figs. 128 and 129 show two vessels of exactly the same diameter, but of different capacity, containing water. Both expose the same amount of surface to the air, but that of Fig. 129 contains eight times more liquid than that of Fig. 128.

If both be subjected to the same temperature, *provided it be below* 100° C. (212° F.), the water will evaporate as rapidly from one as from the other.

Proper Shape of Vessels for evaporating Liquids.—Broad, shallow vessels should be used for evaporating below the boiling point, because the extent of surface is proportionally greater in vessels of this shape. Fig. 130 is an illustration of a porcelain evaporating dish having the proper shape. The chief objection to dishes of this kind is their liability to breakage. Care should be taken to dry the bottom of the dish thoroughly before placing it over a gas flame. A glass evaporating dish is shown in Fig. 131. This should always be used in a sand bath, or should be otherwise protected from direct heat. Enamelled cast iron dishes are very useful, notwithstanding the lack of durability of the enamel. Enamelled sheet iron dishes, called "agate ware," are very light, and are much more lasting than the ordinary enamelled cast iron dishes (see Fig. 132).

Fig. 132



"Agate ware" evaporating dish

Use of Stirrers.—By stirring an evaporating liquid the surface is largely increased, while the currents of air produced at the same time greatly assist in dissipating the vapors which rise. Upon the small scale, porcelain, horn, or wooden stirrers are used (see Figs. 133 to 137), while mechanical stirrers are usually employed in the laboratory in more extensive operations (see Fig. 119). Fig. 138 also shows a rotary stirrer to be operated by steam power.

Vacuum Apparatus.—It has already been shown (page 125) that the boiling point of liquids is lowered by removing the pressure of the atmosphere. This fact is easily proved by placing under the receiver of an airpump some alcohol in a test glass containing a few pieces of broken glass, when, upon exhausting the receiver, many bubbles of vapor will rise from the surface, and the liquid will boil at the ordinary temperature. Water will boil at 84° C. (183.2° F.) upon the top of Mont Blanc, on account of the diminished pressure of the atmosphere.

Fig. 133

Porcelain stirrer

Fig. 134

Double stirrer

Fig. 135

Horn stirrer

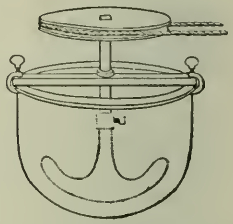
Fig. 136

Wooden stirrer

Fig. 137

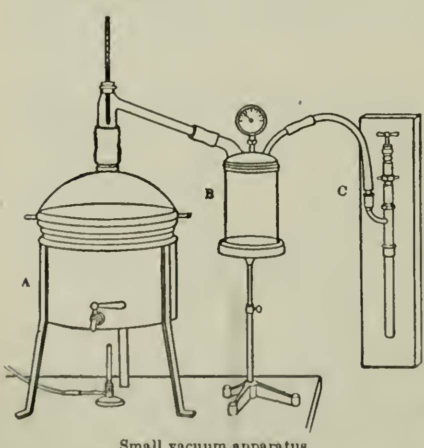
Bent horn stirrer

Fig. 138



Rotary stirrer

Fig. 139

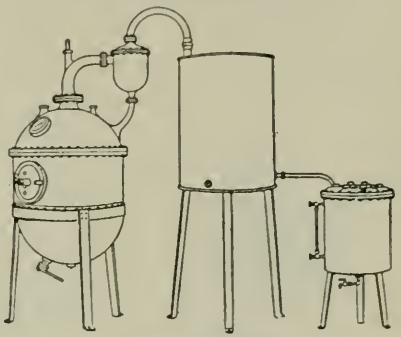


Small vacuum apparatus

The practical application of these principles is of great importance in pharmacy, and vacuum pans are frequently used in the larger laboratories for concentrating solutions which are injured by heat under the ordinary pressure of the atmosphere, and especially in evaporating solutions of organic substances, for these are almost without exception injured by heat.

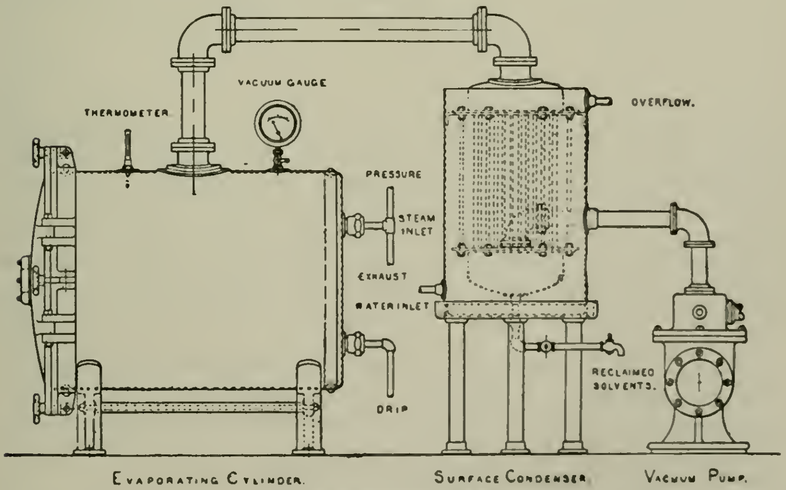
In Fig. 139 a vacuum apparatus is shown which illustrates the principle of this method of evaporation. The copper vessel, A, is used either as a steam or water bath; in this is placed a tinned copper or porcelain evaporating dish covered with a glass dome fitted with an airtight connection. A thermometer is adjusted at the top, and by means of the water pump, C, the air is exhausted ; the glass vessel, B, acts as a receiver. It is closed by a metallic lid, which is furnished with a vacuum gauge which indicates at all times the conditions, and enables the operator to increase or decrease the "vacuum." Fig. 140 shows a larger vacuum apparatus adapted for manufacturing laboratories. At the left is seen the jacketed copper still containing manhole, eyeglasses, aircock, and drain valve, connected with an overflow vessel to be used in case of the boiling over of the contents. The condenser is mounted on a tripod, and this is connected with the receiver, which is furnished with a water gauge, drain valve, and with inlets and outlets for the vacuum pump. The air is exhausted from the entire apparatus by attaching to the receiving vessel the pipe from the pump. With the aid of this apparatus, alcohol may be recovered directly from an exhausted drug by emptying the contents of a percolator into the still. Vacuum pumps operated by steam are to be found in all well equipped pharmaceutical laboratories, and pipes and attachments are just as easily connected with various forms of apparatus as are the pipes used for conveying steam under pressure (see gelatin coated pill apparatus in Part V).

Fig. 140



Vacuum apparatus

Fig. 141

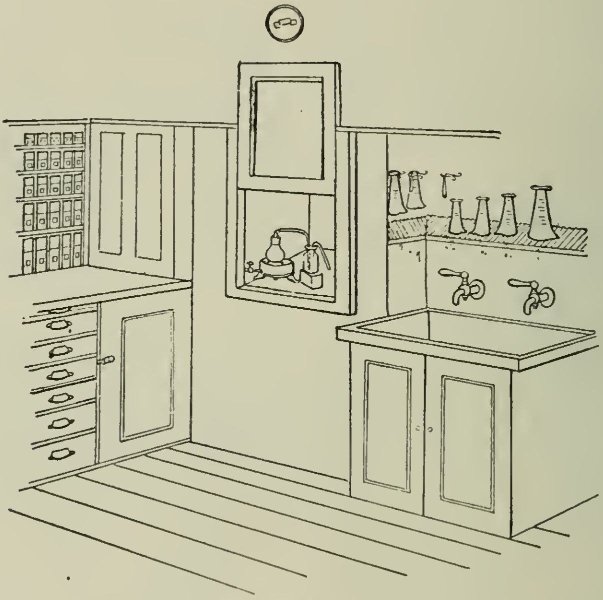


Vacuum apparatus (Stokes)

The F. J. Stokes Machine Company, of Philadelphia, have perfected a vacuum drying apparatus of much value. Fig. 141 shows in detail their application of the vacuum applied to drying substances which are moist ; the vapors may be condensed and reclaimed by the use of the condenser. These vapors may sometimes be injurious or undesirable if allowed to escape into the laboratory, and hence this plan of disposing of them is effective; the condenser may be disconnected, if found advantageous. Substances which require days to dry in heated rooms can be dried in several hours with this apparatus.

It frequently happens that the pharmacist is unable to devote much space to laboratory operations. This is particularly the case in cities or large towns, where rents are high. When pharmaceutical operations must be conducted in the store, an absolutely indispensable convenience is an *evaporating chamber* (see Fig. 142). If the arrangement of the store will admit of it, this should be built into a chimney breast. The bottom of the chamber is preferably made of a slate slab, which should have a slight inclination toward the front, and be large enough to project about two inches over the closet upon which it rests, for the purpose of preventing a liquid, spilled by accident, from running into the closet and soiling the contents. The chamber should have a gas pipe in it, and the upper part should connect, by a flue in which there is a damper, with a chimney having a good draught. A wooden or galvanized iron front having a pane of glass fitting tightly in it will prevent vapors or odors from getting into the store. The space below may be utilized as a closet for evaporating dishes, gas stoves, etc.

Fig. 142

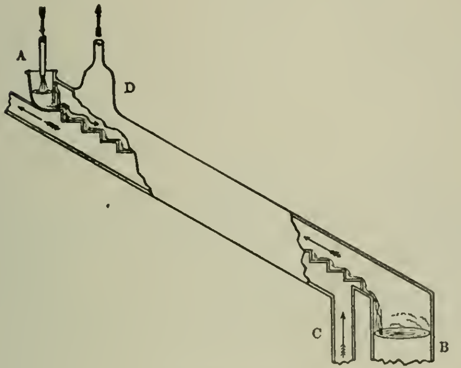


Evaporating chamber

Economical Surface Evaporation.—In large industries where economy in operating is an essential factor, various forms of apparatus must be constructed to meet this need. In Fig. 143 is shown a method of concentrating sulphuric acid, whereby the hot gases from the furnace are utilized as the source of heat. The liquid enters at A, and flows down in a thin stream over a cascade or series of steps, the vapors arising find an outlet at D, the evaporated liquid is collected in a reservoir, B, while the waste heat passes upward in the direction of the arrows through the pipe C.

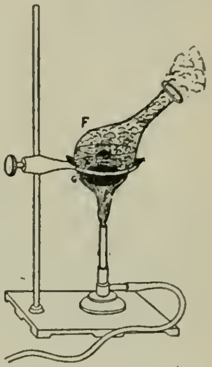
Spontaneous Evaporation.—By this term is meant the evaporation of a liquid at the ordinary temperature of the atmosphere, or without the application of strong, direct heat. It is used in cases where the residue or less volatile liquid is liable to injury or loss by the application of much heat, or in crystallization, where, by the slow vaporization of the volatile liquid, finely formed crystals may be secured, and in other less important operations. Spontaneous evaporation is usually conducted in drying rooms or closets when they are accessible; these, as will be subsequently described, are rooms or closets which are very slightly heated by the use of exhaust steam or other means; or this form of evaporation may be used by placing the liquid in shallow dishes or trays and exposing the surface to the rays of the sun during fine weather. Upon the small scale, one of the most convenient methods is to support the dish upon a wire tripod placed upon a stove, at a sufficient distance above the top of the stove to avoid injury, or if heated air from a furnace is available, it can be utilized by supporting the dish, properly protected, over the register; the upward current of dry heated air greatly assists in promoting the evaporation.

Fig. 143



Surface evaporation

Fig. 144

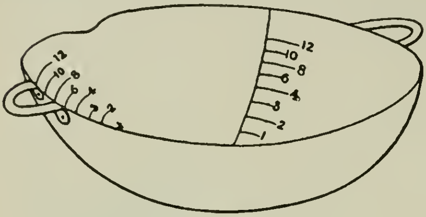


Flask evaporation

Evaporation by Direct Heat.—This method usually requires the greatest amount of care in order to avoid loss or injury by overheating. It is to be preferred, therefore, only in cases where the residue is not easily injured by such an accident. The evaporation of saline solutions in crystallization, or of weak aqueous organic solutions, may usually be performed by the application of direct heat. Careful watching, however, is necessary, and also frequent stirring, to prevent the formation of a crust upon the bottom. Fig. 144 shows a method of evaporating by direct heat by using a flask, F, supported on a piece of brass wire gauze, G, upon a retort stand.

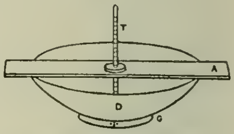
Evaporation to a Fixed Volume.—This operation cannot be performed accurately without inconvenience, and hence it is much more satisfactory to evaporate a liquid to a definite weight,—all that is necessary in the latter case being to use a tared dish, and weigh the dish and contents when evaporation has progressed to the desired point.

Fig. 145



Graduated evaporating dish

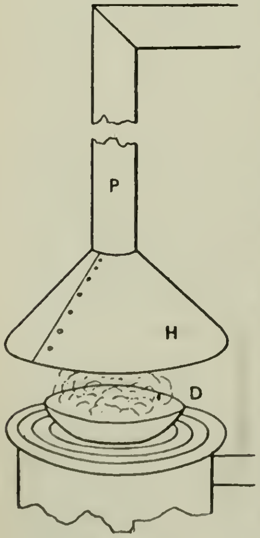
Fig. 146



Measuring evaporation

In evaporation to a definite measure, a graduated evaporating dish (see Fig. 145) may be employed, care being taken to level it by noticing that the height of the liquid is the same on each side, or the expedient illustrated in Fig. 146 may be resorted to. An ordinary evaporating dish, D, is placed upon a grommet, G (see page 139), and subjected to the heat (in this case the temperature is intended to be that of a warm room); a perforated wooden strip, A, is placed across the dish, and a glass thermometer, T, is supported in an upright position in the liquid by a perforated cork. Sufficient water is poured into the dish to equal the final measure of the liquid, and a small rubber band is slipped on the thermometer (or a piece of string tied on) to indicate the desired level of the liquid; the water is replaced by the liquid to be evaporated, and evaporation proceeded with until the liquid has been lowered to the mark on the thermometer. When the use of the thermometer is unnecessary, a notched stick may be substituted. In order to arrive at results approaching accuracy by these methods, the liquid must be allowed to cool to the temperature of the water which was used as the measure of the liquid in the beginning.

Fig. 147



Hood

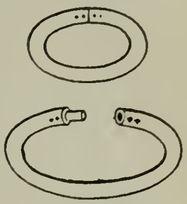
Use of Hoods.—A hood is a contrivance, usually of a conical shape, intended to collect and dispose of vapors which, from their disagreeable odors or their suffocating effects, render the atmosphere of the store or laboratory unwholesome. Fig. 147 shows a form of hood which has been found useful upon the small scale. It is made of galvanized iron, and connects by galvanized stove pipe with the strong draught of a good chimney; the stove pipe running horizontally to the chimney should have a damper in it. If any condensation of the vapors takes place in the stove pipe, the larger diameter of the circular hood will cause the drops of liquid to fall outside of the evaporating dish, and thus contamination of the contents of the dish is avoided. Hoods are usually made of wood when intended for operations upon the large scale. Fig. 148 illustrates the method of using a hood when the dish is placed upon a stove.

Fig. 148

Stove hood

Use of Grommets.—One of the inconveniences in using round bottomed evaporating dishes is due to the shape of the bottom, serious loss often occurring from the tilting of the dish and spilling of the contents. To obviate this, *grommets* should be used. These may be economically made from a cast off piece of rubber hose or tubing by bending it into a circle, placing a wooden plug in one end, tacking it securely, and inserting it in the other end and fastening it in the same manner (see Fig. 149). An elastic ring is thus formed, upon which an evaporating dish or round bottomed vessel may be safely placed. Grommets serve another very important purpose, that of preventing the fracture of a porcelain or glass dish containing a hot liquid, by being placed between the hot dish and the cold surface of a table or floor.

Fig. 149



Grommets

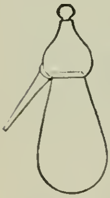
CHAPTER V

DISTILLATION

THE first part of the process of *distillation* is identical with that of evaporation, for it is simply the *vaporization* of the volatile liquid through the application of heat. The next step is distinctive and opposite, and consists in the conversion of this vapor into a liquid by the application of cold. This part of the process is called *condensation.* The elements of distillation are: 1, vaporization, and, 2, condensation. The subject of vaporization was treated of in the preceding chapter. We have now to consider condensation.

Condensation.—It has been already shown (page 124) that when a *liquid* is *vaporized* a certain amount of heat disappears or is rendered latent, and when a *vapor* is *liquefied* a corresponding degree of heat is evolved or reappears. While the practical application of this law is of great service in the use of steam for heating purposes, the opposite process of condensation shows its disadvantages, because of the relatively large quantity of cold water necessary to convert vapors into liquids. The greater the difference in temperature between the condensing surface and the vapor, the more rapid is the condensation; and it has been computed that steam at 100° C. (212° F.) requires about twenty-five times its weight of water at 20° C. (68° F.) to condense it. The proper relation between the heating and condensing surfaces of apparatus used in distillation can only be known by careful study of the laws governing vaporization and condensation, or by practical experience.

FIG. 151

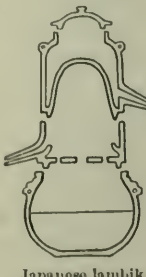


Alembic

Apparatus used in Distillation.—In considering the many kinds of apparatus used in distillation, two typical forms are presented: 1, the *alembic form*, in which the vapor is condensed in an enclosed space immediately above the heated liquid, and, 2, the *retort* form, in which the vapor is condensed in a vessel placed at one side of that containing the heated liquid, and connected with it by a suitable tube or pipe.

The Alembic.—This is probably the most ancient kind of distillatory apparatus, and in its original form it is now rarely employed. The *body*, or *cucurbit*, is usually globular or oval in shape, and at its junction with the hemispherical *head* or *dome* there is a gutter or groove. This serves to collect the condensed vapor or distillate, which is carried off by a tube, as shown in the illustration (see Fig. 151).

FIG. 152



Japanese lambik

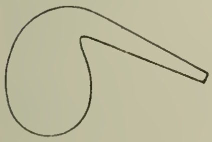
Fig. 152 shows an alembic which, according to Mr. Brady, of Newcastle, England, is still frequently employed in Japan. Into the boiler is fitted a short cylinder. This has a perforated bottom, and the gutter communicates with the spout ; the condenser has a cover, and is also furnished with a spout for carrying off the water used in cooling the dome after it has been heated by the vapors rising from the boiling liquid in the body. This still, or, as it is called by the Japanese, *lambik*, is shown because it represents the alembic probably in one of its best practical forms, and the advantages possessed by this kind of distilling apparatus are seen to be compactness and simplicity. It is, however, not fitted for distilling very volatile liquids, is very inconvenient and troublesome, because of the necessity for constantly replacing the water used in the condenser, and distillation is slow and tedious.

The Retort.—This form of distillatory apparatus has many advantages over the alembic, which it has almost entirely replaced. A retort, in its simplest form, may be described as a long necked glass flask in which the neck, after being heated thoroughly, is bent over until its axis makes an acute angle with that of the bowl of the flask. Retorts are of two kinds,—plain and tubulated. A *plain* retort is shown in Fig. 153. If it has a *tubulure* or orifice at the top of the bowl for the purpose of introducing the liquid to be distilled, it is said to be *tubulated* (see Fig. 154). Retorts are made of glass, porcelain, earthenware, platinum, iron, lead, etc., according to the purposes for which they are designed.

Porcelain and earthenware retorts are used in the distillation of phosphorus, mercury, etc. ; platinum and iron retorts, in destructive distillation ; leaden retorts, in making hydrofluoric acid, ether, etc.

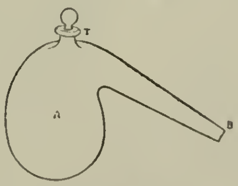
The glass retort is the only kind, however, which will be considered here in detail. The shape of a retort is an important point to regard in its selection. Retorts having deep bowls are best suited for very volatile liquids. The lower surface of the neck of the retort should form a decidedly acute angle with the surface of the bowl if tubulated ; a line drawn from the centre of the stopper should touch the centre of the bowl, A, so that when a funnel is introduced into the tubulure, T, to charge the retort, the contents may all be delivered into the bowl without soiling or splashing the neck. The neck of the retort should gradually taper to the end, and the beak, B, should never be larger in diameter than any other portion of the neck, otherwise difficulty may be experienced in making joints with adapters, receivers, or condensers (see Fig. 180). Such a fault may prevent the use of a cork ring in joining, for this ring should be made tight by forcing it up the gradually increasing diameter of the neck. The

Fig. 153



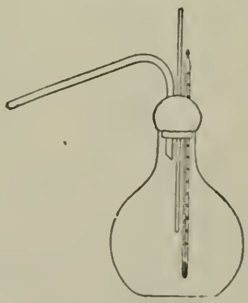
Plain retort

Fig. 154



Tubulated retort

Fig. 155



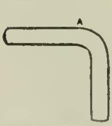
Distilling flask

glass forming the retort should be carefully annealed and have a uniform thickness. Extremes should be carefully guarded against. If the glass be too thick, the sudden changes in temperature, to which retorts are constantly subjected in distillation, may cause fracture; on the other hand, if too thin, they are easily broken in cleaning. Scratches and imperfections in the bowl should cause retorts to be rejected.[1] The objections to the use of retorts are mainly due to their peculiar shape, the principal one being the difficulty of cleaning them thoroughly. The necessity for having a variety of different shapes and sizes to suit special operations is greater than when distillation is performed with flasks and bent tubes.

Flask distillation will be usually found most practicable for pharmaceutical work. The best shape for a flask is shown in Fig. 155. The bowl should have a flat bottom, so that it will stand unsupported; the neck should be wide, to admit a large cork, so that there will be plenty of room for a wide bent tube, a thermometer, and a safety or charging tube. The advantages of using a flask instead of a retort for all distillations that will allow of it are several: it is easily cleaned, it is useful for other purposes, for instance as a measure, as a container, or as a receiver for the distillate; the tubes are readily replaced in case of breakage. One of the most important parts of this apparatus is the bent tube for conducting the vapor to the receiver or condenser. The diameter of the bent tube should be as large as the receiver or condenser will conveniently accommodate.

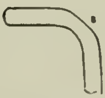
Cutting Glass Tubes.—The glass should be moderately thick and of the proper length. A glass tube may be broken neatly by scratching it across with a sharp three-cornered file, and then grasping it with both hands, one on each side of the scratch, and making a slight outward pressure, which will generally produce a clean fracture. By holding the sharp edges for a few moments in the flame the corners may be rounded so that they will pass through a cork without cutting it and making a ragged edge.

FIG. 156



Tube properly bent

FIG. 157



Tube unequally heated

FIG. 158

Tube hastily bent

Bending Glass Tubes.—A tube may be bent by heating it properly over a gas flame. To make a symmetrical curve in a tube of large diameter requires considerable skill and practice. One end of the tube should be closed by a cork, and the part of the tube that is to be bent held just above the flame and gradually rotated between the fingers, so that it may be heated evenly throughout. It should also be passed to the right and left through the flame for the space of an inch or two on each side of the middle of the proposed bend, and very slowly allowed to curve in one direction, so that the bend shall not be too abrupt. The object of closing one end with a cork is to prevent a current of air from passing through, and, in case collapse from overheating occurs, by gently blowing in the tube the softened

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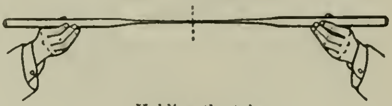
[1] Although there is no disposition on the part of the author to weaken the force of this conventional advice, the possession of a retort having a large bubble in the bottom of the bowl, which was in successful use for ten years and has outlasted many of its more perfect fellows, supplies the needed exception.

glass may be swelled to its proper curve. Fig. 156 shows a tube properly bent, while Figs. 157 and 158 illustrate some of the defects produced by unskilled work. In Fig. 157 the tube was not rotated evenly, and at the top of the bend, B, it was hot enough to collapse. Fig. 158 represents the effects of hurry and unequal heating, the operator having forced the bend, C, before the tube was heated uniformly. A gas burner having a solid, steady flame is the best kind to use (see Fig. 73), and draughts of air should be avoided.

Fig. 159



Holding the tube

In Fig. 159 the method of holding a tube while "drawing it out" over the flame to make a tapering tube is shown. The line in the centre shows the proper place to scratch it when cold with a fine, sharp, triangular file when it is to be broken apart; by holding the edge in the flame for a moment the sharpness may be rounded off. Fig. 160 shows a "well drawn" tube; Fig. 161, one which has not been revolved evenly or heated uniformly. Fig. 162 shows the same fault and careless work besides.

Cork Fitting.—Corks for joining apparatus should be of *the best quality.* They are perforated for the passage of the glass tubes by the use of cork borers (see Fig. 163). These are cylindrical brass tubes of various sizes, sharpened at one end, and surmounted by a milled brass cap. They are furnished in sets. A small hole is drilled through both sides of the brass cap, so that an iron rod may pass directly through it and form a convenient handle. They are used by holding the cork firmly with the left hand and pushing the borer through with the right hand, using a twisting motion at the same time so as to cut a smooth round hole. The mistake frequently made in using cork borers is due to "hurry." The attempt to force the borer through quickly without rotating it sufficiently always ends in breaking off pieces of the cork. The cork borer shown in Fig. 164 is more convenient for larger corks, and may be made from a piece of steel bicycle tubing, the tool handle, I, being large enough to give the operator a firm grasp, so that the cork may be readily bored. The cutting edge of the borers should always be kept sharp and in good condition by the use of the grindstone or emery paper. When the cutters do not bore a hole of the exact size needed for the glass

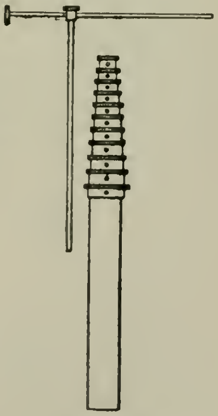
Fig. 160

Fig. 161

Fig. 162

Tubes, properly and improperly drawn

Fig. 163



Cork borers

tube, which of course should fit tightly, it is best to select a borer which will cut a smaller hole than that desired, and then to enlarge the hole by filing with a rat tail file (Fig. 165), or, if the hole is large, with a half round file. When the tubes have been fitted, the cork should usually be thoroughly soaked in hot water, for the purpose of swelling and softening it. It should never be soaked before cutting or filing. The rasp and file shown in Fig. 166 will be useful in fitting up large flasks. Rubber corks can often be used with great advantage, and they may be readily perforated by dipping the cork borer in solution of sodium or potassium hydroxide or strong ammonia water before beginning to use it. If rubber corks are well dried by wiping them thoroughly, they may be filed easily with a new, sharp, flat file. The main advantage of rubber corks is that they are practically impervious to vapors or gases, and hence require no luting. Substitutes for rubber corks may be made by keeping dry corks in melted paraffin or wax until the pores are thoroughly filled, and then cooling.

FIG. 164

Cork borer (large size)

FIG. 165

Rat tail file

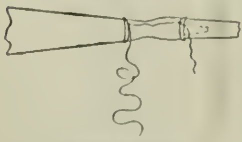
FIG. 166

Rasp and file

Lutes.—The most satisfactory lute for ordinary distillations is made by adding flaxseed meal to *boiling water* and stirring until a thick, sticky mass results. When the perforated and soaked cork containing the tubes is inserted in the neck of the flask, a small quantity of lute should be pressed into the joints, and then followed by sufficient to make the joint vapor tight, the quantity varying with the quality of the cork and the character of the vapor that is to be excluded. If future trouble from leaking is to be avoided, it is usually better to throw away a cork which will not make an almost perfect joint without lute, rather than trust to cover up serious deficiencies with lute. A neat finish may be given to the joint by dipping a finger into water, and with it smoothing the surface of the lute. In Fig. 155 the cork is shown perforated and mounted, luted and in position.

FIG. 167

FIG. 168



Bladder joints

Bladder Joints.—One of the most useful substances to the practical pharmacist who has occasion to join tubes is a strip of moistened bladder. Hogs' bladders are usually preferred, and it is now possible to get them of excellent quality prepared by being thoroughly cleaned and then soaked in an alkaline solution or in petroleum benzin to deprive them entirely of fat. In connecting two tubes of different diameters which are not to be subjected to a high heat, a bladder joint is especially useful. For an ordinary joint of inch glass tube, a strip about six inches long and an inch and a half wide should be moistened and wrapped around the proposed joint; the upper end of the bladder is then tied tightly with strong linen twine, leaving the short end of the twine at least six inches long (see Fig. 168);

this end is carried along the top of the bladder and tied tightly around the lower end of the joint; the long end of the twine is then wrapped spirally and regularly around the bladder until the lower end is reached, when it should be there tied tightly (see Fig. 167). Strips of writing paper soaked for a few moments in water, and then coated with ordinary, smooth flour paste to which 10 percent. of glycerin has been added, may also be used for joining apparatus.

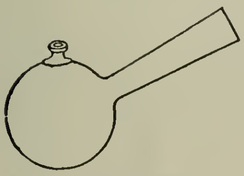
Rubber joints are preferred to bladder joints when there is no likelihood of vapor or high heat dissolving or softening the rubber, and when the tubes to be joined are nearly of the same diameter. The ease and celerity with which such joints can be made are their strong points. A piece of rubber tubing is cut of slightly less diameter than that of the tubes to be joined; by moistening the rubber on the inside with water, and stretching it over one end of the glass tube, and then inserting the end of the other glass tube, the joint is made. Success largely depends upon having the rubber tube slightly smaller in diameter than the glass tube, so that the elasticity of the rubber alone will be sufficient to make a tight joint, otherwise the rubber tube must be tied on, and then the advantage over a bladder joint is lost (see Fig. 169). In all cases it is preferable to select tubes which differ slightly in diameter, so that one may slip into the other, the narrower, of course, having the higher position, so that the vapor or liquid shall not come in direct contact with the rubber.

FIG. 169

Rubber joint

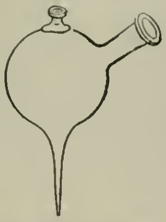
Receivers are glass vessels, usually globular in shape, intended to receive distillates. They are of three kinds,—*plain*, *tubulated*, and *quilled* (see Figs. 170 and 171). When a plain receiver is required, an ordinary flask (see Fig. 172) will answer, but if uncondensable vapors are produced, it is necessary to provide for their escape, or an explosion may occur from the accumulated pressure. This may be done in a tubulated receiver by occasionally removing the stopper, or, better, by connecting a bent glass tube with the receiver and allowing the end of the tube to dip into water, or into an acid solution if the vapors be alkaline, or into an alkaline solution if the vapors be acid. A quilled receiver is useful where the distillation is to be carried to a definite point and a certain amount of distillate is to be received, or, as in the preparation of hydrocyanic acid, the end of the quill is made to dip below the surface of cooled diluted alcohol or water, in order to condense all of the gas. In the distilla-

FIG. 170



Tubulated receiver

FIG. 171



Tubulated and quilled receiver

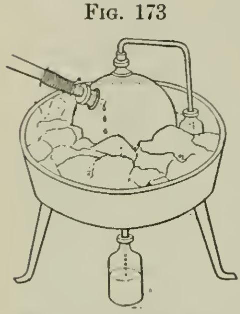
FIG. 172

Plain receiver

tion of very volatile liquids an effective mode of using a quilled receiver is shown in Fig. 173. A hole is cut in the bottom of a rather shallow tin pan and a short tube soldered into it; a perforated cork will permit the quill of the receiver to pass through it, and at the same time a tight joint should be made; ice or snow is heaped up over the receiver, and any uncondensable gases may escape from the bent tube in the tubulure or be absorbed by the liquid into which the tube dips.

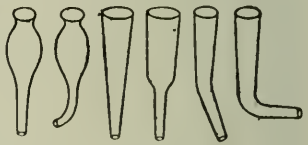
Adapters are tapering tubes of glass which are used to connect retorts with receivers. Figs. 174, 175, 176, 177, 178, and 179 show the various shapes. Good adapters may be made from retorts having broken bulbs by cutting off the broken portion, scratching the tube with a file, and extending the crack thus made entirely around it by slowly passing a red hot poker over the line marked for the fracture. Fig. 180 shows an adapter of this kind in position. Adapters are also employed to deliver the distillate from Liebig condensers into receivers or flasks.

Fig. 173



Mode of using quilled receiver

Fig. 174 Fig. 175 Fig. 176 Fig. 177 Fig. 178 Fig. 179



Adapters

Charging Retorts.—Plain retorts must be charged by using a funnel tube; this may be a funnel with an elongated tube, or a modification of it, as shown in Figs. 181, 182, and 183, or one may be improvised by selecting a tube of sufficient diameter to permit of the introduction of a small funnel (see Fig. 184). The object of using a funnel tube is to prevent the soiling of the neck of the retort; as the object of distillation is usually to purify the liquid, the latter must be delivered into the bowl of the retort without touching the neck. Fig. 185 shows the method of charging a plain retort; a small piece of rubber tube is sometimes

Fig. 181

Stoppered funnel tube

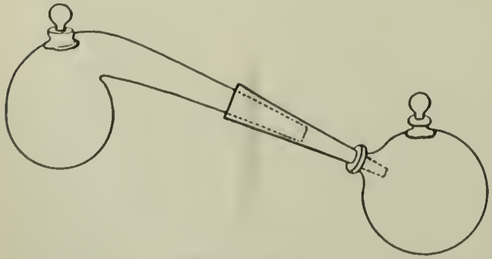
Fig. 182

Funnel tube

Fig. 183

Thistle top funnel tube

Fig. 180



Use of adapter

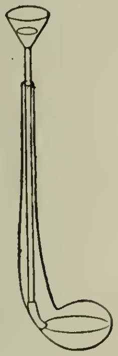
placed on the end of the funnel tube to guide the liquid safely and guard against fracture. Tubulated retorts are charged by simply placing a funnel in the tubulure and pouring the liquid through it.

Safety Tubes.—It is sometimes impossible to avoid sudden evolutions of vapor during distillations. When there is a likelihood of such occurring, it is advisable to insert a Welter's safety tube into the tubulure of the retort. This tube (see Fig. 186) is bent into the form of an S, having a bulb blown in the middle, and a thistle funnel at the top. Mercury is poured into the tube before inserting it into the tubulure of the retort, and a piece of loose cotton is placed in the thistle funnel; when undue pressure occurs, the mercury is forced into the cotton and the vapor escapes; when the retort has been thus relieved, the mercury descends into the bulb and the distillation proceeds.

Fig. 184

Improvised funnel tube

Fig. 185

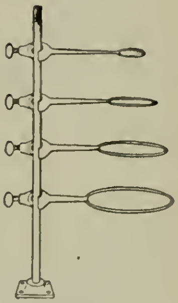


Charging a plain retort

Fig. 186

Welter's safety tube

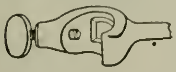
Fig. 187



Retort stand

Retort stands are used to properly support retorts, flasks, receivers, etc., during distillation, although they are also employed by pharmacists for a variety of other purposes, as in filtration, percolation, evaporation, etc. Fig. 187 shows a retort stand which has been used with much satisfaction in the laboratory of the Philadelphia College of Pharmacy. It is more substantial than those that are commonly furnished by the chemical apparatus makers. The clamp (see Fig. 188) is made upon the principle of one originally devised by S. Floyd Wiegand, and is hook shaped, so that any of the different sizes of rings may be unscrewed from the upright rod without disturbing the rest. In many of the common retort stands the bottom ring cannot be removed without first slipping off all above it. Fig. 189 shows

Fig. 188

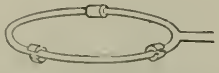


Retort ring clamp

Fig. 189

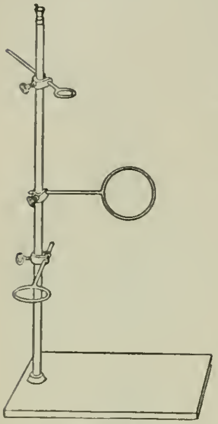
Retort ring

Fig. 190



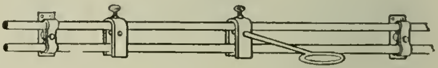
Ring with split sections of rubber tubing the ordinary retort ring. The almost universal fault of the retort stands in common use is their extreme lightness and want of stability; the rings frequently bend under such weights as should be easily borne, and, owing to the base being too light and small, the whole stand is sometimes upset during an operation. In the stand shown in Fig. 187 the base plate is permanently fastened to the operating counter in a place known to be the most convenient; if the counter is one that must be used for other purposes, the base plate may be screwed to the under side of the counter, and a five-eighths inch hole bored through the counter, so that the centre shall coincide with the centre of the hole in the base plate. When the retort stand is not in use, the hole in the counter may be closed with a cork. The upright is made of half-inch iron tubing, and can be quickly screwed into the base plate with the hands without the use of pipe tongs. The rings and clamps are all in one piece, and are made of malleable iron, so that if dropped on the floor they are not likely to break. When used for holding a glass percolator or funnel, the danger of fracture on account of the contraction of the iron ring may be avoided by stretching three split sections of rubber tubing upon it (see Fig. 190).

Fig. 191



Apparatus stand

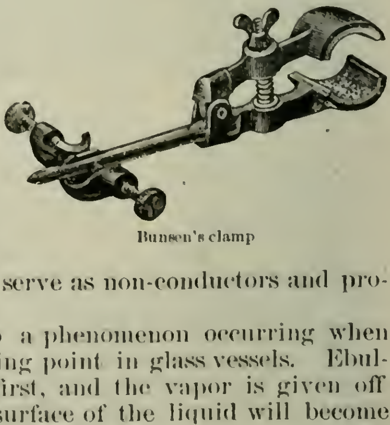
Fig. 192



Apparatus stand (horizontal)

An apparatus stand designed by J. Percy Remington is shown in Fig. 191; the clamp is simple and effective; it is U shaped and perforated so as to permit the passage of the rod of the ring freely; the thumb screw is depended upon to firmly fasten the ring upon the upright rod, and the clamping device permits the ring to be placed in any position, pushed in or out, or turned, so that, as often happens in adjusting retorts, flasks, funnels, or percolators, if some slight change in the position of the ring is required, it can be made easily. Fig. 192 shows how the apparatus can be used for a horizontal attachment to be fastened on the wall. Fig. 193 illustrates Bunsen's clamp, which is very useful for holding condensers, retorts, etc.; the jaws of the clamp are lined with cork to serve as non-conductors and protectors against fracture.

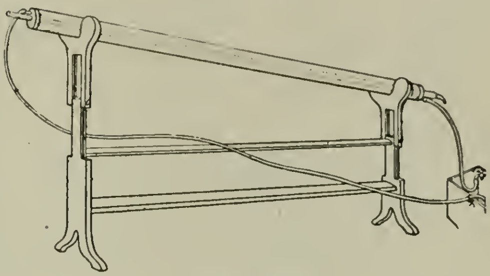
Fig. 193



Bunsen's clamp

Bumping is the term applied to a phenomenon occurring when certain liquids are heated to a boiling point in glass vessels. Ebullition often proceeds regularly at first, and the vapor is given off continuously, when suddenly the surface of the liquid will become smooth for a few seconds. This is succeeded by a slight explosion, when the accumulated vapor is violently expelled and the liquid is said to "bump." These effects occur alternately, and increase as distillation progresses, and some liquids, particularly sulphuric acid, cannot be distilled in glass vessels without using certain precautions. The exact cause of bumping has not yet been satisfactorily explained, but the fact that the forces of cohesion and adhesion in certain liquids are greater when they are boiled in glass vessels than in metallic vessels has been proved. The expedients that have been used to prevent bumping, or rather to lessen its effects, usually consist in the addition of some insoluble solid substance to the liquid, such as broken glass, a fragment of charcoal (when admissible), pieces of clay pipe, rock crystal, etc. ; these serve to break the explosive force of the vapor in its upward course, and are thus serviceable. Probably as good an expedient to use as any in pharmaceutical operations, is to add a few pieces of glass of irregular shape to the liquid before it is heated.

Fig. 194

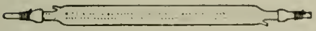


Liebig condenser

Liebig Condenser

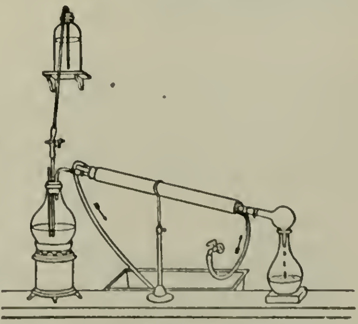
This condenser, although now bearing the name of the great chemist, was used before his time. It consists of a long glass tube, surrounded by another tube of larger diameter ; two small openings are made, one near the bottom and the other near the top of the large tube. Connection is made with the tube leading to the bottom with a cold water supply, and the water circulates in the space between the inside of the large tube and the outside of the smaller tube, and finally has its exit at the opening near the top. Fig. 194 shows a large condenser of this form, well suited for illustrating the process of condensation practically. Both tubes are of glass, the ends being of rubber, and made by cutting two sections from a clothes wringer roller ; the lowest rubber cork is perforated at its lowest convenient point, for the introduction of a short piece of glass tubing, and the upper rubber cork is similarly perforated for the same purpose. A rubber tube connects the lower

Fig. 195



Liebig condenser (all glass, rubber joints)

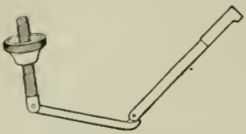
Fig. 196



Liebig condenser in use

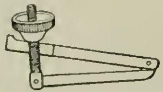
short glass tube with the cold water supply, while another rubber tube, connected with the upper short tube, carries off the warmed water. For smaller condensers the form shown in Fig. 195 answers very well ; the outer glass tube is contracted at the ends and supplied with short tubes as shown, a rubber tube or bladder joint being used to make the joint between the condenser tube and the outer tube. This form is recommended in preference to the kind frequently sold, in which a long and thin glass tube, designed to supply the cold water, is joined to the large tube at right angles. This glass tube is very easily broken off, and the condenser is then useless. If the outer case is of sheet copper and the tubes metallic, this objection is overcome, although the great advantage of using glass tubes, that of being able to watch the process of condensation and of regulating the heat accordingly, is then lost. Fig. 196 shows a glass Liebig condenser in operation, and in addition the method of using a glass tubulated receiver, with a flask to collect the distillate. The liquid which is being distilled is gradually supplied to the distilling flask by the feed tube from the contents of the bottle on the shelf. The rate of flow is controlled by a pinchcock compressing the rubber tube. An enlarged view of the best form of pinchcock to use for this purpose is shown in Figs. 197 and 198. It was contrived by Dr. Squibb to overcome the annoyances experienced in using the ordinary forms. It can be easily and quickly applied to or removed from a rubber tube without breaking a joint, and much more perfect control of the flow can be secured than by the form seen in Fig. 199, which is known as Mohr's. Hoffman's screw pinchcock (see Fig. 200) is often useful, but it cannot be applied or removed so conveniently as

Fig. 197



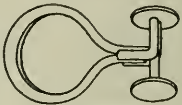
Squibb's pinchcock (open)

Fig. 198



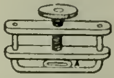
Squibb's pinchcock (closed)

Fig. 199



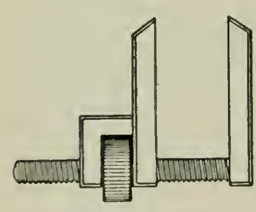
Spring pinchcock (Mohr's)

Fig. 200



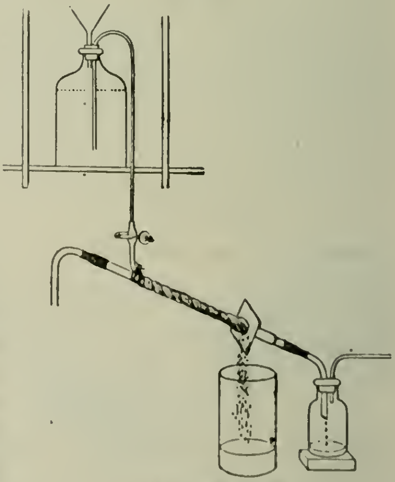
Screw pinchcock (Hoffman's)

Fig. 201



Pinchcock (Remington's)

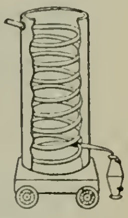
Fig. 202



Tube condenser in use

Squibb's. A section of compressed tube is shown at A. Fig. 201 shows a powerful pinchcock designed by J. Percy Remington for use upon large sized rubber tubes. Fig. 202 shows a method of refrigeration which may be used when the ordinary condensers and a steady supply of water are not to be had. A wide tube is connected with the distilling flask, and some lint, lampwick, or other absorbent material is wrapped spirally around it and tied at the ends; a square piece of cardboard is perforated so that it will fit tightly upon the tube, and it is pushed upon the lower end until it is in close contact with the lint. If water can be supplied from a faucet, a rubber tube is connected with it and conducted to the upper part of the condensing tube, and tied in such a position that a stream of water will trickle from it and be carried down by the lint until it reaches the cardboard, where it falls into the vessel prepared to receive it. If hydrant water is not available, a large bottle containing water may be placed upon a shelf, and a syphon, having a rubber tube and pinchcock, attached, as shown in the cut.

Fig. 203



Condensing worm

The Condensing Worm.—The method of condensing by the use of the worm is very old, and its advantage in securing economy of space and its ease of application are very apparent. Fig. 203 affords a good illustration of this kind of condenser used in the larger laboratories. It will be found most convenient to attach the condenser to a wooden base, mounted on wheels, of suitable height. This permits the convenient shifting of the condenser to the different stills. Block tin pipe is the best that can be used for general pharmaceutical work. Copper or tinned copper tube should be avoided, because it is impossible to prevent the action of acid vapors or liquids upon the copper. Soluble salts of copper would thus be formed and the distillate often rendered poisonous. Iron tube is not admissible, on account of the contamination from iron salts. Pure tin is not affected so easily, and the salts that possibly would be formed are not so objectionable. Block tin pipe may be wound spirally around a convenient cylindrical vessel, such as a tin can or similar object, to give it the proper shape, and then fastened to three notched uprights and placed in position. Earthenware condensing worms of all sizes, of excellent quality, are made by Doulton & Watts, Lambeth, London, England, and by John Cliff & Sons, Leeds, England; they are also made in this country. For condensing acid vapors, as in the making of spirit of nitrous ether by distillation, these condensers are undoubtedly superior to metallic ones.

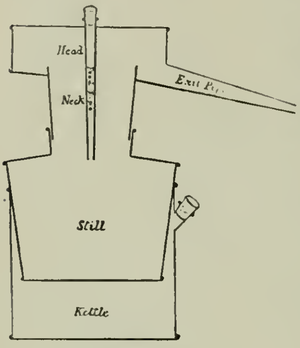
Pharmaceutical Stills

Stills are preferred in all distillatory operations where the liquids or vapors do not act chemically upon the metals of which they are made. Tinned copper is the best material to use in the construction of stills, for, although tinned iron is cheaper, the greater durability of the former renders them in the end more economical. The same typical forms may be seen in the construction of pharmaceutical stills as in glass distillatory apparatus,—*i.e.*, the alembic and retort.

Pharmaceutical Stills—Alembic Principle.—One of the most useful stills constructed on this principle was devised by Prof. Procter.

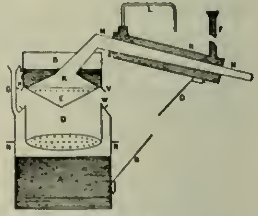
The still body was connected with the condensing head or dome by a water joint, and the sides of the dome were continued up into the head so that an alembic gutter was formed to catch the condensed liquid; this was delivered at the spout, and this spout was partly surrounded by the jacket. Water for refrigeration was supplied by a tube; this first circulated around the delivery spout, and then found an exit through a rubber tube. Wiegand's still is shown in Fig. 204. It differs from Procter's principally in the method of joining the head of the still to the body; the sides of the head are tapering, so that the head can be pressed down tightly into the body, and with the aid of flaxseed lute a tight joint can be made; the feed pipe is useful in charging the still, from the fact that it carries the liquid below the point where it would be likely to soil the condensing surface by splashing. Prof. Curtman's still (see Fig. 205) has several modifications about it which require special notice. The jacketing of the neck of the alembic, which is partially carried out in Procter's and Wiegand's stills, is extended so that it is converted into a Liebig condenser; a bent tube, L (see Fig. 205), serves to convey water partially heated from contact with the vapor over into the head, B. This modification is especially intended to strengthen alcohol which is in process of recovery from weak tinctures; the water used for refrigeration circulates around the central tube, N, in the Liebig's condenser, and then finds an outlet into the head B by means of the bent tube L. The intention is to regulate the flow of water so that it shall be sufficient to condense alcoholic vapor passing through the tube, the heated water from L being at the same time of a temperature just above that of the boiling point of alcohol (180° F.). The vapor of water coming over with the alcoholic vapor comes in contact with this heated surface, and, as the boiling point of water is 100° C. (212° F.), the temperature of the condensing surface (180° F.) is sufficient to condense the vapor of the water, but not that of the alcohol; thus the water is separated and trickles back into the still, while the alcoholic vapor passes on into the condenser.

Fig. 204



Wiegand's still

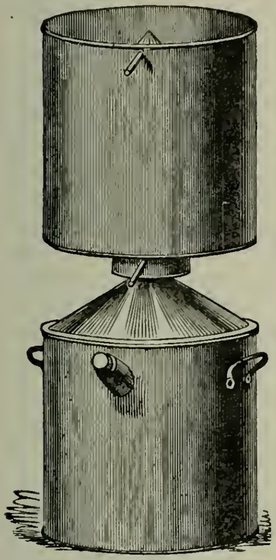
Fig. 205



Curtman's still

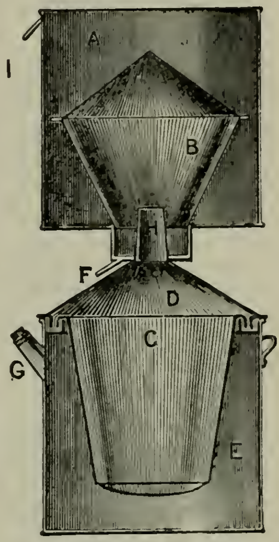
A still on the alembic principle, made by the Whitall Tatum Company, is shown in Figs. 206 and 207. E represents the boiler, the pan C being used as a water bath if required. The vapor rises through the tube H and passes into the chamber B, where it is condensed. The reservoir A is supplied with cold water, ice, or snow. The condensed liquid flows into a trough around the tube H and is discharged through F. At G there is a tubulure, closed with a screw cap, through which the boiler can be supplied with water or the liquid which is to be distilled. The reservoir A is furnished with an overflow pipe to conduct away the warm water as distillation proceeds. The still is simple in construction, but in practice it will be found advisable to attach a rubber tube to F to conduct the distillate away from the flame or other source of heat.

Fig. 206



Pharmaceutical still

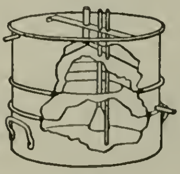
Fig. 207



Pharmaceutical still

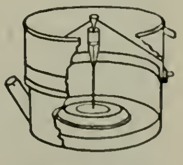
Fig. 208 represents Game's still, made by J. M. Maris & Co., of Philadelphia. This still is also constructed on the alembic principle, the special features being the tubes, as shown in the drawing, which are used to supply the still with liquid continuously during the distillation. One of the tubes connects with the reservoir and furnishes air to replace the liquid as it flows into the still; in the distilling chamber one of the pipes is shown descending nearly to the bottom of the still; one of the pipes terminates in an inverted funnel near the bottom for the purpose of lessening the possibility of the air pipe becoming closed by the splashing of a thick liquid. The mouth of this cone is about three-fourths of an inch above the bottom, and it will be seen that when sufficient liquid has been run into the still from the supplying tube to reach the bottom of the funnel tube, no more liquid falls from the reservoir, and thus the amount of liquid in the still is always limited. When the distillation reduces the quantity of liquid so that it falls below the level of the funnel tube, the liquid runs again from the reservoir, and thus the supply becomes automatic. The other parts of the still will be readily comprehended by inspecting Fig. 208.

Fig. 208



Game's still

Fig. 209



Stevens's still

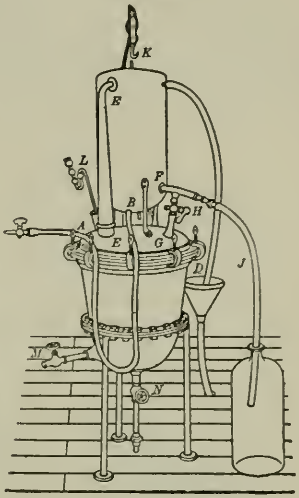
The still shown in Fig. 209 was invented by Prof. A. B. Stevens, of Ann Arbor, Michigan. As will be seen from the illustration, it is made on the alembic principle, but it has several features about it which differ from the stills heretofore described. A light copper float, having a central rod or stem, is arranged in the still body, so that it will warn the operator when the liquid in the still has evaporated below the danger point, previously adjusted. One of the best features about this still is the method of joining the two principal parts. The water joint, which is never satisfactory in actual practice, is replaced here by a rubber rod ring, which fits into a circular groove and is held in place by clamps which are easily disconnected when the distillation is over. The methods of conducting and refrigerating are similar to those indicated in the preceding descriptions of alembic stills.

Stills constructed on the alembic principle have the disadvantage of having the cold water supply directly over the source of heat, and, as the latter is usually a coal stove or gas burner, the cold water used for refrigeration is rapidly heated, and much more is required to effect condensation than is the case with stills constructed on the retort principle. Again, the delivery tube of the condensed liquid is immediately over the fire, and in recovering alcohol from weak percolates (one of the principal uses of pharmaceutical stills) the danger from alcoholic vapor taking fire is great, if constant vigilance is not exercised. Many accidents have occurred through the neglect of the operator to keep a constant supply of cold water applied to the condenser. In cities and towns where water is supplied by a tap or faucet the flow is sometimes stopped by the shutting off of the water when workmen are making repairs to the pipes, and serious accidents are thus likely to occur through the water in the condenser becoming so hot that it will not condense alcoholic or ethereal vapors, which soon come in contact with the flame, and fire or explosion results. In all stills made on the alembic principle care should be observed to connect a metal or glass tube with the delivery tube of the still, so as to lengthen it and convey the condensed liquid as far as possible away from the flame. Fortunately, water joints are now rarely employed. These usually consist of a gutter running around the top of the still body and filled with water; the head of the still is simply laid on top and held in place by a clamp; in a short time the heat evaporates the water, permitting the escape of vapor; hence watchfulness is required to renew the supply of water.

The distilling apparatus known as the Prentiss still, or alcohol reclaimer, possesses some peculiarities, a portion of the vapors being condensed immediately over the still. The still body has an upright column screwed to it; this connects by a union joint with the condenser, which is a single pipe bent into a zigzag form and terminating in a spout. The water intended for refrigeration is poured into the funnel at the top. The distinctive feature, however, is the series of perforated diaphragms which are soldered to a central rod and are placed inside of the column; these are asserted to impede the passage of and condense aqueous vapor when mixed with that which is alcoholic; the alcoholic vapor passes over and is converted into alcohol in the condenser, while the condensed water falls back into the still.

A condenser contrived by Charles Rice, in which the block tin worm is enclosed and placed immediately above the still head, is shown in Fig. 210. The still is heated by steam, which enters at *M*, *N* being the exhaust pipe. The still head is constructed of copper. The condenser is a cylindrical copper vessel, with rounded bottom and closed top, having short half-inch tubes projecting from the bottom and from the top at *B* and *C*. There are two such tubes at the bottom, one for attaching the rubber hose, *A*, bringing the water; the second, shown in the cut immediately alongside the letter *B*, is closed with a cork, and is used to permit the water to be emptied without detaching the hose from the other. At the top there are two tubes, one at *C* for attaching rubber hose to carry off the water into the wastepipe *D*; the other, which is closed with a cork, is not shown in the cut, as it is on the back of the condenser.

FIG. 210



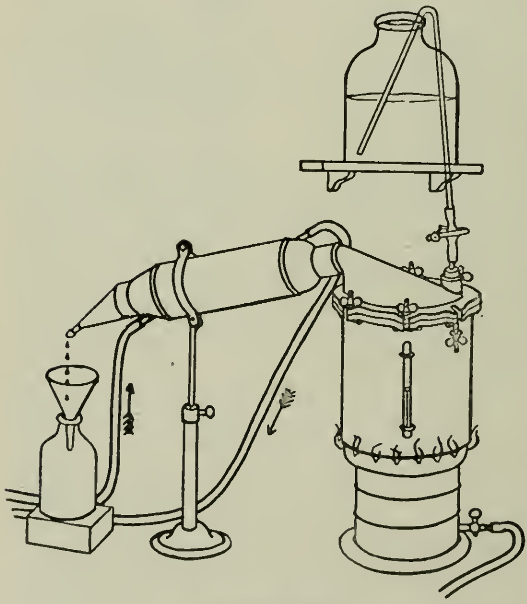
Rice's still and condenser

The head of the still carries three short tubulures, only one of which is visible in the cut. This one contains a cork bearing the safety valve, *L*. A second one is at the other side, for refilling the still when required, with another narrower tube intended for the insertion of a thermometer. The condensing pipe begins at *E*, where it rises from the head parallel with the condenser. It is made of copper as far as the point indicated by the upper *E*, where it is soldered to the *downward projecting* upper end of the block tin worm contained in the condenser and emerging from it at *F*. This arrangement makes it impossible for any condensed liquid to come in contact with anything but block tin. The worm inside the condenser is made by carefully winding block tin pipe upon a round block of wood, taking particular care to give the coil a uniform downward descent throughout. After emerging from the condenser at *F*, it extends for a short distance, where the cut shows it to be connected to the separate block tin pipe, *J*, by means of a union joint lined with tin. Half way between *F* and the end proper of the worm the pipe is tapped, and a branch, carrying the faucet *H*, leads into the still at G, where it terminates under the centre of the head in the form of an ∽, forming a trap to prevent the escape of vapors by this passage. The object of this arrangement is to cause the condensed liquid to flow back into the still as long as the faucet *H* is open, or to collect it outside by turning off the faucet. Prolonged digestions with alcohol may be made by means of this apparatus without any loss of liquid. The head is attached to the still by means of a rubber washer and iron clamps, and when it is desired to remove it the water is allowed to drain from the condenser, the clamps are taken off, and the whole is hoisted up by the tackle *K*, and moved aside.

Pharmaceutical Stills—Retort Principle.—The method of condensing vapors by cooling them in a separate vessel connected with the still by a tube or tubes has been largely employed. The simplest plan is to connect the still head with a Liebig condenser or a worm. The principal disadvantage of the former method is that considerable space is required in providing for the long tube and its refrigeration, and this is an important consideration in most laboratories. The disadvantage about the worm is one which is still greater, for, while space is economized, the spiral shape of the worm prevents the possibility of thoroughly cleaning it, and where a still is used for several purposes the odor and taste of the last liquid used in the still will be very apt to pervade and contaminate the distillate in process of collection. Kolle, in his endeavor to overcome these objections, retained the condensing tub, but, instead of using a worm, bent the pipe into a zigzag form and adjusted it in a vertical plane, the angles of the zigzag tube upon one side projecting through the sides of the tub. These projecting angles were made of separate, short pieces of tube, which were cemented to the condensing pipe. The objection to this condenser was the inconvenience of breaking and making so many joints. Mitscherlich improved Gadda's condenser by constructing a condenser from two cylindrical vessels, the inner one removable and yet capable of being connected with the outer vessel by a tight joint. Deficiency of condensing surface and the inconvenience of making vapor tight joints were objectionable in this condenser.

From a consideration of the necessity for some new plan for condensing liquids in pharmaceutical stills, whereby the above objections could be overcome, the author was led, in 1872, to employ the principle of the tubular boiler for condensation (see Fig. 211). The body of the still is made of tinned copper; the bottom is not rounded, but flat, permitting it to stand securely on an ordinary counter; the bottom is made of heavier copper than the sides, and is fastened by tucking and folding, thus making a tight joint. A glass tube water level on the side of the still shows when the liquid has been distilled to a dangerously low point, as well as heated to active ebullition, which may result in frothing. The glass tube may be removed from the lower connection by simply unscrewing the cap, and if a thick residue in the still remains, it may be transferred to a bottle or dish by allowing it to escape at the lower tube orifice, thus avoiding loss of product by waste. The still body is connected with the top by a "twine joint," a flat brass ring being soldered to the top of the still

Fig. 211



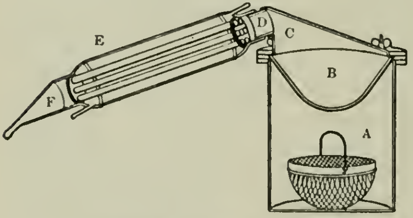
Remington still

body, and another of exactly the same size being soldered to the still top or dome. When the connection is to be made, a piece of soft, thick twine, two inches longer than the circumference of the ring, is soaked in water, and carefully laid upon the brass ring in such a way that the ends overlap; the top is then carefully laid upon the wet twine and securely fastened with clamps, which should be applied at opposite points at the same time, so as to bear equally. The new form of hinged clamps is shown in Fig. 211. They are fastened to the ring and cannot be mislaid, a disadvantage of the old form of clamps.

The *still top* differs from most others in having the opening for the escape of vapors drawn over to one side, instead of in the centre; by this arrangement the condensing surface of the dome is reduced to a minimum, and condensation *inside the still* is obviated as far as possible.

The construction of the condenser shows the application of a well known principle which has been made to do service for an opposite purpose. The substitution of a number of tubes of small diameter for one large vessel is recognized as an effective means of rapidly producing vaporization (see page 126). The principle is of equal value in condensation. The condenser has seven parallel, solid block tin tubes, surrounded by a copper case. This case is perforated twice, and a short tube is soldered in at each extremity. To the lower tube a rubber tube is attached, which is connected with a cold water faucet; a rubber tube is slipped over the upper short copper tube of the condenser for carrying off the water after it has served its purpose of condensing the vapors, which it does by circulating freely between the outer surface of the block tin tubes and the inner surface of the containing case. The proportions of this condenser are so adjusted that if any liquid likely to be used is actively boiled in the still body, and cold water is running through the condenser, there can be no escape of condensable vapor at the exit tube. In the condenser for the still holding three gallons the combined length of the tubes is about six feet, and about one hundred square inches of condensing surface are obtained. The condenser itself is fifteen inches long and about four inches wide. Straight, smooth, solid block tin parallel tubes are used because of the convenience of cleaning them. A piece of cloth wrapped on the end of a rattan or stiff wire may be rapidly pushed through each tube, which serves to clean it when a very odorous liquid has been distilled, but usually it suffices to hold the condenser under a hot water faucet for a few moments. The methods of connecting the various parts of the apparatus are simple. Two ground brass joints are made, one at the point of junction of the condenser, with the still head top, and the other where the nose piece is attached to the end of the condenser. These, on account of their comparatively small diameter, require no clamps or lute, and are vapor tight. Where a moderate heat below the boiling point of water is required the still body is placed in a kettle; and, if the quantity of liquid to be distilled is not large, a round bottomed, tinned copper water bath is clamped between the still body and still head, and the still body filled with water, the waste steam escaping through three apertures in the rim of the water bath. This water bath arrangement may be used in addition in making ointments. The automatic feeding attachment consists of a glass syphon, a rubber and a glass tube (the latter passing through a cork), and a pinchcock. The manner of using this is as follows: The still having been charged (about half full), the remainder of the liquid is placed in a vessel above the still body upon any suitable support; the syphon is placed in the liquid, then connected with the rubber tube carrying the pinchcock, and by suction or other means the syphon is filled and the pinchcock screwed down; the other end of the rubber tube is then connected with the glass tube running through the cork, which passes through the tubulure in the still head. Heat is now applied to the still body, the cold water faucet is turned on to supply the condenser with cold water through the lower rubber tube, and when the distillate comes over in a steady stream a narrow strip of paper is pasted on the glass gauge tube on the body of the still to mark the level of the liquid at starting. The pinchcock is then opened, and the level of the liquid in the still is regulated so that the liquid neither rises nor falls. This indicates that a stream of liquid from the reservoir above is running into the still exactly equal in volume to that of the distillate running from the exit tube, and the apparatus may be left to take care of itself. The empyreumatic odor which distilled and aromatic waters often possess, and which is usually caused by the solid substances lying in immediate contact with the hot still bottom, is obviated in this still by putting the substance into a hemispherical, coarse wire sieve cage (see Fig. 213). The round bottom of the cage prevents any possibility of contact with the flat bottom of the still, while circulation of the water and vapor takes place through the meshes; a handle serves to lift it out when the distillation is completed. Fig. 212 shows a dissected view of the still, which illustrates the relative position of the parts,—A, the still body; B, water bath; C, the still top, or dome; D, joint; E, condenser; F, exit tube for distillate.

Fig. 212

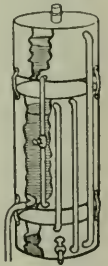


Remington still (sectional view)

Fig. 213

Wire cage

Fig. 214



Herrick's water still

A very useful automatic water still, devised by Herrick, is illustrated by Fig. 214. The lower vessel is the boiler, the middle one the condenser tank, the upper one the supply tank provided with a loose cover. The distillation of water proceeds, after it is once started, automatically. The advantages possessed by such a still are that a constant supply of distilled water can be furnished at a minimum cost. It can be operated by a gas flame, coal oil stove, or by placing it upon the top of a range or stove, or in fact by any source of heat, and a very little care suffices to keep it running. It is, of course, only suited for distilling one liquid like water, where a constant supply of liquid can be maintained, and is not intended to be used for general pharmaceutical work, such as recovering alcohol from weak percolates, etc.

Owing to the necessity for using distilled water in pharmaceutical operations, and to the widespread agitation in the public print on the subject of impure water in cities, distilled water has become an important product, and pharmacists in some localities use a water still constantly for supplying the demand. This has stimulated the manufacture of water stills, and a number of such are to be found on the market.

Fractional Distillation.—By this term is meant the process of separating by distillation liquids having different boiling points or vapor densities. When a mixed liquid, or one consisting of liquids of unequal volatility, is distilled, the first portion of the distillate contains a larger proportion of the most volatile constituent than of the others; hence the boiling point is observed to rise as the distillation proceeds; and if a means is provided for collecting the distillate in several portions, or fractions, as they are called, fractional distillation offers a process by which liquids may be purified or separated. It is impossible, however, *in a single operation* to effect this separation of the component parts of a mixed liquid perfectly, because the distillate obtained at any period of the process is nearly identical with the vapor that is rising from the hot liquid, and therefore it is made up of the condensed vapor of that part of the liquid having a boiling point at or below the temperature registered by the thermometer, plus the smaller amount of condensed vapor that is given off from the constituents having higher boiling points, but which emit sensible vapors much below the point at which they actively boil. The relative proportions of the constituents of the mixed liquids have also a bearing in determining the composition of the distillate. By collecting the fractions carefully at stated temperatures, and redistilling each by itself, a more thorough separation may be effected, and this method is usually followed when such a separation is necessary. Upon the small scale one of the simplest forms of apparatus for fractional distillation is made by taking a gas bulb (a glass flask having a bent lateral tube in the neck), and, having adjusted a perforated cork in the neck for a thermometer, passing the tube of the gas bulb into a loosely stoppered test tube, which is placed in a vessel surrounded with ice or properly refrigerated. A more efficient method is to connect the lateral ascending tube of a flask with the end of a worm, or a condenser so arranged that the liquid condensed at a certain temperature may run back into the flask. Vapors having lower boiling points pass through it uncondensed until they reach the second condenser, which is refrigerated to a degree sufficient to condense all the vapor. This method is used for manufacturing purposes upon the large scale.

Destructive distillation is the process of heating dry organic matter in a distillatory apparatus until all volatile substances are driven over. The residue is said to be carbonized. Destructive distillation is a process which is rarely employed by the pharmacist; hence it is not necessary in this work to treat the subject in detail. Glass vessels are not adapted to the process, because they will not usually stand the heat required without fracture, and the solid residue frequently fuses, is insoluble in water, and becomes so firmly attached to the bottom and sides that it cannot be removed without great difficulty. The best form of apparatus is an open vessel of cast iron, like a crucible, having a flange at the top, a dome with a corresponding flange, and a bent tube for carrying off the gaseous products. The connection is made with fireclay lute and iron clamps. The manufacture of acetic acid, creosote, methyl alcohol, etc., affords illustrations of the use of this process, which is nearly always performed on a large scale.

The application of the process of destructive distillation to wood results in the production of many valuable products, as acetone, methyl alcohol, methyl ether, acetic acid, creosote, tar, etc., while charcoal remains in the still. When applied to coal the distillate yields illuminating gas, ammonia products, coal tar, from which is obtained numerous phenol bodies, cresols, benzene, toluol, dye color bases, etc., coke remaining in the still.

The distillate from this operation represents a decomposition product,—*i.e.*, a substance which did not exist in the original matter placed in the still, but which results from the application of heat without the presence of air. A characteristic smoky odor, called empyreuma, is usually recognized in the distillate, but may be removed by purification.

CHAPTER VI

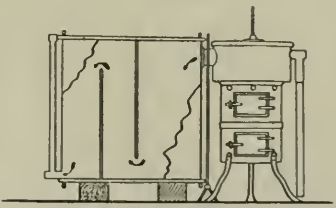
SUBLIMATION

SUBLIMATION is the process of distilling *volatile solids.* The product is termed a *sublimate.*

The objects of sublimation are as follows: 1. To purify volatile solids from admixed and fixed impurities. 2. To provide a convenient means of collecting volatile solids resulting from chemical reaction at high temperatures. The retorts or apparatus used may either be of iron or glass, or of stoneware if the degree of heat necessary will admit of the use of the latter.

Sublimation is almost exclusively confined to operations which are conducted by manufacturers on the large scale. A process was formerly official for the sublimation of benzoic acid. It consisted in introducing benzoin into a shallow tinned iron pan, and pasting over the top a sheet of filtering paper. A pasteboard hood, shaped like a hat box, was then fitted to the pan and tied or pasted with paper so that a tight joint was made. The apparatus was placed on an iron plate and subjected to a low but *uniform* heat. The vapors of benzoic acid passed through the pores of the filtering paper, were separated from impurities, and, coming in contact with a cooler atmosphere in the hood, slowly condensed, often forming crystals of great beauty.

FIG. 215

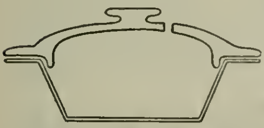


Sublimation of benzoic acid

Fig. 215 illustrates Hager's apparatus for subliming benzoic acid. The stove is shown on the right; upon the top is placed the vessel containing a mixture of benzoin and sand. A pipe enters this vessel at the upper part from the right; through this a regulated current of air is forced after the mixture has been slowly heated, and the vapors of benzoic acid are driven, as shown by the arrows, into the large chamber, where they condense and the crystals collect upon the partitions and floor.

The temperature at which the condensation of the vapor is effected in sublimation has a very important influence in determining the physical character of the sublimate, and two kinds of sublimates are produced,—1. Cake sublimates. 2. Powder sublimates.

FIG. 216

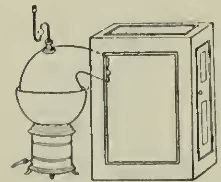


Subliming apparatus (cake)

Cake Sublimates.—If the temperature of the condensing surface and of the air in contact is but slightly below that at which the volatile body is capable of subliming, the particles will be deposited in compact masses, like corrosive sublimate, commercial sal ammoniac, or ammonium carbonate. Fig. 216 shows a simple apparatus for obtaining sublimates in cakes or masses. A shallow sheet iron dish, having its upper edge turned out so that it forms a flat ring, is provided with an earthenware cover (it will be usually found more convenient to have the iron dish made to fit the cover than the reverse), through which a hole is drilled to permit the escape of air (this may be done with a three cornered file). After the substance which is to be sublimed has been placed in the iron dish, a piece of asbestos twine, slightly longer than the circumference of the ring, is laid upon it, and this is covered with a lute composed of equal parts of potters' clay and flaxseed meal with sufficient water, the earthenware cover is pressed upon it until it adheres, and, when necessary, iron clamps are used to make a tight joint. The aperture in the cover is loosely covered with a cone of cardboard, the dish is placed in a sand bath and gradually heated. The aperture is kept open during the sublimation by occasionally probing it with a glass rod. After cooling, the sublimate will be found adhering to the earthenware top in one cake or mass, and may be removed by a spatula. The earthenware top may be replaced by a sheet iron one in cases in which the former would be likely to be fractured by excessive heat. For subliming iodine, earthenware vessels alone should be used.

Powder Sublimates.—If the apparatus for conducting sublimation is so contrived that there is a marked difference between the temperature of the air in contact with the vapor and the subliming point of the volatile body, the sublimate will be deposited very rapidly and in small particles, like calomel, sulphur, etc.

Fig. 217



Sublimiug apparatus (powder)

Fig. 217 shows a convenient apparatus for subliming camphor in powder. It is well adapted also for a lecture room illustration of the process. A wooden case has two openings made in the sides to admit sheets of glass, which are secured in place by putty in the usual manner. One of the sides has a hinged door, which fits the frame snugly; the opposite side has a tapering circular aperture, which admits the shortened beak of a retort, as shown in the cut. Camphor is placed in the retort, a safety tube is adjusted in the tubulure, and the retort is then placed deeply in a sand bath on a good gas stove. Care must be observed in heating at first, and a Bunsen burner should be at hand to heat occasionally those portions of the top of the retort and the beak upon which the sublimate is forming. When the boiling point is reached, the camphor vapor passes over rapidly, and at once falls in the form of powder upon coming in contact with the cold air in the chamber. The especial points to be observed are care in heating, and watchfulness that the beak of the retort does not become clogged with the sublimate. A judicious use of the Bunsen flame will soon melt the obstruction.

The most important, and in practice the most difficult, part of the operation of sublimation is the regulation of the heat. The temperature of the condensing surface should always be below the fusing point of the substance if distinct crystals or crusts are expected.

CHAPTER VII

DESICCATION

Desiccation is the process of depriving solid substances of moisture, and in pharmacy should be effected at as low temperatures as possible. (See Exsiccation.)

The objects of desiccating medicinal substances are threefold: 1. To aid in their preservation. 2. To reduce their bulk. 3. To facilitate their comminution.

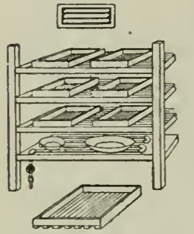
1. To Aid in Preservation.—Chemical salts frequently contain water either chemically or mechanically combined with them. An elevation in the temperature, or the absorption of water from moisture present in the air, will in some instances cause *deliquescence*, while in others contact with a dry atmosphere will cause *efflorescence*, due to the evaporation of chemically combined water; hence such salts in their natural condition are unstable; they are much more permanent when dried. Vegetable drugs soon decompose or become mouldy if allowed to remain in a moist condition, and desiccation is absolutely necessary to preserve them.

2. To Reduce Bulk.—If desiccation is performed successfully,—*i.e.*, at properly regulated temperatures under certain precautions,—the substance is merely deprived of water without suffering any loss of medicinal activity, and the reduction in bulk that follows is a practical advantage which results in adding to the strength of the medicinal substance.

3. To Facilitate Comminution.—The presence of water gives to drugs an elasticity and ability to resist disintegration, which in some cases interfere greatly with the process of bruising, grinding, or reducing the drugs to particles. One of the first steps in comminution is to dry the substance thoroughly in order to make it brittle or crisp.

The apparatus employed in desiccation is frequently of the simplest character, and the heat is usually not especially created for the purpose, for it is most economical to use the waste heat from kitchen fires or cellar furnaces or the diffused heat in lofts or unused attics. There can be no objection to this if care is taken to provide protection for the substance from dust, light, and injury during desiccation. Herbs may be dried by tying them in bunches and suspending them to the attic ceiling or to the rafters of a barn during summer weather, and this is an excellent method usually, notwithstanding its slowness, because there is no danger of the heat being strong enough to cause loss of valuable volatile principles. Roots, barks, and leaves may be dried by spreading them out upon clean tables or floors in a dry room and turning them repeatedly, so as to expose fresh surfaces to the dry air. On the large scale, and in the laboratory, special apparatus must be employed. Fig. 218 illustrates a portion of the interior of a laboratory drying room. Live steam is passed through the pipes when higher temperatures are needed, but waste or exhaust steam from steam kettles is economically and properly used. Trays of suitable size, containing the substance to be dried placed on thin muslin, are set upon the shelves of the rack. Ventilators should be provided to carry off the moist air. The space immediately over the steam boiler can often be economically used for a drying room by placing a sheet iron floor over it to secure the radiated heat, and arranging racks and trays upon it in convenient positions, or by placing the drugs in barrels in which the heads have been replaced by wire netting, or by simply enclosing the drugs in coarse bags which permit the escape of moisture.

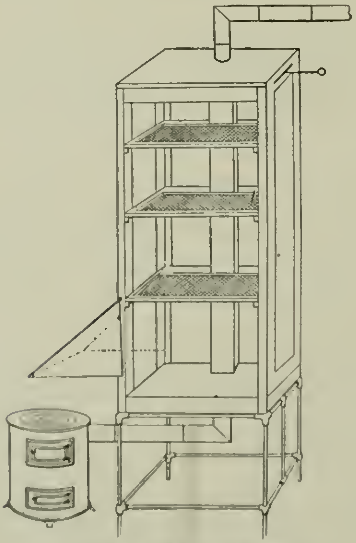
Fig. 218



Desiccating frame and trays

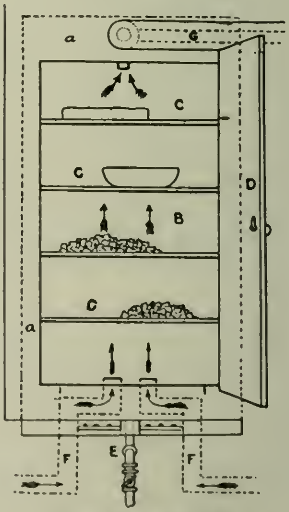
Fig. 219 shows a pharmaceutical drying closet which is simple, economical, and easily made. The heat from the flue of a pharmaceutical stove (see Fig. 65) is utilized. The frame which supports the closet is made of half-inch steam pipe, and to the uprights the retort rings (see Fig. 187) may be clamped, and the filtration of chilled oils in winter time, or warm filtration or percolation of many kinds, may be carried on. The sides of the closet are of galvanized sheet iron or of asbestos cloth, tacked to a wooden frame, and cleats at convenient intervals are arranged for the trays to slide upon. The stovepipe from the stove is connected with the flue at the bottom of the drying closet, and the heat from the smoke and gas passing up the

Fig. 219



Pharmaceutical drying closet

Fig. 220



Drying closet (gas heat)

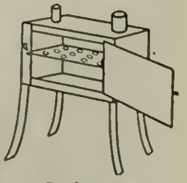
flue is thus utilized; the hood may be dropped over the top of the stove when the latter is not needed for other purposes, the heated air carrying the moisture from the substance to be dried, rising and escaping at the ventilators. Lozenges, crystallized salts, extracts, filters, etc., may all be dried in this cheap and simple closet. One practical point about desiccation is frequently overlooked. It is that substances which are being dried must be repeatedly turned over, so that the parts underneath shall be exposed to the external dry atmosphere. In the case of salts, crystals, and other bodies, if this is not done, a hard crust is formed upon the surface which is often difficult to break up.

A convenient drying closet, suitable for a small laboratory, is shown in Fig. 220. It was contrived by T. Edward Greenish, of London; it is heated by gas, and is intended to fit into a recess in the wall. The drying closet, B, is made of thin sheet iron, and provided with wire shelves, C, and a tightly fitting door, D. The closet is made of such a size that when fixed into the recess in the wall a space of about two inches is left at the back, sides, bottom, and top, the space being covered in front by the flanges *a*, *a*; these constitute, with the door, the front of the closet. E is a gas burner supplied from the pipe, and F, F are two air pipes which enter at the bottom of the closet. These pipes draw their supply of air from an *external* source, and thus the laboratory fumes and odors cannot taint the substances which are to be desiccated. The upper ends of these tubes are covered with a layer of sand two inches deep, forming a sand bath.

The gas being lighted is supplied with air from the front, and the heated air, together with the products of combustion, passes around the closet through openings made for that purpose in the sides and back of the gas chamber, up the space between the closet and the wall to a pipe, G, and thence to a chimney. The substances to be dried, or the liquids to be evaporated, are placed either upon the shelves or upon the sand bath. The air which enters by the pipes F, F, slightly warmed by the sand, will carry up any vapor therefrom to a pipe at the top of the closet, and thence to the pipe G. In order to regulate the draught of air at the back and sides of the closet, and thereby to adjust the degree of heat, the pipe G is provided with a circular damper, and the gas chamber also has in front of it an arrangement for regulating the supply of air to the gas, thus preventing sudden fluctuations of temperature. By these means the heat of the closet may be readily adjusted. If the temperature of the upper shelf is 82° F., the next lower will be 85° F., the next 88° F., the lower one 92° F., while the sand bath will register about 130° F.

A drying oven, intended for drying precipitates in analytical work, but very useful for desiccating small quantities of pharmaceutical substances, pills, lozenges, or drugs like squill, saffron, Castile soap, etc., is shown in Fig. 221. Water is poured into the tubulure at the top of the jacketed copper case, and a Bunsen burner furnishes the requisite heat when placed so that the flame touches the under surface, the legs of the oven being long enough to permit its use.

Fig. 221

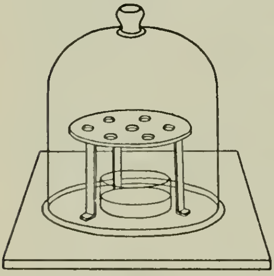


Drying oven

In Fig. 222 is shown a desiccator for use in finer laboratory operations. It consists of a bell glass having a ground rim fitting closely to a ground glass plate, a perforated porcelain dish is placed upon a tripod to hold the material to be dried, and underneath is placed a glass dish to hold sulphuric acid or other substance intended to absorb the moisture.

Loss in drying Medicinal Substances.—When drugs are powdered, loss is always experienced. This arises partly from the escape of fine particles, but principally from loss of moisture in drying. Again, in powdering almost all drugs, a portion remains which resists disintegration. This is called by the miller "gruffs," and is usually worthless and should be thrown away. The gruffs are frequently kept, however, and sent with the next lot of the same drug to be ground at the mill. The dose of a powdered drug is usually somewhat less than that of the same drug before it was pulverized, because the weight it has lost generally represents inert matter, water, etc. Powdered ipecac is a good illustration of this. The active principle *emetine* resides in the starchy cortical portion of the root; the internal ligneous cord constitutes the "gruffs" of ipecac, and is inert. The exception to this is the case of those drugs containing an active volatile constituent, like the aromatics, cloves, cinnamon, nutmeg, or like asafetida, myrrh, cubeb, etc. These drugs, when powdered, generally contain less of their active constituents than they did before they were ground. The volatile oils to which their virtues are due are driven off to a greater or less extent by the amount of heat necessary to make them brittle enough to be readily pulverized. The U. S. Pharmacopœia recognizes the importance of this fact by directing myrrh, and not powdered myrrh, in the compound iron mixture; asafetida, and not powdered asafetida, in the asafetida mixture; and in the compound tincture of cardamom by the direction to mix the unpowdered drugs, cardamom, cinnamon, caraway, and cochineal together, and reduce the mixture to powder, in preference to mixing the separate powders of these drugs. If care is exercised in desiccating, the powders of most drugs possess all their medicinal properties, and in many cases they will retain indefinitely these properties unimpaired if they are properly preserved and not unduly exposed to air, light, or moisture.

Fig. 222



Desiccator

The practice of some drug millers of establishing a loss in the weight of a drug as a regular standard, and then making up the deficiency by adding the same amount of some inert substance, is reprehensible. That the amount of moisture present in different lots of the same drug varies greatly may be seen by a glance at the following table, compiled by Mr. T. J. Covell from accurate records obtained from Dr. E. R. Squibb's drug mills. The table is valuable because it represents the loss in powdering considerable quantities of drugs:

Table showing Loss in Powdering Medicinal Substances

Substance	Greatest Loss percent. on any Single Lot	Smallest Loss percent. on any Single Lot	Average Loss percent.
Acacia	1.88	0.40	0.83
Acacia (granulated)	1.67	1.03	1.35
Aloe Capensis	19.31	7.09	11.13
Aloe Socotrina	24.62	10.00	17.31
Acidum Tartaricum	2.50	0.54	1.06
Buchu	4.10	0.20	2.00
Cambogia	2.46	0.74	1.35
Canella	3.07	0.50	1.77
Cantharis	6.22	0.63	2.05
Cardamomum	7.10	5.00	6.02
Cassia	2.90	2.26	2.61
Catechu	1.30	0.86	1.08
Cinchona Flava	3.75	1.18	2.57
Cinchona Pallida	2.22	0.96	1.73
Cinchona Rubra	1.72	1.24	1.58
Cubeba	3.55	1.99	2.40
Ergota	5.72	0.00	3.62
Extractum Glycyrrhizæ	13.06	8.14	10.45
Gentiana	11.79	9.20	10.23
Gentiana (ground)	8.30	1.56	5.09
Ipecacuanha	3.66	0.64	1.91
Iris Florentina	9.00	1.10	6.22
Jalapa	12.24	2.95	9.58
Myrrha	8.81	3.59	5.80
Opium	22.85	9.91	19.61
Podophyllum	1.15	0.49	0.75
Potassii Chloras	2.70	1.52	2.01
Potassii Bitartras	1.11	0.05	0.38
Pulvis Ipecacuanhæ et Opii	1.63	0.63	1.05
Rheum	3.40	0.10	1.74
Saccharum Lactis	0.85	0.70	0.78
Sapo	18.05	11.70	15.92
Sarsaparilla (Rio Negro)	0.96	0.35	0.70
Scammonium	5.65	1.33	2.70
Scilla	16.45	10.83	13.60
Valeriana	1.51	1.45	1.48
Tragacantha	7.38	6.47	6.93
Zingiber (nigrum)	3.72	3.13	3.43
Zingiber (album)	11.74	8.57	9.70

CHAPTER VIII

COMMINUTION

Comminution is the process of reducing drugs to particles, or breaking up their state of aggregation.

Medicinal substances in their natural state require to be mechanically divided in order to facilitate the action of menstrua or solvents, or to permit their administration *per se* in the form of fine powders.

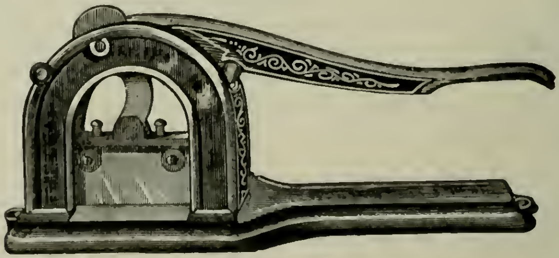
A simple illustration is offered in the case of alum. A solid lump of alum weighing one ounce, if added to a pint of water, will not dissolve nearly so quickly as will one ounce of the same alum in the same quantity of water *if finely powdered.* Vegetable substances offer very variable degrees of resistance in powdering, owing to the proportion and toughness of their ligneous fibre and the amount of cellular tissue.

Under the head of comminution will be grouped the various mechanical operations used in pharmacy by which the surface of solid substances is increased, whether by cutting, rasping, grating, chopping, crushing, rolling, stamping, grinding, powdering, triturating, levigating, elutriating, granulating, or similar processes.

By far the greater number of substances employed in medicine belong to the vegetable kingdom, and, while many of the processes of comminution used for these are also applicable to the chemical substances of the materia medica, it will be necessary in the following chapter to note the apparatus specially adapted to each class.

Cutting, Slicing, and Chopping.—This process is used principally in bringing roots, barks, leaves, herbs, etc., to the proper condition for treating with suitable solvents. For very small operations either the pruning knife or pruning shears answers a good purpose. The tobacco knife or herb cutter shown in Fig. 223 is well adapted for the purpose. It should be observed, however, that the principle upon which a knife operates successfully should be carefully carried out in constructing apparatus designed for cutting. Direct

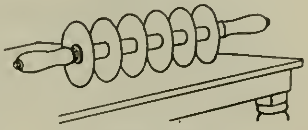
Fig. 223



Tobacco cutter

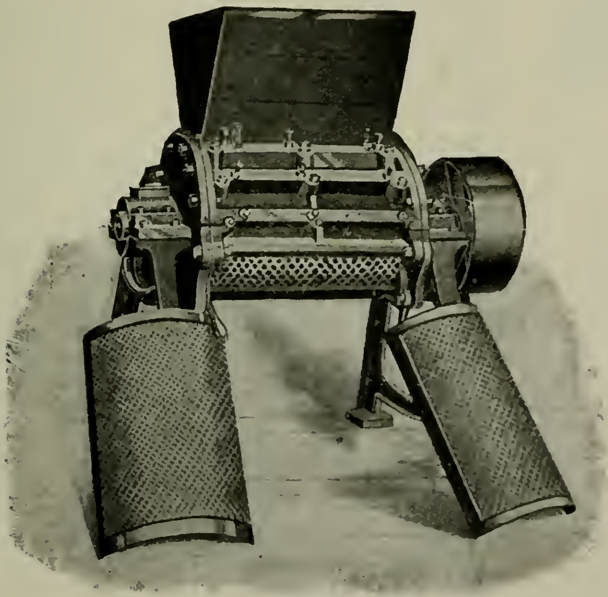
pressure without a slight drawing or sawing motion is not effective; therefore those knives which have guides arranged so that the knife edge sunders the particles at an angle are greatly preferred. Fig. 224 shows a roller knife which is very serviceable. It is made by W. Weber, Evansville, Indiana. The circular blades or knives are made of the same quality of steel that is used for saws, and are mounted upon a shaft, being separated by a series of spools or collars. The handles are of wood and mounted on the ends of the shaft, so that they are loose upon the shaft, thus permitting the handles to be grasped tightly while the roller knife revolves. The substances to be cut are placed upon a smooth board and the roller knife passed over them with more or less pressure. Upon the large scale drugs are cut with hay cutters, implements usually consisting of four or more circular blades fastened to a shaft and revolving at the end of a trough, down which the substance that is to be cut is gradually fed. Sarsaparilla root is cut in this way before it is contused. Fig. 225 shows a rotary cutter made by the Abbé Engineering Company, of New York. A cylinder to which is attached five knives revolves in a circular case, upon the inside surface of which are fastened six knives; the knives are straight but are set at a slight angle, so that a "shearing action" is exerted on the substance to be cut. The bottom

Fig. 224



Roller knife

Fig. 225



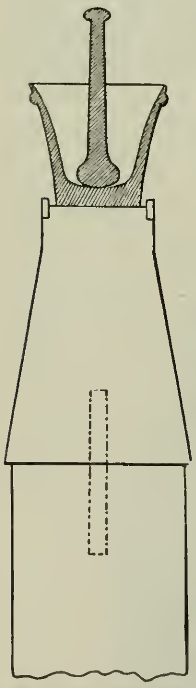
Rotary cutter

of the case consists of a perforated plate, which can be replaced, and as the knives revolve a portion of the cut substance drops through the perforations. What remains is carried around and again subjected to the action of the cutters; by selecting the perforated plates the product may be cut coarser or finer as required.

Rasping or Grating.—A half round rasp (see Fig. 166) or a nutmeg grater is very useful at the prescription counter, as it frequently enables the pharmacist to prepare a small quantity of a powder for a prescription in case the regular stock bottle is found empty or a very fresh powder is needed. The small pocket pepper mills used by European travellers, but now to be obtained in this country, for grinding whole pepper at the table will be found especially useful.

Contusion, or bruising, is an operation very frequently resorted to. It may be defined as the process of reducing a drug to particles by striking it a succession of blows. The instrument generally employed is the well known mortar and pestle, which, for contusing drugs, should be made of cast iron, bell metal, or brass. The shape best adapted for this purpose is shown in Fig. 226, the mortar being represented on a mortar block. The bottom of the mortar should be flat and heavy, so that it may rest firmly upon whatever base it is placed; the sides should flare slightly, but the mortar should be so deep that substances will not be easily forced out on to the floor by the blows of the pestle. A leather or wooden cover should be used upon the mortar when corrosive or irritating substances are contused. The pestle should be heavy and sufficiently flat on the under surface to permit the convexity nearly to coincide with the concave surface of the mortar. The inner surface of the mortar should be tinned, to prevent rusting and facilitate cleaning. The best support for an iron mortar is the top surface of a hard wood post six or eight inches in diameter and of sufficient length to pass from the top of the floor into the cellar and rest on the ground. A turned wood mortar block two feet high should rest upon the post; this block should have a flat iron hoop upon the top projecting half an inch above the surface, as suggested by Dr. H. T. Cummings, while the bottom should have an inch hole bored up through the centre for the distance of twelve inches; an inch wooden pin, two feet long, should be firmly fixed in the centre of the post for the distance of twelve inches, which would leave twelve inches of the wooden pin projecting above the floor. Now, if the mortar block is placed over it so that the pin enters the hole in the base, it will be found that a solid foundation is provided for resisting the blows of the pestle, and jarring and vibration, so destructive to balances and fragile apparatus, are prevented.

Fig. 226



Mortar and pestle (on a mortar block)

When for good reasons the post support cannot be used, the next best base is a deep, strong box filled with dry sand. The principal objection to this is the constant loss of the sand and the inconvenience of having it spilled on the floor. When it is necessary to use an iron mortar and pestle for a continuous operation, for a considerable length of time, it will be found advantageous to connect the upper part of the pestle with an elastic wooden spring attached to the ceiling, so that the labor of lifting the pestle will be lessened. This spring is preferably made from a tapering hickory strip seven or eight feet long and four inches wide at the base, the rope connecting the pestle with the end of the spring being of such length that the pestle barely touches the bottom of the mortar when the spring is stretched to its utmost tension. On account of the large number of mills scattered over the country, established for grinding drugs, and the increase of facilities for grinding and powdering drugs on the large scale, the skilful use of the mortar and pestle by the pharmacist must be regarded as a lost art. The necessity for thoroughly drying drugs before subjecting them to comminution has already been mentioned. (See Desiccation.)

Wooden mortars and pestles are occasionally used for contusing soft bodies, like prune pulp, almonds, recent fleshy roots, substances that are affected by iron, etc. Lignum vitæ is a very hard and suitable wood for this purpose, although boxwood is preferable when it can be procured, because it has less tendency to split.

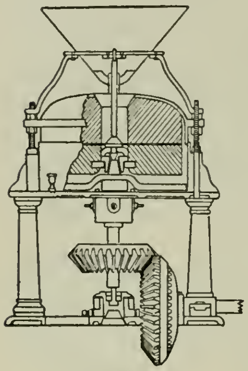
Marble mortars are also used for operations of a similar character on a somewhat larger scale; but care must be used to avoid putting substances containing acid into such mortars, on account of the reaction upon the marble and the consequent contamination of the product.

Grinding and Pulverizing.—The former term is applied to the reduction of a substance by mechanical means to *coarse* particles, the latter to the production of *fine* particles. These processes are the most important of any grouped under comminution. At present they are very largely carried on by drug millers. It is necessary for the pharmacist to be familiar with the methods employed, however, if intelligent judgment is to be exercised in the subsequent treatment of the vegetable and mineral substances of the materia medica. Before pulverizing a substance it must be dried, and the desired fineness of the powder determines the character of the preliminary treatment. In order properly to grind or powder substances upon the large scale, special knowledge and experience are required; previous acquaintance with the methods best suited to accomplish the object on the small scale, while useful to some extent, will be found inadequate. If a drug is to be coarsely ground, the necessity for thoroughly drying it is generally not so pressing as when a fine powder is to be made of the substance; drugs containing volatile oils are apt to be rendered worthless if they are dried sufficiently to enable them to be ground to a fine powder. Myrrh, cloves, cubebs, nutmegs, etc., afford good illustrations of this; hence these drugs are preferred when coarsely powdered. Within the last few years an important change in pharmaceutical practice in this respect has been effected, and preparations in which formerly very fine powders were directed are now ordered to be made from coarse powders; the processes for extracting the soluble principles having been greatly improved, the necessity no longer exists for using the very fine powders, and hence volatile principles are not sacrificed.

Drug Mills

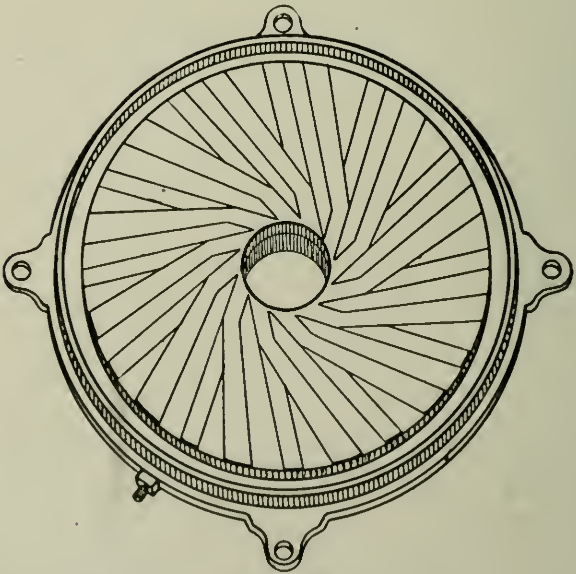
The buhrstone mill is very extensively employed in drug milling. There are two kinds, termed respectively under runners and upper runners. The principle upon which this mill operates is that of reducing the substance to particles by the friction and contusion that follow the delivery of the substance in the contracted space formed by a rapidly revolving stone disk, brought in nearly close contact with a similar disk which is stationary. In the under runners the upper stone is stationary and the lower stone revolves, the upper stone having a central circular opening through which the subtance is fed, as shown in Fig. 227, the under stone being connected with the shaft. In the upper runners the lower stone is stationary, the upper stone being perforated as in the under runners. In both, the stones revolve horizontally. The stone used must be very hard. The best buhr-mill stone is obtained from the old and celebrated quarries of La Ferté-sous-Jouarre, in France. The surfaces of the millstones are crossed with "furrows," which pass from the centre to the circumference, as shown in Fig. 228. The object of the furrows is to provide a means

Fig. 227



Buhrstone mill

Fig. 228

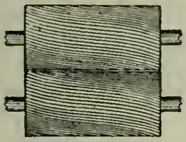


Buhrstone

for the passage of the ground particles to the outer circumference and to the trough. This is accomplished through the centrifugal force and current of air caused by the rapid revolution of the stone in motion. The fineness of the powder is regulated by raising or lowering one of the stones, this of course increasing or decreasing the space between them ; the character of the powder is also influenced by the dressing of the stone. Fig. 227 illustrates one of the best of the buhrstone mills,—Munson's under runner.

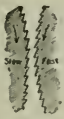
Roller mills operate by crushing, or crushing and cutting, the substance. In their simplest form they consist of two smooth faced iron rollers revolving in opposite directions, which can be brought into close contact by regulating screws. The principle has been extended and improved in modern milling, so that for grinding certain drugs this mill gives excellent results. The rollers are now made of steel, chilled iron, or biscuit (porcelain), and are corrugated or ribbed to suit special purposes. The sections of these corrugations are serrated, undulated, or crenated. The rollers revolve in the same direction or in opposite directions, and at equal or different speeds. Fig. 229 shows the position of the grooved rollers, and Fig. 230 shows a sectional view of the same. Corrugated roller mills are used in grinding drugs, but they are much more largely employed in flour mills.

Fig. 229



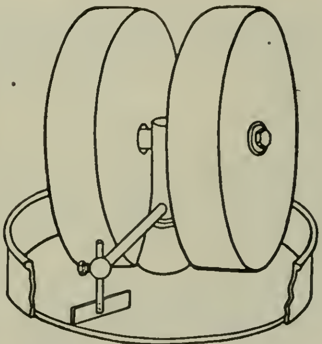
Grooved rollers

Fig. 230



Grooved rollers (cross section)

Fig. 231



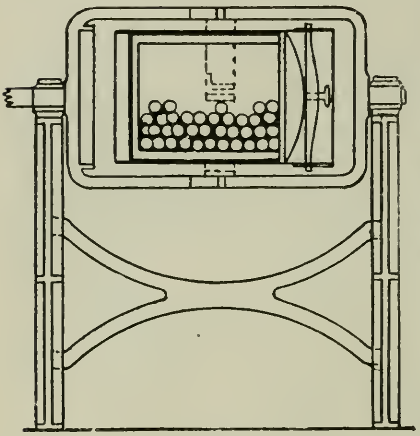
Chasers

Fig. 232

Chasers (curved grinding surface)

Chaser mills are so called because two heavy granite stones, mounted like wheels and connected by a short horizontal shaft, are made to revolve or *chase* each other upon a granite base (see Fig. 231). The stones are discoid, and the grinding surfaces are the circumferential edges of the stones and the surface of the granite base ; an iron cylinder, called a "curb," surrounds the circular base, and a "scraper," made of iron and adjusted at an angle, is connected with the shaft. It is evident that if the substance to be powdered is delivered upon the granite base in the path of the rapidly revolving stones it must speedily be reduced to powder, not only on account of the crushing weight of the heavy stones, but also because of the attrition caused by the outer edge of the stone travelling through a longer distance than the inner edge. In some mills the stones having flat, grinding surfaces have been replaced by stones having curved surfaces, and the flat base by a circular gutter curved to correspond with that of the surface of the stone. In this way the grinding surfaces have been greatly increased and rapid pulverization facilitated. Fig. 232 shows the shape of the stones of this form in use in Squibb's drug mill. In practice the chasers are enclosed in a tight box or small room. closed with air tight doors, and the substance to be powdered is fed in from the top by an elongated funnel, the spout of which delivers the material immediately upon the path of the stones. The height of the curb is increased by pasting heavy paper around it, and the fineness of the powder is influenced by the height of the curb. The revolution of the chasers produces an upward current of air; this carries over the lighter particles, which fall outside the curb and are subsequently collected as a fine powder; those particles which are larger are of course heavier and cannot rise to the height of the curb, but fall back under the stones to be reground. In this way refractory substances can be reduced to very fine powder. Chasers are more largely employed in making "dusted" or very fine powders than any other form of pulverizing apparatus.

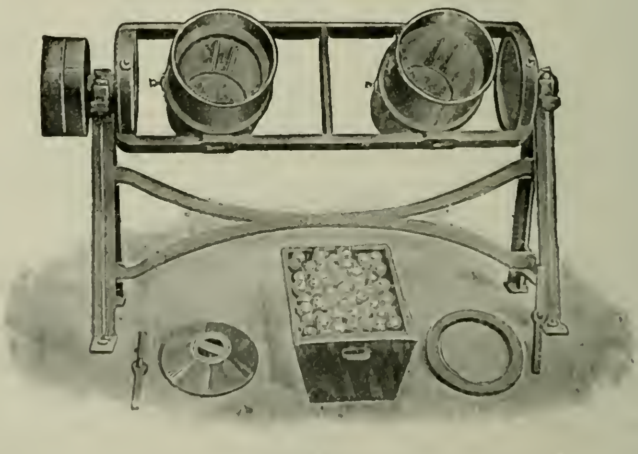
Fig. 233



Single jar mill

Pebble Mills.—These mills are operated on the principle of *attrition*, the grinding being effected by bringing the substance in contact with "pebbles" of flint or porcelain balls confined in jars or cylindrical vessels which are caused to revolve at a regulated speed. The advantages of such mills is that they afford a large grinding surface within

Fig. 234

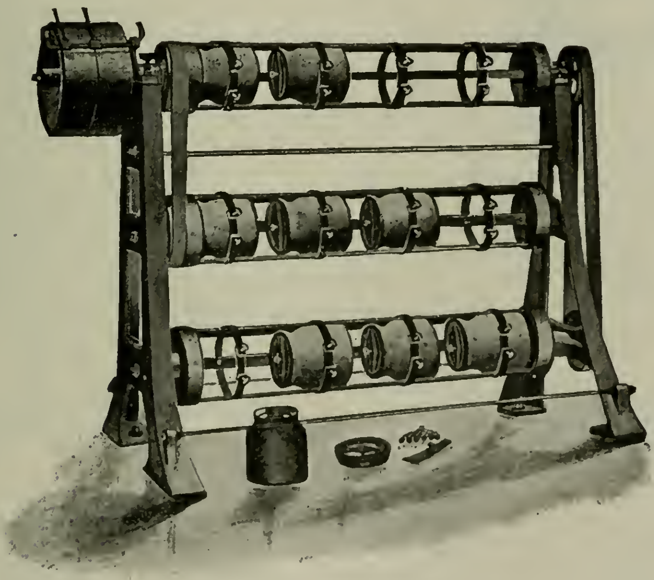


Double jar mill

a limited space. They are cleanly in their action, economical, and, on account of the simplicity of their construction, not liable to get out of order. Much depends, however, upon the hardness of the pebbles; for it must be seen that these are continually operating against each other while in action, particularly if care is not used in "feeding" the mill frequently. Such mills are adapted for grinding friable substances, extracts, chemicals, etc. Fig. 233 shows a sectional view of a single jar mill, Fig. 234 illustrates the double jar mill, while in Fig. 235 three batteries of laboratory mills are shown. The advantage of this combination is that four, six, or a dozen different substances may be ground at one time, and, as it is not necessary to put a definite weight in each jar, the quantity can be made to suit the demand.

Mills with Iron Grinding Surfaces.—Many mills have been constructed from time to time to suit special purposes. These cannot be noticed at length in a work having the scope of the present one. *Barrel mills* have been used. These consist of strong barrels lined with sheet iron, supported by strong iron shafts attached to the heads. The substance to be comminuted is placed in the barrel, and large round iron balls, like cannon balls, are introduced. Upon revolving the barrel rapidly, disintegration is effected. This principle is used also in pulverizing dried extracts and friable substances. A hollow circular iron ring, having a diameter slightly larger than that of the cannon ball which is placed inside with the charge of substance to be powdered, is made to revolve rapidly; the inertia of the cannon ball and the friction render its speed less than that of the ring, and the

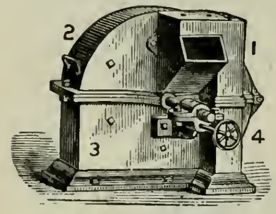
Fig. 235



Battery of pebble mills

substance is quickly ground. The *Bogardus mill* is constructed on a very ingenious principle. The grinding surfaces are two horizontal chilled iron plates, the lower one revolving, the upper one stationary ; both have corrugations having sharp edges, arranged concentrically. The peculiarity of this mill is that the centres of the grinding plates are not directly over each other as in buhrstone mills, but the centre of the lower plate is placed a few inches to one side ; by this arrangement the substance to be ground is caught by the ring edges of the revolving plate and dashed against the cutting edges of the stationary upper plate at an angle, the effect being to incise it as if cut with scissors and crush it at the same time.

Fig. 236



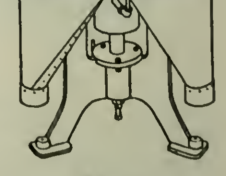
Mead's disintegrator

Mead's disintegrator differs from the mills thus far considered in the principle of construction, in the character of the grinding surfaces, and in its method of operation. The grinding is effected by hardened steel beaters riveted to a steel disk, which revolves vertically between corrugated rings ; the beaters are placed on the side of the disk nearest to the feeding trough, and catch the material as it enters the mill, beating it with great force against the corrugated rings until it is fine enough to pass between the disk and the face of the rings ; as soon as it passes here, it is on the side of the mill from whence it is discharged, and all that is fine enough is immediately driven out by the beaters on the back of the disk. That portion of the substance which is not fine enough is caught by the beaters and beaten against the screens until sufficiently fine to pass through. The screens are two inches in width, and extend around three-fourths of the diameter of the mill. They are made of square steel bars, and present a grinding surface to the beaters, but there is sufficient space between them to permit the passage of fine particles. The substance, as it is ground, falls into a receiving box below the mill, or is discharged through the floor into a room below. One prime requisite in running this mill is high speed. The disk must make three thousand revolutions a minute. The disintegrator is capable of grinding one hundred and fifty pounds of Ignatia bean, or six hundred pounds of wild cherry bark, in one hour. Fig. 236 gives an illustration of the mill, while Fig. 237 shows an enlarged view of the revolving disk and a section of the screens immediately above.

Fig. 237

Revolving disk and screens

Fig. 238



Max mill

The Max mill (Fig. 238) made by the Abbé Engineering Company, like Mead's disintegrator, acts on the principle of *percussion*. Power is conveyed by a vertical shaft, to which is attached a carrier provided with hard steel beaters, and as the substance is fed into the mill it is thrown by centrifugal force against a corrugated hard iron plate, the particles at the same time being thrown into violent contact with each other. Coarse or fine powders can be made at will.

Hand Mills

It is more difficult to construct a drug mill for the general use of the pharmacist than one for the special purposes of a drug miller. The latter has the choice of a buhrstone mill, chaser, disintegrator, iron mill, etc., which he can adjust to suit the character of the substance he desires to grind. The pharmacist's drug mill, on the other hand, is expected to do all kinds of work rapidly and well. It must, therefore, be capable of ready adjustment, possess durability, and have cutting surfaces not quickly dulled, and working parts not liable to get out of order.

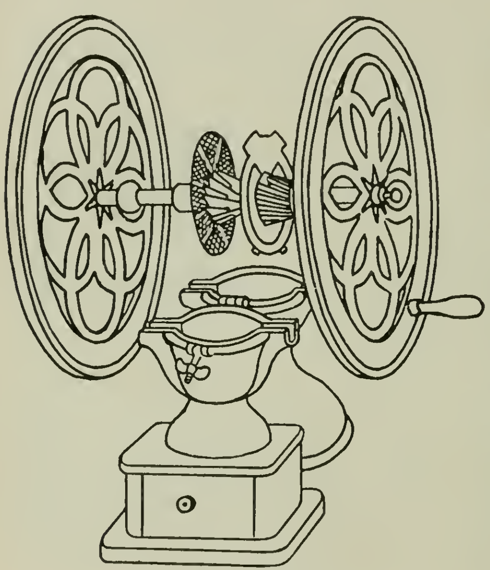
It is not easy to realize that every medicinal substance has an individuality of its own, but he who neglects the study of the physical characters of the substances of the materia medica can never expect to overcome successfully the obstacles which stand in the way of disintegration. Hand drug mills may be divided into three classes: 1. Those having vertical grinding surfaces. 2. Those having horizontal grinding surfaces. 3. Those having conical grinding surfaces. They have the following points in common: iron is the principal material of construction, the grinding surfaces are of hardened iron or steel and consist of teeth arranged in concentric rows, and the regulation of the fineness of the powder is effected by a screw or screws, by which the plates are made to approach or recede from each other.

1. Hand Drug Mills with Vertical Grinding Surfaces

Swift's Mill (old style).—This hand mill has been in use longer than any other in the American market. Its introduction marked an era in the history of pharmacy, and, although superseded now by greatly improved mills, it is still remembered with grateful feelings by those of the present generation, who had been previously accustomed to laborious mortar practice. In this mill there are two vertical grinding plates, one of which is stationary, while the other is connected with the horizontal revolving shaft; a conical breaker is also attached to the shaft, and when in position it is immediately below the lower opening of the hopper; a fly wheel with a handle is bolted to the outer end of the horizontal shaft, and furnishes the power required. The teeth are of iron and arranged in concentric rows, and the plates are made to approach each other or to separate by an adjusting screw. The supports of the mill are of ash or oak, and are durable and firm. The principal disadvantages of this mill are the difficulty of cleaning it, its slow action, its liability to become clogged, and the absence of a tight box or drawer to receive the ground drug. Two improvements have been made in the Swift's new style mills. In one the fly wheel has been made larger and heavier, in the other a double fly wheel has been attached.

Troemner's Mill, while constructed upon the same principle as Swift's, is much more thorough in its action, and requires less labor to operate it, than Swift's mill (old style). It has vertical plates, a thumb screw to regulate the fineness of the powder, a heavy fly wheel, and a close fitting drawer to receive the powdered drug. It is not so easily cleaned, however, as the next mill to be mentioned.

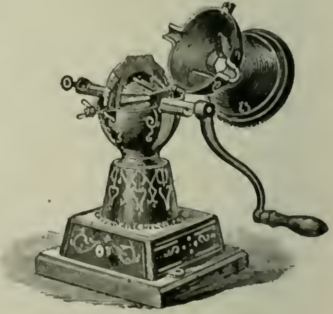
Fig. 239



Enterprise drug mill

The Enterprise Mill.—The introduction of this mill, in 1875, gave an impetus to the manufacture of hand drug mills which is still felt. The application of several new principles, and the extension and improvement of some valuable old ones, at once gained the attention of practical pharmacists. The great advantage possessed by this mill over those in the market at the time it was introduced was the ease with which the interior and the working parts could be reached. The principle of supporting the grinding plates upon a horizontal shaft, to the extremities of which heavy fly wheels were attached, and providing a means for lifting all the working parts out of the interior to facilitate their cleaning, were novel features. Fig. 239 so thoroughly illustrates this mill that it is hardly necessary to dwell upon its other features. The left hand grinding plate revolves, being geared to the shaft, while the one on the right hand is stationary. When in position for grinding they are, of course, nearly in contact. The opening of the interior is effected by simply turning the thumb screw in front. A smaller mill is shown in Fig. 240. It is very conveniently used at the dispensing counter.

Fig. 240



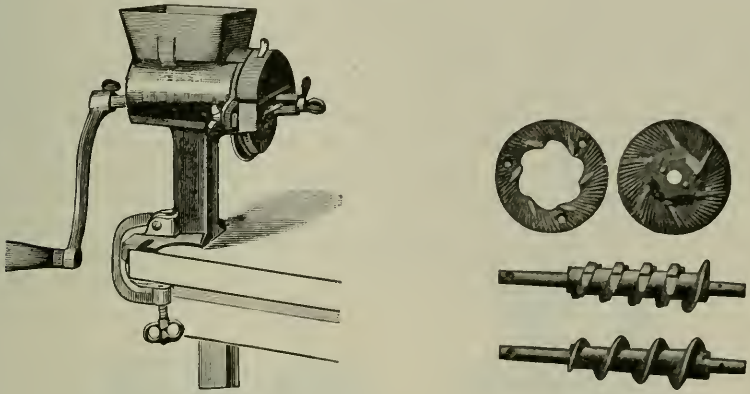
Drug mill (dispensing)

The small mill, made by the A. W. Straub Co., of Philadelphia, shown in Fig. 241, is very useful at the counter of the pharmacist for grinding small quantities of drugs; the plates and crushers are also shown. Ball bearings are used to facilitate easy running. The adjustment for making coarse or fine powders can be quickly changed, and it is the best small mill in use.

2. Hand Drug Mills having Horizontal Grinding Surfaces

Thomas's Mill.—This was one of the first hand drug mills made upon this principle. There are two horizontal grinding plates, the lower one revolving and the upper one stationary. A vertical shaft, which is geared to a horizontal shaft by bevel wheels, communicates the power to the lower plate upon revolving the fly wheel. The absence of a closed receptacle, and the difficulty of quickly cleaning the grinding surfaces, are the principal objections to this mill.

Fig. 241



Quaker City F. No. 4 mill

Plates and crushers

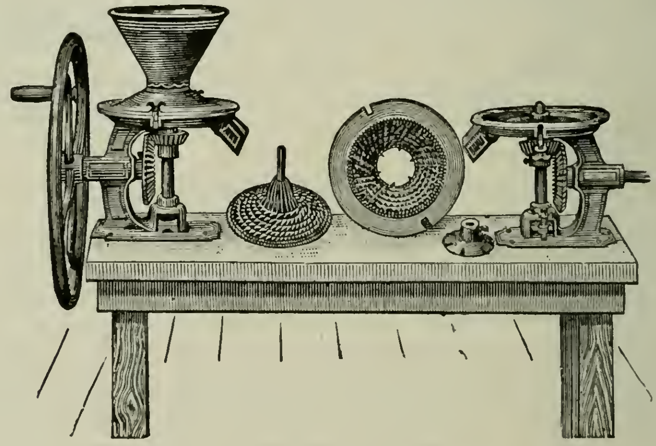
Swift's B Mill.—This is a comparatively new mill, very different in appearance from the old Swift's mill, and different in principle. The grinding plates are horizontal, the lower one revolving, while the upper one is stationary and forms the lower part of the hopper. It has two fly wheels, but the receptacle for the powder is an open one. A valuable feature of the Enterprise mill is present here,—*i.e.*, that of opening horizontally in the centre. The fineness of the powder is regulated by raising or lowering the lower plate by the thumb screw.

3. Hand Drug Mills having Conical Grinding Surfaces

The principle of construction in these mills is probably the best, because it avoids the fault of those constructed on the vertical plate principle, that of permitting particles to drop into the receptacle before they are finely ground, and also the fault of the horizontal plate mills, which may hold the ground particles too long, often until clogging results. The conical plate mill, if properly constructed, leaves little to be desired.

Hance's Mill is made on this principle. Formerly, the objection to this mill was the loss of time and labor consumed in getting it apart. This has been obviated by the introduction of the principle of opening it horizontally with the same kind of thumb screw and hinge that is used in the Enterprise mill. The Hance mill is better adapted for heavy work than any other of the hand drug mills, and, if desired, a belt and pulley can be attached for steam power. The lower plate is conical in shape, the summit being elongated into a breaker; the teeth are arranged in consecutive rows, a scraper being attached to the under surface of the lower plate; the upper grinding surface is situated upon the lower surface of the hopper, and corresponds in shape and in the arrangement, number, and size of teeth with the surface of the lower plate. The revolving plate is attached to the upright shaft by a simple key; this permits the easy removal of the plate when the mill is to be cleaned, yet holds it securely when in operation. Power is communicated by means of two shafts at right angles, geared with bevel cog wheels. The fineness of the powder is regulated by a thumb screw at the base, which elevates the revolving plate. The support to the mill is a strong iron frame, which is cast in one piece, and, although the mill has but a single fly wheel, this is partially compensated for by the length of the bearing for the horizontal shaft. Figs. 242 and 243 show the form which is designed to be bolted to the working table or counter; the new form, in which the mill is mounted on a box stand, may be preferred by some. Fig. 242*b* shows the upper grinding plate, and Fig. 242*a* the lower plate; a feeder is shown lying upon the counter, which is fastened to the upper portion of the lower plate by its set screw, so that seeds and similar drugs may be automatically fed to the mill.

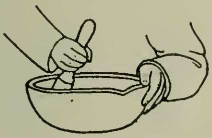
FIG. 242 FIG. 242*a* FIG. 242*b* FIG. 243



Hance mill Lower plate Upper plate Base

General Rules for operating Hand Mills.—Much of the dissatisfaction experienced in operating hand mills has arisen from improper methods of using them, or from failure to measure accurately the degree of resistance to disintegration possessed by the substance to be ground. One of the first requisites, as before mentioned, is to dry the substance as perfectly as its physical character will permit without injuring it. If coarse, bulky, fibrous roots, barks, or similar substances are to be ground, they must first be cut or bruised. Most substances are ground with less labor if they are first passed through the mill with the coarse adjustment, returning the portion which is sifted out, for regrinding, after setting the plates more closely together. This plan is repeated until the whole is ground. Care should be taken not to feed the substance into the hopper faster than it can be ground. The desire to get through quickly is the most frequent cause of clogging the mill, and when this occurs much time is lost, and the operator is strongly reminded of the well worn proverb about undue haste. If a considerable quantity is to be ground, two persons can operate the mill more economically than one,—one feeding the mill carefully, the other supplying the physical labor, and, after the expiration of a given time, exchanging places. Good judgment is necessary in determining the rapidity with which substances can be fed into the hopper. Resinous or oily drugs, or substances which soften by heat, require very careful treatment and cannot be fed rapidly; dry ligneous barks or roots, on the other hand, can be fed as rapidly as the extent of grinding surface of the mill and the muscle of the operator will permit. The mill should be thoroughly cleaned after each operation, particular attention being given to the grinding plates. In the case of substances which form hard lumps by heating or clogging up the plates, the quickest way is to use boiling water to soften or dissolve the lumps; the plates should then be quickly dried, to prevent rusting. By running sawdust or rice chaff through a mill, after an odorous drug has been ground, it may be speedily cleaned and freed from odor.

FIG. 244

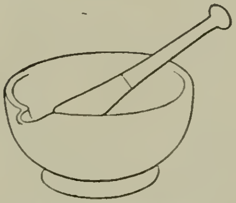


Trituration

FIG. 245

Spiral track of the pestle

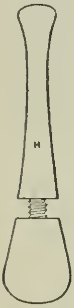
FIG. 246



Mortar for trituration

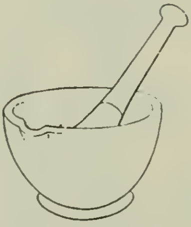
Trituration is the process of reducing substances to fine particles by rubbing them in a mortar with a pestle. The pestle is given a circular motion, accompanied by downward pressure, and the most effective method of using the pestle is to begin in the centre of the mortar and describe a circle of small diameter with the pestle on the substance, and gradually increase the size of the circle with each revolution until the side of the mortar is touched, when the motion is reversed and circles continually smaller in diameter are described until the centre is reached. This is repeated until pulverization is effected. By this treatment all the particles are brought under the action of the pestle. Fig. 244 shows the manner of holding the mortar during trituration and Fig. 245, the spiral, showing the direction traversed by the pestle in trituration as described above. The mortar and pestle best adapted for this operation have the shape shown in Fig. 246. Mortars with pestles having flattened ends are the best. Wedgwood ware is very serviceable, but is difficult to keep clean. As triturating mortars are rarely subjected to blows, porcelain mortars of proper shape are preferred. One of the principal annoyances in the use of wedgwood or porcelain mortars and pestles is that of the continual loosening of the handle of the pestle. The cement employed by the manufacturer is chiefly rosin of bad quality, and in using the pestle the particles of loosened cement often drop into the mixture in the mortar during trituration. The best plan is to pull the handle out of the pestle entirely as soon as possible and reset it. This is easily done by heating the end of the pestle in a sand bath until the cement has softened so that the handle may be extracted, then some hot cement (good sealing wax) is poured into the pestle hole, and the wooden handle is at once pressed forcibly in and held in its place by wedging or other means until the sealing wax has hardened. The hard rubber handle, which is made to screw accurately into the pestle (see Fig. 247), is a great improvement over the ordinary handle, and the additional cost is more than repaid by the comfort of using it. Where trituration is combined with contusion, as frequently happens in effecting solutions of chemical substances, a wedgwood mortar of the shape shown in Fig. 248 is well suited for the purpose. The selection of good mortars and pestles is frequently overlooked amidst the many items of detail in furnishing a pharmacy; but few implements bring more satisfaction to the operator than good mortars and pestles. It is a safe rule to examine every purchase carefully before accepting it finally, to see whether the pestle fits the mortar accurately. It should have as much bearing on the interior surface of the mortar as its size will permit, because the rapidity of the trituration depends largely on the amount of contact of the surfaces. The use of a round surfaced pestle in a flat surfaced mortar is just as great a waste of labor as that of a flat surfaced pestle in a round surfaced mortar. Trituration, as a distinct method of preparing a class of preparations, was officially recognized in the U. S. Pharmacopœia of 1880, and a new preparation, *Trituratio Elaterini*, made by triturating elaterin with sugar of milk, was introduced.

Fig. 247



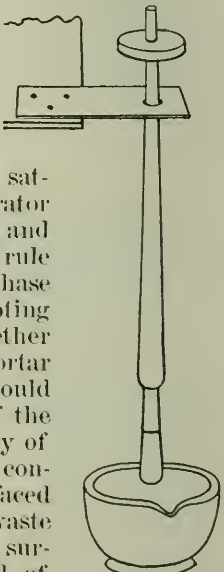
Pestle, hard rubber handle

Fig. 248



Wedgwood mortar and pestle

Fig. 249

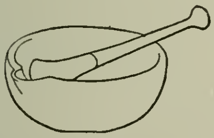


Triturating with a loaded pestle

Fig. 249 shows a device for facilitating trituration. It was communicated by Charles Rice, and is simpler and more effective than similar contrivances which have been described. It consists of an ordinary mortar and pestle, the latter having been lengthened by cutting down the mushroom top of the handle, so as to admit of its being inserted into the large end of a wooden handle, shaped somewhat like a ball bat, and between two and three feet long. The upper end of this handle should be about an inch in diameter, and during the use of the pestle is to be kept upright and steady by passing through an opening in a piece of heavy pasteboard or wood which may be tacked to the under side of some convenient shelf. The mortar should stand on a counter about three feet from the floor, and the upper end of the pestle pass through a shelf above. To stop the noise caused by the pestle striking against the sides of the opening, a piece of sole leather is attached to the under side of the shelf and the pestle passed through a hole in its centre. This also serves another purpose,—viz., when it is necessary to raise the pestle to admit of changing or stirring the contents of the mortar, the leather will clasp the enlargement of the handle so as to suspend the pestle securely out of the way of the hands. In using the apparatus, one hand grasps the handle just above its lower end, and a very slight effort is requisite to give it the necessary motion. The weight of the handle is usually sufficient to insure a proper degree of friction. If, however, more pressure is desired, the pestle can be weighted by slipping a perforated weight on to an iron pin driven in the top of the handle.

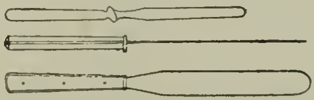
Mortars and pestles are sometimes made of green or white glass. The former are to be preferred because they are stronger; the latter, however, present a handsomer appearance. Glass mortars are not adapted to the continued trituration of hard substances. They are useful only in dissolving certain chemical substances directed in prescriptions, like corrosive sublimate, the alkaloids, etc. It is best to place the glass mortar over a dark surface, in order to show by contrast more clearly when the solution of the white object is effected.

FIG. 250



Porcelain mortar and pestle

FIGS. 251, 252, 253



Solid handle and balanced handle spatulas

Porcelain mortars and pestles (see Fig. 250) are, however, more generally useful as solution mortars. Pestles entirely of porcelain are objectionable, because they are easily broken.

Spatulas.—The process of trituration as ordinarily performed requires the use of spatulas. These consist of flexible steel blades attached to handles, and in trituration they serve to loosen the substance as it becomes packed upon the sides of the mortar. Spatulas are largely used in extemporaneous pharmacy, and they will be alluded to frequently under various special heads in Part V. The blade of a spatula is frequently broken when too much pressure is applied, but if the broken blade remaining in the handle have its sharp corners ground off upon a grindstone, or filed off, it will be just as useful for some purposes as it was when perfect.

Spatulas may now be had of excellent quality, and greatly improved in style over those formerly used. The best form is the balanced handle spatula (see Fig. 252). In this the metal of the handle and that of the blade are continuous and of the same width, so that the annoyance of the tang becoming loose in the handle, as in the old style spatulas, is avoided. The flat metal handle is enlarged by riveting smooth, flat pieces of hard wood to it to insure convenience in using. The balanced handle derives its name from the fact that when lying upon the counter the weight of the handle is sufficient to overcome the weight of the blade, so that contact of the blade with the counter is prevented. Solid handled spatulas (see Fig. 251) are also made, the whole being of one solid piece of metal, and the handle being nickel plated. A pocket spatula, which closes like a clasp knife, is also furnished by dealers.

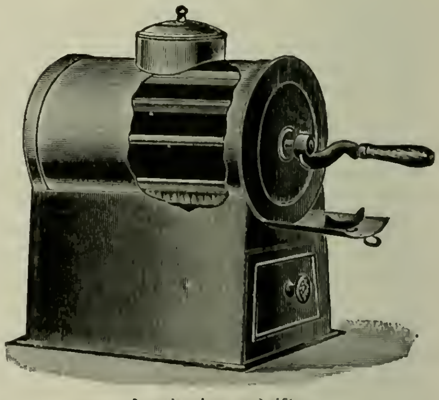
Fig. 254

Spatula, blade coated with hard rubber

Fig. 254 shows a spatula coated with hard rubber, made by Fox, Fultz & Co., for making ointments which contain corrosive substances, or substances acting on steel.

Sifting is the process of passing a powdered substance through the meshes of perforated material with the object of separating the coarser from the finer particles. Sieves are employed in this process. The frames are usually round, although sometimes they are oval, square, or rectangular. The ordinary sieve is usually made by stretching wire gauze over a flat wooden ring, and keeping it in its place by slipping over it a narrow wooden ring of slightly greater diameter, which is tacked securely. Covered sieves, or drum sieves, have tight covers for the top and bottom. The simplest pharmaceutical sieves for general use are obtained by making five rectangular frames, each four inches deep, ten inches wide, and sixteen inches long. These should be light but strong, and the bottoms covered with brass wire gauze of different degrees of fineness. A box, ten inches deep, twelve inches wide, and twenty-two inches long, with a tight cover, is provided to hold the sieves and prevent dust from escaping. Two cleats are nailed horizontally upon the sides of the box, five inches from the top, for the sieve to slide upon, and a hole is cut in the front of the box in order to permit a handle, with a hook at the end, to pass through and be attached to a screw eye in the front side of the sieve; two large corks are screwed to the back of the sieve at either end to act as buffers. The powdered substance is introduced into the proper sieve, which is placed upon the cleats, and the handle passed through the hole and hooked to the sieve; the cover is then placed in position, and the sieve pushed backward and forward, touching the back lightly.

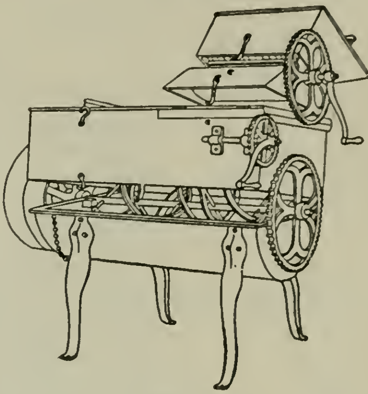
Fig. 255



Jones's mixer and sifter

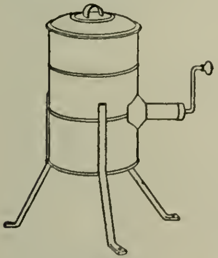
A very important point, which must not be omitted after sifting substances, is the thorough mixing of all portions of the sifted powder, in order that each part of the finished powder may have a uniform composition. The starchy portions of a drug will be powdered more quickly than the ligneous portions, and will usually pass through the sieve first; hence the sifted powder must always be thoroughly mixed. Upon the small scale this may be easily effected with a spatula or mortar and pestle; upon a larger scale special apparatus is needed. Fig. 255 shows the Jones's mixer and sifter, which is well adapted for smaller operations; the principle is that of using revolving mixers and brushes. A perforated metal plate forms the bottom of the sifter, and, when mixing, an unperforated plate is pushed over the perforated plate, so that when the powder is thoroughly mixed this plate can be pulled out, and the powder then sifts through the perforated plate into the drawer below. Hunter's sifter is one of the most effective large machines; it is shown in Fig. 256. In this the powder is sifted in the cylindrical sieve, and adhering particles or small lumps are brushed through by the revolving brushes; the revolving spiral mixers in the large box cause the particles to be thoroughly mingled. The illustration shows the method of operating so well that further description is unnecessary. In Fig. 257 is seen an enclosed sifter well adapted for many purposes, while Fig. 258 shows a sectional view of the same kind of sifter for smaller operations. The sieve is hemispherical in shape, and is contained in a tinned iron scoop (see Fig. 259, which shows the end view). Two circles of stout wire are soldered to a central axis at right angles to each other, and the axis passes through the tin handle and terminates in a crank. When a powder is placed in the scoop, and the wire rings are made to revolve by turning the axis with the hand, the particles of powder are rapidly forced through the meshes of the sieve. This apparatus is especially useful in breaking up moistened lumps in powders which are about to be percolated. (See Percolation.)

Fig. 256



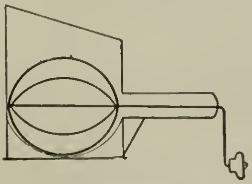
Hunter's sifter

Fig. 257



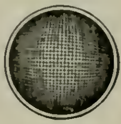
Enclosed sifter

Fig. 258



Scoop sifter

Fig. 259



Scoop sifter sieve (end view)

Fineness of Powder.—The fineness of powder is expressed, in the Pharmacopœia, either by descriptive words (generally so in the case of brittle or easily pulverizable substances), or in terms expressing the number of meshes to a linear inch of the sieve through which the powder will pass. The corresponding values, in terms of metric measures of length, are added below in parentheses, but it has not been deemed advisable to substitute them in the text of the Pharmacopœia for those at present in use. The diameter of the wire (gauge number) used in making sieve cloth has an important influence upon the size of the mesh, and it is necessary to specify in each case the *thickness of the wire.*

These different forms of expression correspond to each other as follows:

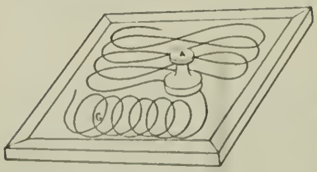
A *very fine* powder	should pass through a sieve having 80 or more meshes to the linear inch (30 meshes to the cm.) and should be made from gauge No. 38 wire	= No. 80 powder.
A *fine* powder	should pass through a sieve having 60 meshes to the linear inch (24 meshes to the cm.) and should be made from gauge No. 36 wire	= No. 60 powder.
A *moderately fine* powder	should pass through a sieve having 50 meshes to the linear inch (20 meshes to the cm.) and should be made from gauge No. 35 wire	= No. 50 powder.
A *moderately coarse* powder	should pass through a sieve having 40 meshes to the linear inch (16 meshes to the cm.) and should be made from gauge No. 33 wire	= No. 40 powder.
A *coarse* powder	should pass through a sieve having 20 meshes to the linear inch (8 meshes to the cm.) and should be made from gauge No. 28 wire	= No. 20 powder.

In certain cases, powders of a different degree of fineness (*e.g.*, No. 30, No. 12) are directed to be taken.

Not more than one-fourth of the powder is expected to pass through a sieve having ten more meshes to the inch than the one designated.

For very fine powders, bolting cloth is used for the sifting medium; and when acid substances are to be sifted, horsehair sieves are used.

Fig. 260

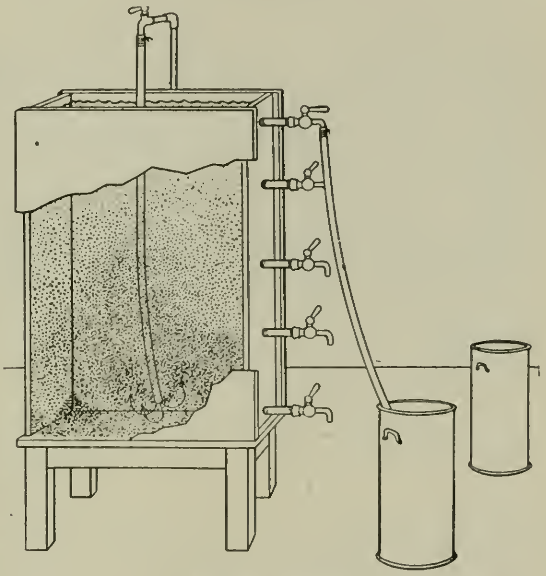


Slab and muller

Levigation is the process of reducing substances to a state of minute division by triturating them after they have been made into a paste with water or other liquid. This is effected in a shallow mortar with a flat surfaced pestle, or upon a ground glass slab with a flat surfaced glass muller (see Fig. 260). The motion imparted to the muller, A, closely resembles the figure 8; this is frequently varied with that of elongated circles which intersect each other, the object being to vary the motion so that all particles of the powder may be brought under the action of the muller upon the slab G. Certain substances, like red mercuric oxide and zinc oxide, if made into a paste with alcohol or water, are more readily reduced to fine powder in this way than by the action of the mortar and pestle. The process is termed *porphyrization* when performed with a porphyry slab and muller.

Elutriation is the process of obtaining a substance in fine powder by suspending an insoluble powder in water, allowing the heavier particles to fall to the bottom of the vessel, and decanting the liquid containing the lighter particles into another vessel, and there collecting them. It is *water sifting* practically, wherein the superior gravity of the larger particles is used as a means of separating them from the smaller. Fig. 261 illustrates elutriation. The stopcocks on the side of the tank are intended to be used for drawing off a portion of the liquid after the heavier particles have subsided; this liquid may be transferred to another tank to finally permit the fine particles to settle. Prepared chalk is a familiar illustration of an elutriated powder.

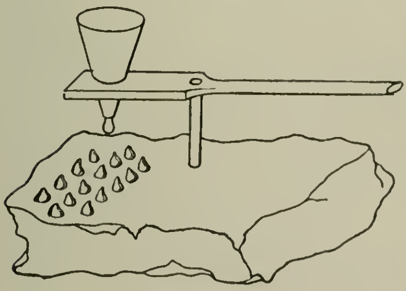
Fig. 261



Elutriating apparatus

Trochiscation is the process of making the pasty mass or magma obtained by elutriation into dry, conical masses. This is usually accomplished by the use of the little apparatus shown in Fig. 262. This consists of a tinned iron cone, supported in a circular wooden frame which has one short wooden leg and a handle. A slab of chalk or other porous substance is provided, and after filling the cone with the pasty mass the handle is taken in the hand and the leg of the frame is tapped gently upon the slab of chalk. The shock causes a conical mass of the substance to fall upon the slab, whereupon the moisture present soon becomes absorbed, so that the little cone dries quickly. A succession of taps, with a slight lateral movement, deposits the cones in regular rows, and when

Fig. 262



Trochiscator

the slab is full the first cones are found to be dry enough to be transferred, and all will soon be in the same condition. Chalk, bismuth, lake, and other insoluble powders are formed into conical nodules in this way.

Pulverization by intervention is the process of reducing substances to powder through the use of a foreign substance, from which the powder is subsequently freed by some simple method. No general process can be given for this method of pulverization, as the character of the substance must determine the method. The metal gold may be powdered by rubbing gold leaf in a mortar in contact with potassium sulphate. The latter is subsequently dissolved out with water. Camphor may be pulverized through the addition of a few drops of alcohol, chloroform, or other solvent. The foreign substance in this case is disposed of through evaporation. Metallic tin may be granulated by melting it and agitating it in a box containing powdered chalk. The latter is subsequently dissolved out with diluted acetic acid. Phosphorus may be pulverized by placing it in water contained in a small flask, then heating the water gradually until the phosphorus is melted, and shaking the flask while the phosphorus is cooling. The agitation in the presence of water keeps the particles from cohering.

CHAPTER IX

SOLUTION

Solution.—In pharmacy this term is applied to the process whereby any substance is liquefied or made to disappear when brought in contact with a liquid. The particles of the substance being uniformly diffused through the liquid, no separation takes place upon standing. The liquid used to effect this change is called a *solvent*, and, after its combination with the dissolved substance, a *solution;* if the liquid has exercised its powers as a solvent to its utmost extent, and is incapable of retaining any more of the dissolved substance, it is termed a *saturated solution.* A substance which is not acted on by a solvent is said to be *insoluble.*

Solution of Solids.—This is an operation which is very frequently performed by the pharmacist. In this place only the methods of effecting the solution of solid bodies which can be entirely dissolved in the solvent will be noticed. This excludes the operations of Infusion, Decoction, Percolation, Maceration, etc., which will be considered at length in subsequent chapters. Solution may be of two kinds : 1, Simple ; 2, Chemical.

1. Simple Solution is where the solid suffers no alteration on being dissolved, except that which depends upon its external form, and where, if the reverse operation of evaporation is applied, the solid substance is recovered unchanged. The making of syrup is an example.

2. Chemical Solution is where the properties of the dissolved body are changed by the chemical action of the solvent or some of the substances added, and the simple process of evaporation results in the production of a body having different properties, as, for example, in the official solution of mercuric nitrate.

Effects of Pulverization and Agitation.—The solution of solids may be facilitated by pulverizing them and stirring the mixture, thus increasing their extent of surface and promoting the frequent contact of the surfaces with fresh portions of the solvent. This is easily illustrated, as already noted in the chapter on Comminution, by placing half an ounce of lump alum and half an ounce of powdered alum each in a separate pint of water at the same time. A few vigorous stirs will soon cause the latter to dissolve, while the former will require a much longer time.

Effect of Heat.—The application of heat generally favors solubility, for nearly all substances are more soluble in hot liquids than in cold ones. In addition to this, the convection currents in the liquid caused by heat hasten the solution by constantly bringing fresh surfaces into contact with the liquid. In many cases the ratio of solubility is not the same for equal increments of heat.

Density of Solutions.—The effect of dissolving a solid body, specifically heavier than the solvent, is always to increase the density of the liquid in which the solid is dissolved. The specific gravity of water is 1.000. If 5 percent. of sugar is dissolved in it, the specific gravity is 1.021; if 10 percent., 1.070; if 20 percent., 1.088, etc. This fact is capable of optical proof; for if a piece of sugar is suspended near the top of some water in a beaker, the downward currents of the solution can readily be noticed if viewed by transmitted light.

Solubility of Substances in Saturated Solutions.—While a saturated solution is one which is incapable of dissolving any more of the substance which was dissolved in the liquid, it must not be assumed that the saturated solution will not dissolve *other* solids. For example, if granulated potassium nitrate be mixed with 2 percent. of copper sulphate, and then placed in a funnel having a plug of cotton in the throat, it will be found that the copper sulphate can be very easily removed by pouring on the potassium nitrate mixture a *saturated solution* of potassium nitrate. The potassium nitrate cannot suffer loss, because the liquid passing through is a saturated solution of the same substance; but copper sulphate is soluble in a saturated solution of potassium nitrate, and it is thus washed out.

Reduction in Temperature caused by Rapid Solution.—When solids dissolve rapidly in liquids without chemical action, a reduction in temperature always takes place, and cold is produced, in accordance with the well known law governing the conversion of solids into liquids, whereby sensible heat is converted into latent heat. The so-called freezing mixtures are produced in this way. Thus, if 5 parts of potassium sulphocyanide are quickly mixed with 4 parts of cold water, the temperature of the solution falls to —20° C. (—4° F.); 32 parts of sodium chloride, if mixed with 100 parts of snow, will produce a brine having a freezing point of —23° C. (—9.4° F.). Equal parts of crystallized calcium chloride and snow, when well mixed, will have a temperature as low as —45° C. (—49° F.).

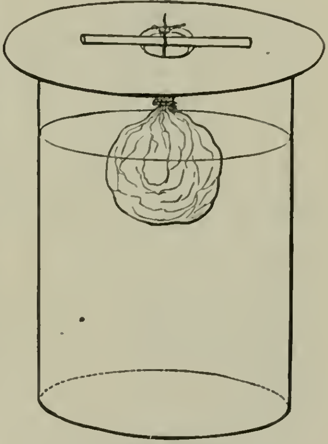
Elevation of Temperature produced by Solution accompanied by Chemical Action.—If chemical action takes place while solution is progressing, the opposite effect, or elevation of temperature, is frequently produced, as in dissolving anhydrous salts. The same fact is noticed when the solution of an alkaline oxide made by calcination is effected by treating it with an acid, as when calcined magnesia is dissolved in a solution of citric acid.

Modes of effecting Solutions of Solids.—The method usually employed by the pharmacist is one which requires the use of the solution mortar and pestle (see Fig. 216). The ordinary practice is to crush the substance into fragments in the mortar with the pestle, and then pour upon it the solvent, meanwhile stirring with the pestle until solution is effected. If definite quantities are used, and the whole of the solvent is required to dissolve the given weight of the salt, a portion only of the solvent should be added at first, and when this is saturated the solution is poured off and a fresh portion of solvent added. This operation is repeated until the solid is entirely dissolved; the solutions are then mixed. Other methods of effecting solution are to shake the solid with the liquid in a bottle or flask, or to apply heat to the substances in a suitable vessel.

Circulatory Solution.—A very excellent mode of dissolving substances, particularly where the solid is not very soluble or the relative proportion of liquid is small, is to suspend the solid near the top of the liquid upon a porous diaphragm or a suitable sieve, or tied up in a gauze bag if its nature will admit of this treatment. The substance immediately in contact with the solvent is dissolved, and the solution descends, its place being supplied by fresh portions of the solvent. A circulation is thus created and solution facilitated (see Fig. 263).

Solvents used in Pharmacy.—*Water.* The most useful of all solvents is water. It has a more extensive range than any other liquid, and the aqueous solutions are among the most important preparations of pharmacy. They are especially treated of in the following chapters, under the heads of Liquores, Aquæ, Syrupi, etc.

FIG. 263



Circulatory solution

Alcohol as a solvent is next in importance to water. It has an important advantage over water in the fact that preparations made with it keep almost indefinitely, while most aqueous solutions of organic substances soon decompose or become worthless. Resins, volatile oils, alkaloids, glucosides, salts, etc., are dissolved by alcohol, while many inert principles, like gum, albumin, and starch, are insoluble in it, so that it has also great usefulness in its negative character.

Glycerin is an excellent solvent, although its range is not so extensive as either of the preceding. It has in its concentrated state antiseptic qualities of a high order, but has not the valuable negative qualities of alcohol. It dissolves the fixed alkalies, some of the alkaline earths, a large number of neutral salts, and vegetable acids, pepsin, tannin, etc., but it also dissolves gum, albumin, starch, etc., and thus its solutions are generally loaded with inert constituents. (See Glycerites.)

Ether is a good solvent for special purposes. Oils, fats, resins, and some of the alkaloids and neutral principles are dissolved by it.

Petroleum Benzin is very similar in its solvent properties to ether.

Chloroform resembles ether and petroleum benzin as a solvent. It has an advantage over both, however, in not being inflammable.

Benzene obtained from the distillation of coal tar like ether is a good solvent for many substances.

Acetone is a good solvent for resins, oils, etc., and is used officially in making oleoresins.

Carbon Disulphide is an excellent solvent for rubber, phosphorus, etc. Its range is limited, however, and its odor and inflammability detract from its usefulness.

Acids, either strong or diluted, are used as solvents ; as in vinegars. *Oils* are also used in this way in liniments, etc.

Solubility as a Test.—The solubility of a substance in various solvents constitutes a factor whereby its identity and purity can be determined, and all pharmacopœias recognize solubility as one of the means of testing substances. The U. S. Pharmacopœia indicates the degree of solubility of a body by stating the number of parts, by weight, of the solvent required to dissolve one part of the substance. The temperature at which solution is to be effected is frequently given ; in other cases such terms as "readily soluble" or "sparingly" are used. For taking the solubility of substances at ordinary temperatures—25° C. (77° F.)—a convenient portion of the substance should be placed in a small glass flask provided with a stopper, the solvent should be added, and the flask shaken until a saturated solution is made. This is, of course, known by a portion of the substance remaining undissolved at the temperature of 25° C. (77° F.). The flask should be set aside and kept at about this temperature for a few days, and occasionally stirred to avoid supersaturation. The solution is passed through a dry, clean filter into a tared dish and weighed, the filtrate is evaporated to dryness, and the residue weighed. The difference between the weight of the solution and that of the dry residue furnishes the basis for the calculation. To illustrate, the weight of the filtrate is 12 Gm. ; the dry residue weighs 1.5 Gm. The difference, 10.5 Gm., gives the weight of the evaporated solvent ; by dividing this weight by that of the dry residue, 10.5 ÷ 1.5, the substance is found to be soluble in 7 parts of the solvent ; or, stated differently, if 1.5 parts of the substance required 10.5 parts of the liquid for solution, 1 part would require 7 parts of the liquid, 1.5 : 10.5 :: 1 : 7.

FIG. 264

Rice's lysimeter

For taking the solubility of substances in hot solvents, Dr. Rice devised an ingenious instrument which he called a lysimeter (see Fig. 264).

Table of the Solubility of Official Substances in Water and in Alcohol

Abbreviations : s. = soluble ; ins. = insoluble ; sp. = sparingly ; v. s. = very soluble ; alm. = almost ; dec. = decomposed ; r. s. = readily soluble ; p. s. = partially soluble

One part is soluble	In Water		In Alcohol	
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling
	Parts	*Parts*	*Parts*	*Parts*
Acetanilidum	179	18	2.5	0.4
Acetphenetidinum	925	70	12	2
Acidum Benzoicum	281	15	1.8	1
Boricum	18	3	15.3	4.3
Camphoricum	125	10	r. s.	—
Citricum	0.54	0.4	1.55	1.43
Gallicum	83–86	3	4.14	1
Salicylicum	308	14	2	v. s.
Stearicum	ins.	ins.	16.6	r. s.
Tannicum	v. s.	v. s.	v. s.	v. s.
Tartaricum	0.71	0.5	1.67	0.2
Trichloraceticum	v. s.	dec.	v. s.	—
Aconitina	3200	—	22	—

Solubility of Official Substances in Water and in Alcohol—*Continued*

One part is soluble	**In Water**		**In Alcohol**	
	At 25° C. (77° F.) *Parts*	Boiling *Parts*	At 25° C. (77° F.) *Parts*	Boiling *Parts*
Adeps	ins.	ins.	v. sp.	—
Æthylis Carbamas	v. s.	—	0.6	—
Aloinum	120	—	15	—
Alumen	9	0.3	ins.	ins.
Exsiccatum	17	1.4	ins.	ins.
Alumini Hydroxidum	ins.	ins.	ins.	ins.
Sulphas	1	v. s.	ins.	ins.
Ammonii Benzoas	10.5	1.2	28	7.6
Bromidum	1.2	0.7	12.5	9
Carbonas	4	dec.	dec.	dec.
Chloridum	3	1	80	—
Iodidum	0.6	0.43	9	3.7
Salicylas	0.9	r. s.	2.3	1
Valeras	v. s.	v. s.	v. s.	v. s.
Antimonii et Potassii Tartras	15.5	3	ins.	ins.
Antipyrina	v. s.	—	1	—
Apomorphinæ Hydrochloridum	39.5	16 (80° C.)	38.2	30 (60° C.)
Argenti Cyanidum	ins.	ins.	ins.	ins.
Nitras	0.54	0.1	24	5
Nitras Fusus	0.54	0.1	24	5
Oxidum	v. sp.	v. sp.	ins.	ins.
Arseni Iodidum	12	—	28	—
Arseni Trioxidum	30–100	15	sp.	—
Atropina	450	86.7 (80° C.)	1.46	0.9 (60° C.)
Atropinæ Sulphas	0.38	0.22 (80° C.)	3.7	1.9 (60° C.)
Benzinum	ins.	—	6	—
Benzosulphinidum	250	24	25	—
Betanaphthol	950	75	0.61	v. s.
Bismuthi Citras	ins.	ins.	ins.	ins.
et Ammonii Citras	v. s.	v. s.	sp.	sp.
Subcarbonas	ins.	ins.	ins.	ins.
Subgallas	ins.	ins.	ins.	ins.
Subnitras	alm. ins.	alm. ins.	ins.	ins.
Subsalicylas	alm. ins.	—	—	—
Bromoformum	v. sp.	v. sp.	v. s.	v. s.
Bromum	28	—	—	—
Caffeina	45.6	5.2 (80° C.)	53.2	17.1 (60° C.)
Calcii Bromidum	v. s.	v. s.	v. s.	v. s.
Carbonas Præcipitatus	alm. ins.	alm. ins.	ins.	ins.
Chloridum	1.3	v. s.	8	1.5
Hypophosphis	6.5	6	ins.	ins.
Phosphas Præcipitatus	alm. ins.	dec.	ins.	ins.
Sulphas Exsiccatus	378	451	ins.	ins.
Calx	760	1600	ins.	ins.
Camphora	v. sp.	v. sp.	r. s.	r. s.
Camphora Monobromata	alm. ins.	alm. ins.	v. s.	v. s.
Carbonei Disulphidum	526	—	v. s.	v. s.
Cerii Oxalas	ins.	ins.	ins.	ins.
Cetaceum	ins.	ins.	alm. ins.	50
Chloralformamidum	18.7	—	1.3	—
Chloralum Hydratum	v. s.	v. s.	v. s.	v. s.
Chromii Trioxidum	v. s.	v. s.	dec.	dec.
Chrysarobinum	4812	2170 (80° C.)	308	275 (60° C.)
Cinchonidinæ Sulphas	63	21 (80° C.)	72	32 (60° C.)
Cinchoninæ Sulphas	58	32 (80° C.)	10	5.2 (60° C.)
Cocaina	600	260 (80° C.)	5	—
Cocainæ Hydrochloridum	0.4	0.1 (80° C.)	2.6	1.4 (60° C.)
Codeina	120	59 (80° C.)	1.6	0.92 (60° C.)
Codeinæ Phosphas	2.25	0.46 (80° C.)	261	97 (60° C.)

Solubility of Official Substances in Water and in Alcohol—*Continued*

One part is soluble	In Water		In Alcohol	
	At 25° C. (77° F.) *Parts*	Boiling *Parts*	At 25° C. (77° F.) *Parts*	Boiling *Parts*
Codeinæ Sulphas	30	6.25 (80° C.)	1035	340 (60° C.)
Colchicina	22	20 (80° C.)	v. s.	v. s.
Creta Præparata	alm. ins.	alm. ins.	ins.	ins.
Cupri Sulphas	2.2	0.5	400	—
Elaterinum	ins.	ins.	262	75 (60° C.)
Ferri Chloridum	v. s.	v. s.	v. s.	v. s.
Citras	s.	r. s.	ins.	ins.
et Ammonii Citras	r. s.	r. s.	ins.	ins.
et Ammonii Sulphas	2.7	0. 8.	ins.	ins.
et Ammonii Tartras	v. s.	v. s.	ins.	ins.
et Potassii Tartras	v. s.	v. s.	ins.	ins.
et Quininæ Citras	s.	v. s.	p. s.	p. s.
et Quininæ Citras Solubilis	r. s.	—	p. s.	—
et Strychninæ Citras	r. s.	v. s.	p. s.	p. s.
Hypophosphis	2300	1200	—	—
Phosphas Solubilis	v. s.	v. s.	ins.	ins.
Pyrophosphas Solubilis	v. s.	v. s.	ins.	ins.
Sulphas	0.9	0.3	ins.	ins.
Sulphas Exsiccatus	0.9	0.3	ins.	ins.
Sulphas Granulatus	0.9	0.3	ins.	ins.
Gelatinum	ins.	s.	ins.	ins.
Glycyrrhizinum Ammoniatum	r. s.	r. s.	r. s.	r. s.
Guaiacol	53	—	v. s.	v. s.
Guaiacolis Carbonas	ins.	ins.	48	r. s.
Hexamethylenamina	1.5	1.5	10	8
Homatropinæ Hydrobromidum	5.7	—	32.5	8.7 (60° C.)
Hydrargyri Chloridum Corrosivum	13	2	3	1.2
Chloridum Mite	ins.	ins.	ins.	ins.
Iodidum Flavum	alm. ins.	alm. ins.	ins.	ins.
Iodidum Rubrum	alm. ins.	alm. ins.	116	15
Oxidum Flavum	alm. ins.	alm. ins.	ins.	ins.
Oxidum Rubrum	alm. ins.	alm. ins.	ins.	ins.
Hydrargyrum Ammoniatum	ins.	ins.	ins.	ins.
Hydrastina	alm. ins.	4000 (80° C.)	135	17 (60° C.)
Hydrastininæ Hydrochloridum	v. s.	v. s.	v. s.	v. s.
Hyoscinæ Hydrobromidum	1.5	—	16	1.3 (60° C.)
Hyoscyaminæ Hydrobromidum	v. s.	v. s.	2	—
Sulphas	v. s.	v. s.	6.4	—
Iodoformum	9391	—	46.7	12
Iodolum	4900	—	9	—
Iodum	5000	—	10	—
Lithii Benzoas	3	2.5	13	10
Bromidum	0.6	0.3	v. s.	v. s.
Carbonas	75	140	ins.	ins.
Citras	2	1.5	alm. ins.	alm. ins.
Salicylas	v. s.	v. s.	v. s.	v. s.
Magnesii Carbonas	ins.	ins.	ins.	ins.
Oxidum	alm. ins.	alm. ins.	ins.	ins.
Oxidum Ponderosum	alm. ins.	alm. ins.	ins.	ins.
Sulphas	1.1	0.13	ins.	ins.
Mangani Dioxidum Præcipitatum	ins.	ins.	ins.	ins.
Hypophosphis	6.6	6	alm. ins.	alm. ins.
Sulphas	0.7	0.53	ins.	ins.
Menthol	sp. s.	—	v. s.	—
Methylis Salicylas	sp. s.	—	v. s.	—
Methylthioninæ Hydrochloridum	r. s.	—	s.	—
Morphina	3330	1040 (80° C.)	168	76 (60° C.)
Morphinæ Acetas	2.25	2 (80° C.)	21.6	2.5 (60° C.)
Hydrochloridum	17.2	0.5 (80° C.)	42	35.5 (60° C.)

Solubility of Official Substances in Water and in Alcohol—*Continued*

One part is soluble	In Water		In Alcohol	
	At 25° C. (77° F.)	Boiling	At 25° C. (77° F.)	Boiling
	Parts	*Parts*	*Parts*	*Parts*
Morphinæ Sulphas	15.3	0.6 (80° C.)	465	187 (60° C.)
Naphthalenum	ins.	—	13	v. s.
Paraffinum	ins.	ins.	ins.	ins.
Paraldehydum	8	16.5	—	—
Pelletierinæ Tannas	235	—	12.6	—
Phenol	19.6	—	v. s.	—
Liquefactum	12	—	—	—
Phenylis Salicylas	2333	—	5	v. s.
Phosphorus	ins.	ins.	350 (15° C.)	240
Physostigminæ Salicylas	72.5	15 (80° C.)	12.7	4 (60° C.)
Sulphas	v. s.	v. s.	v. s.	v. s.
Pilocarpinæ Hydrochloridum	0.3	—	2.3	1.1 (60° C.)
Nitras	4	—	60	16 (60° C.)
Piperina	ins.	ins.	15	4.4 (60° C.)
Plumbi Acetas	2	0.5	30	1
Iodidum	1300	200	v. sp.	v. sp.
Nitras	1.85	0.75	alm. ins.	alm. ins.
Oxidum	alm. ins	alm. ins.	ins.	ins.
Potassii Acetas	0.4	v. s.	2	v. s.
Bicarbonas	3	dec.	alm. ins.	alm. ins.
Bitartras	200	16.7	v. sp.	v. sp.
Bromidum	1.5	v. s.	180	16
Carbonas	0.91	0.65	ins.	ins.
Chloras	16	1.7	ins.	ins.
Citras	0.5	v. s.	sp.	sp.
Cyanidum	2	dec.	sp.	sp.
Dichromas	9	1.5	ins.	ins.
et Sodii Tartras	1.2	v. s.	alm. ins.	alm. ins.
Ferrocyanidum	4	2	ins.	ins.
Hydroxidum	0.4	v. s.	2	v. s.
Hypophosphis	0.5	0.3	7	3.6
Iodidum	0.7	0.5	12	6
Nitras	3.6	0.4	v. sp.	v. sp.
Permanganas	15	3	dec.	dec.
Sulphas	9	4	ins.	ins.
Pyrogallol	1.6	v. s.	1	v. s.
Quinina	1550	775 (80° C.)	0.6	2
Quininæ Bisulphas	8.5	0.68 (80° C.)	18	0.5 (60° C.)
Hydrobromidum	40	3 (80° C.)	0.67	—
Hydrochloridum	18	0.4 (80° C.)	0.6	v. s.
Salicylas	77	35 (80° C.)	11	11 (60° C.)
Sulphas	720	45 (80° C.)	86	9 (60° C.)
Resorcinol	0.5	v. s.	v. s.	v. s.
Saccharum	0.46	0.2	137.2	28
Lactis	4.79	1	ins.	ins.
Salicinum	21	3.3 (80° C.)	71	22 (60° C.)
Santoninum	5300	800 (80° C.)	34	5 (60° C.)
Sevum Præparatum	ins.	—	—	44
Sodii Acetas	1	v. s.	23	v. s.
Arsenas	1.2	v. s.	v. sp.	alm. ins.
Arsenas Exsiccatus	3	v. s.	v. sp.	alm. ins.
Benzoas	1.6	1.3	43	12
Bicarbonas	12	dec.	ins.	ins.
Bisulphis	3.5	2	70	49
Boras	17	0.5	ins.	ins.
Bromidum	1.7	0.8	12.5	11
Carbonas Monohydratus	2.9	1.8	ins.	ins.
Chloras	1	0.5	100	40
Chloridum	2.8	2.5	alm. ins.	alm. ins.

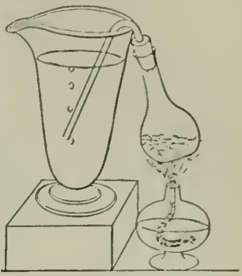
Solubility of Official Substances in Water and in Alcohol—*Continued*

One part is soluble	In Water		In Alcohol	
	At 25° C. (77° F.) *Parts*	Boiling *Parts*	At 25° C. (77° F.) *Parts*	Boiling *Parts*
Sodii Citras	1.1	0.4	sp.	—
Hydroxidum	1	0.8	v. s.	v. s.
Hypophosphis	1	0.12	25	1
Iodidum	0.5	0.33	3	1.4
Nitras	1.1	0.6	100	40
Nitris	1.4	v. s.	sp.	sp.
Phenolsulphonas	4.8	0.7	130	10
Phosphas	5.5	—	ins.	ins.
Pyrophosphas	11.5	1.1	ins.	ins.
Salicylas	0.8	v. s.	5.5	v. s.
Sulphas	2.8 (15° C.)	0.47	ins.	ins.
Sulphis	2	1.4	sp.	sp.
Thiosulphas	0.35	dec.	ins.	ins.
Sparteinæ Sulphas	1.1	—	2.4	—
Strontii Bromidum	1	0.4	r. s.	r. s.
Iodidum	0.5	0.27	s.	s.
Salicylas	18	3.5	66	10.5
Strychnina	6400	3000 (80° C.)	110	28 (60° C.)
Strychninæ Nitras	42	8 (80° C.)	120	60 (60° C.)
Sulphas	31	6 (80° C.)	65	20 (60° C.)
Sulphonethylmethanum	195	r. s.	r. s.	—
Sulphonmethanum	360	15	47	2
Sulphur Lotum	ins.	ins.	sp.	sp.
Præcipitatum	ins.	ins.	sp.	sp.
Sublimatum	ins.	ins.	sp.	sp.
Sulphuris Iodidum	alm. ins.	dec.	dec.	dec.
Terebenum	sp.	sp.	s.	s.
Terpini Hydras	200	32	10	2
Thymol	1100	—	v. s.	v. s.
Thymolis Iodidum	ins.	—	sp.	—
Vanillinum	100	15 (80° C.)	r. s.	—
Veratrina	1750	1300 (80° C.)	2.2	—
Zinci Acetas	2.5	1.5	36	0.6
Bromidum	r. s.	r. s.	r. s.	r. s.
Carbonas Præcipitatus	ins.	ins.	ins.	ins.
Chloridum	0.4	—	v. s.	v. s.
Iodidum	r. s.	r. s.	r. s.	r. s.
Oxidum	ins.	ins.	ins.	ins.
Phenolsulphonas	1.7	0.3	1.7	0.56
Stearas	ins.	ins.	ins.	ins.
Sulphas	0.53	0.2	ins.	ins.
Valeras	50	—	35	—

Solution of Gases in Liquids

The methods employed to effect the solution of gases in liquids differ essentially from ordinary processes of solution, and depend upon the solubility of the gas in the liquid, the relative specific gravity, and the strength of the solution desired. It is usually sufficient to conduct the gas into the liquid by a suitable tube, reaching nearly to the bottom, when more or less of the gas is absorbed by the liquid. Fig. 265 shows a simple method where the gas is readily soluble in the liquid, as in making chlorine water. For a continuous operation, as in making hydrochloric, nitric, and hydrobromic acids, and similar liquids, the well known Woulffe's, or three necked bottles are employed advantageously, the gas which escapes solution in one bottle passing over into the next. The washing bottle shown in Fig. 266 is easily made, and well adapted for purifying the gas after it is generated. B is an ordinary wide mouthed bottle, closed with a perforated rubber cork, C; a wide tube, D E, passes nearly to the bottom, and a narrow tube, A, is joined by a short piece of rubber tubing, J, to the tube leading from the generating flask, and at the other extremity is curved upward so as properly to deliver the gas into the water placed in the bottle to wash it. It escapes by the bent tube, T, which is continued until it dips into the liquid in which the gas is to be dissolved. The space between the tube A and the wide tube D E acts as a safety valve. If the pressure accumulates through the too rapid generation of the gas, or if a stoppage occurs in the delivery tube, the liquid in the bottle is first blown out through this space, and the pressure is thus relieved.

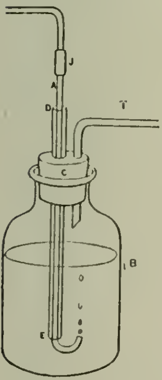
Fig. 265



Method of absorbing gas

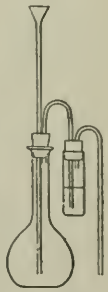
Fig. 267 shows a very convenient little apparatus for generating and washing small quantities of gases, for testing, or other purposes. The wash bottle is made from a homœopathic vial, rubber corks being used, and the bent tubes by bending ordinary glass tubing over a flame as described on page 142. The funnel tube permits the addition of fresh liquid to hasten or continue the action as the operation progresses. It is usual to add merely sufficient water to cover the orifice of the delivery tube in the wash liquid at the beginning of an operation, as the aqueous vapor carried over by the gas condenses in the wash bottle, which soon increases in quantity, and may accumulate in a long operation to an extent which will necessitate a partial discharge of its contents or the entire cessation of the process. As the apparatus suitable for each operation must be especially selected, general observations on the solution of gases will not be so useful in this chapter as a detailed process in connection with each preparation where it is described in the subsequent pages. One general rule should be noted, however,—*i.e.*, that gases are generally more rapidly and thoroughly absorbed by cold liquids than by hot ones. Hence the receiving bottle should be kept surrounded by ice or otherwise refrigerated.

Fig. 266



Wash bottle

Fig. 267



Gas generator

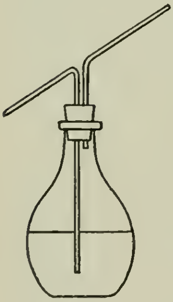
CHAPTER X

SEPARATION OF FLUIDS FROM SOLIDS

THE operations involved under this head are among those which are most frequently used in pharmacy,—*i.e.*, Lotion, Decantation, Colation, Filtration, Clarification, Expression, Percolation, etc.,—and the principles which govern the successful performance of these practical processes should be well understood. They are almost exclusively mechanical processes.

Lotion, or **Displacement Washing,** is the process of separating soluble matter from a solid by pouring a liquid upon it which will dissolve and wash out the soluble portion. The separation of the fluid from the solid is generally effected by placing an obstruction in a funnel or cylindrical vessel, such as a plug of cotton or tow, notched cork, filter paper, etc., and then, having introduced the solid into the funnel and arranged a suitable vessel beneath, the liquid is poured upon it. (See Percolation.) Precipitates are frequently purified from contaminating soluble matter in this way. A very convenient method of applying the liquid is by the use of the spritz bottle (see Fig. 268). This is usually made from a flask, but a round shouldered pint bottle of the diameter most easily grasped by the hand is preferable. Two glass tubes, one bent at an acute angle and the other at an obtuse angle, are used; one end of the former is drawn out to a capillary orifice, and the other extends nearly to the bottom of the bottle. The obtuse angled tube merely enters the bottle below the cork; the upper portion of this tube should be held in the gas flame, so as to fuse the edges of the glass and thus prevent cutting the lips when it is used. By filling the bottle with liquid, and blowing with the mouth through the tube, a stream of liquid is ejected from the capillary orifice which can be directed to any portion of a solid substance that is to be washed. It is often desirable, in order to save time, to use the liquid hot. One of the wicker covered bottles in which Farina cologne is imported answers a good purpose here to prevent burning the fingers, and if care is used to pour in a small quantity of hot liquid first and agitate it before adding the rest, so that the glass may be *gradually* warmed, there is no danger of fracturing the bottle.

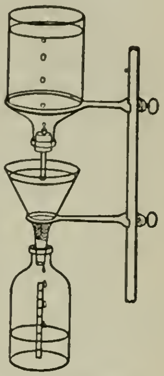
FIG. 268



Spritz bottle

Continuous Washing.—The use of the spritz bottle for small operations is convenient. A simple method of automatically supplying the wash liquid in larger quantities is shown in Fig. 269. This requires no attention from the operator except at the beginning of the operation. The bottle is furnished with a perforated cork and a short glass tube. All that is necessary is to fill the bottle and adjust it over the funnel so that the end of the tube shall be at the height desired for the liquid. On tilting the bottle slightly (if the tube selected is not too narrow in diameter) the liquid will run out into the funnel until it rises to the orifice of the tube, when the flow will cease. As the liquid gradually passes through the solid substance in the funnel, the level falls, and bubbles of air pass through the tube into the bottle, the liquid once more flows, and the operation continues until the bottle is empty. Many elaborate methods of continuous washing have been suggested, and many have been practically tried by the author, but if care is taken in the simple apparatus just described to have the tube of proper diameter, at least so wide that the force of capillary attraction shall not be strong enough to prevent the ingress of air, it is the most satisfactory of all. Bottles having narrow mouths may often be used in the same way, and the cork and tube be dispensed with. A little practice will enable the operator to make an apparatus in which the parts are adjusted to a nicety. On the large scale, Prof. B. S. Proctor's suggestion of two carboys may be used,—one above and inverted, containing the liquid, supported by a box having a circular hole cut in its side, and the other inside the box, containing the funnel and filter.

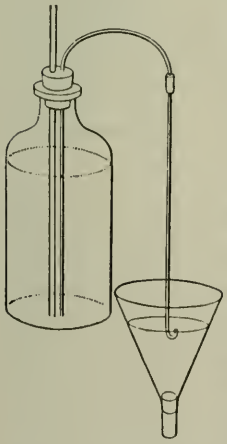
Fig. 269



Continuous washing

A modification of Gay Lussac's apparatus is one of the most successful and practical for continuous washing (see Fig. 270). The bottle containing the wash liquid is furnished with a doubly perforated cork and two glass tubes. One is bent as shown in the cut, and its lower extremity curved upward. By blowing a current of air through the other tube the syphon tube is filled, and the extremity may then be adjusted to such a height in the funnel as is desired. When the level of the liquid in the funnel falls below the orifice of the tube, bubbles of air will enter the bottle through the air tube, and the liquid will run out until it rises in the funnel to the level of the ends of the tubes, when it will cease. It will be found a practical convenience to cut the syphon tube just below the bend, so that a piece of rubber tubing may be used to form a flexible joint.

Fig. 270



Continuous washing apparatus

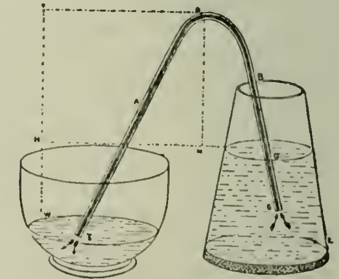
Decantation.—The process of separating a fluid from a solid by decantation is very simple, and consists usually of allowing the solid to deposit at the bottom of the vessel, and then carefully pouring off the liquid by inclining the vessel. The theory of washing by decantation shows its effectiveness, and this may be illustrated by the following example. If 360 grains of mercuric chloride dissolved in 50 fluidounces of water are mixed with 220 grains of potassium iodide dissolved in 50 fluidounces of water, double decomposition takes place, an insoluble precipitate of mercuric iodide subsides, and 100 grains of potassium chloride remain dissolved in the 100 fluidounces of water. As it is desirable to free the mercuric iodide from the contamination of potassium chloride, the supernatant liquid is poured off; if 90 fluidounces are decanted, 90 grains, or $\frac{9}{10}$ of the whole quantity of potassium chloride, are thus disposed of, and 10 grains are left. If the vessel is filled with water to 100 fluidounces, and 90 fluidounces are again poured off, 9 grains are again removed, and but 1 grain is left; this by a third washing and decantation in a similar manner would be reduced to $\frac{1}{10}$ of a grain, and thus the purification is speedily effected. Some skill is required to decant liquids neatly from vessels of various shapes, particularly if they are not furnished with lips, or if filled nearly to the brim. The *guiding rod* may be used in many cases with effect. Indeed, it is a good practice to form the habit of using a stirrer or rod as a guide in decanting, as shown in Fig. 271, for it has a tendency to steady the hand of the operator. The practice recommended by some writers of greasing the rim of the vessel to facilitate decantation is a clumsy and usually unsuccessful expedient.

The Syphon (or **Siphon**).—It often happens in washing solid substances that decantation by pouring off the liquid cannot be successfully performed, either because the vessel is too full, or because, owing to the light character of the precipitate, the inclination of the vessel is sufficient to cause a disturbance in the powder, and an admixture of the liquid and solid. In such cases, and in many others, the useful instrument known as the syphon may be resorted to. This usually consists of a glass tube bent at a rather acute angle, and having one of the limbs longer than the other. It is used by filling the syphon with liquid, and then inserting the short limb into the liquid that is to be drawn off, when a flow of liquid from the long limb is established, which need not cease until as much of the liquid is abstracted as is desired. After filling the syphon the liquid may be prevented from running out (if a tube of small diameter is used) by stopping up the end of the long limb with the forefinger of the right hand, or, if the liquid to be drawn off is not caustic or unpleasant to the taste, the short limb of the syphon may be placed in the vessel at the proper height, and suction applied by the mouth at the long end until the current is established. The principle of the action of the syphon is

FIG. 271

Use of the guiding rod

FIG. 272

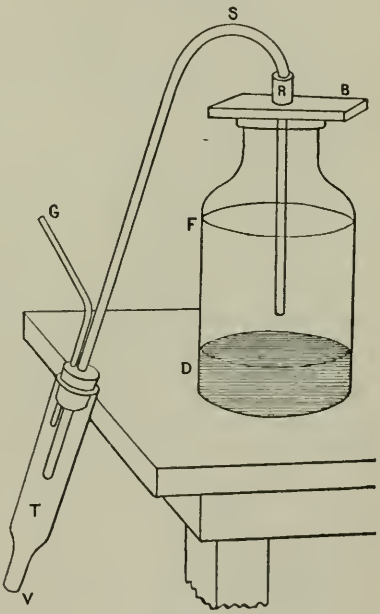


Syphon diagram

shown in Fig. 272. The combined lengths of the limbs of the syphon are not equal to the length of the glass tube, T O S, but the real syphon is only the tube acting between the levels of the liquid in the vessels. In all operations with the syphon there must be a difference in the levels of the liquid. In Fig. 272, O S represents the liquid in the short limb, and O T the liquid in the long limb. It is obvious that, if an equal limbed, narrow tube syphon is filled with liquid, and held level in liquid on the same plane, there can be no movement in the liquid ; equilibrium is established, because the tubes are equal in length and in level liquid, and the pressure of the air is the same upon all parts of the liquid. But the descending column of liquid in the long limb exceeds in weight that in the short limb, and it follows on account of the excess of weight of liquid in this limb that if it is once set flowing through the longer limb it will continue until the levels of the liquid in the two vessels are the same. It will be observed that the custom of having one limb longer than the other is not a necessity, for if there is sufficient difference between the levels of the liquid the syphon will operate with the position of the limbs reversed ; but it is a convenience in a syphon of unequal limbs always to immerse the short limb, as there is then the certainty that the other limb contains the longest column of liquid. The syphon, obviously, cannot be operated in a vacuum, nor if the length of the upward column of water exceeds thirty-three feet.

Syphons for Special Purposes.—In the larger laboratory operations the most convenient syphon is made from a six-, eight-, or ten-foot length of rubber hose. This syphon, on account of its flexibility, can be used in many operations where glass or metal would be inconvenient or inadmissible, while its durability and simplicity of operation make it a necessity. Indeed, the utility of glass syphons is greatly increased by cutting the long limb just below the bend and joining it to the other by a piece of rubber tube.

Fig. 273

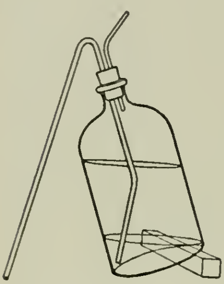


Syphon

The method, already referred to, of starting a syphon by applying suction with the mouth at the long end, or filling the syphon with liquid, is not always practicable, and various other expedients are in use. The *syphon with a bulbed lateral tube* is useful where caustic liquids are to be decanted. The finger is placed over the end of the long limb, and suction applied at the small tube until the downward current is started. Negretti's syphon has a glass syringe attachment upon the lower part of the long limb to accomplish the same purpose. Fig. 273

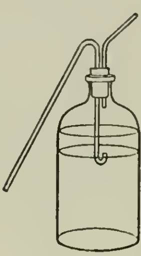
represents a modification of Mohr's syphon, the bottom having been cut from a Farina cologne bottle, T, by starting a cut with a three cornered file near the bottom and extending it around the surface with a red hot poker. The edges are now filed so that they are no longer sharp, and a cork is fitted and twice perforated to admit the longer limb of the syphon and a suction tube, G. It is started like the syphon with a lateral tube, the moistened forefinger closing the lower aperture, V, while suction is being used at G until the liquid has been started. A simple glass tube, with a short piece of rubber tube attached, is in practical hands an efficient substitute for elaborate contrivances to start the flow in a syphon; even if the liquid is caustic or disagreeable, there is no risk in careful hands if the rubber tube is held between the thumb and finger so that it can be instantly pinched tightly to prevent the upward flow of the liquid into the mouth.

FIG. 274



Syphon in bottle

FIG. 275



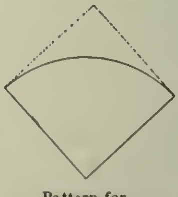
Syphon

Fig. 274 represents a form of syphon for drawing off the liquid to almost the last drop in the bottle. The shorter limb of the syphon is bent, and the syphon is started by blowing through the shorter tube in the cork. Fig. 275 shows a syphon with the shorter limb "turned up." This form has the advantage of retarding the tendency to empty itself, and, in syphoning the liquid from precipitates, there is not so much danger of stirring up the particles on the bottom.

Colation, or **Straining** (*colare*, to strain), is the process of separating a solid from a fluid by pouring the mixture upon a cloth or porous substance which will permit the fluid to pass through, but will retain the solid. This operation is frequently resorted to for separating sediment or mechanical impurities of various kinds from liquids. Gauze, fine muslin, cotton flannel, woollen felt, and other fabrics are used. Strainers are employed where the solid particles to be removed are not in very fine powder, or where complete separation is not especially desired.

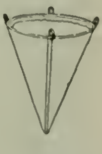
Felt strainers are usually in the shape of felted, seamless, conical bags; the material is of wool and quite thick. They form excellent strainers for melted fats, petrolatum, wax, oils, syrups, elixirs, etc., where a large quantity of substance is to be strained. Their expensiveness is, however, an objection to their use, and the difficulty of cleaning them, owing to the tenacity with which they retain odors, unfits them for general use by the apothecary, but for special purposes in a manufacturing pharmacy they are very useful.

FIG. 276



Pattern for Hippocrates's sleeve

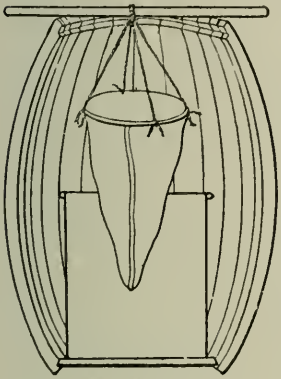
FIG. 277



Strainer, Hippocrates's sleeve

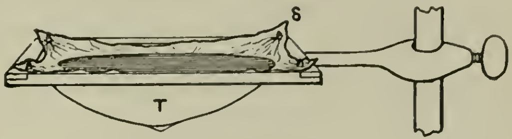
Woollen strainers made of twilled woollen cloth, flannel blanket material, etc., are more economical, because they can be cut to any size desired, and the material costs less, while if the seams are closely sewed or overseamed they will last a long time. The form known as Hippocrates's sleeve (see Fig. 277) is that generally used. Fig. 276 shows the shape and dimensions before being sewed. A wooden hoop or brass ring is required to keep the opening extended. This should be arranged so that it can be removed when the bag is to be washed. The most convenient support is a stick passed through the cords which are attached to the strainer, the whole suspended in a barrel arranged as shown in Fig. 278. The object of suspending it in the barrel is to avoid currents of air, which, in the case of many liquids, would cause evaporation from the surface and the formation of a crust, and thus impede the rapidity of colation. A tin or copper can of proper size may be placed in the barrel to collect the strained liquid.

FIG. 278



Use of strainer

FIG. 279

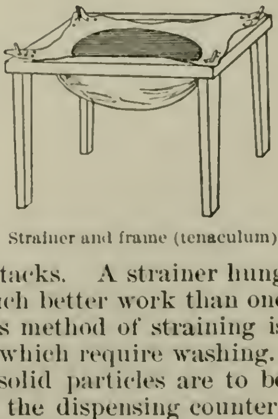


Cotton cloth strainer

Cotton flannel or Canton flannel strainers are cheaper than those of woollen, and if bleached they have the great advantage that they can be used for alkaline solutions. The unbleached cotton flannel is probably stronger, but the coloring matter naturally present, being soluble in alkalies, is apt to discolor the liquid.

Cotton cloth or muslin strainers are generally suspended on a wooden frame, (*tenaculum*) see Fig. 279. The frame should be securely joined without glue, and at each corner there should be a strong, pointed nail projecting slightly outward. The cotton cloth should always be soaked in boiling water before fastening it to the frame, to dissolve out the substances used by the manufacturer in calendering the goods. Fig. 280 shows the method of fastening the strainer to the frame. It should be secured at each corner, first upon the permanent nails, and then two tacks at the side of each nail should be driven two-thirds of their length into the frame; this partial driving of the nail is sufficient to hold the cloth and permit of the easy removal of the tacks. A strainer hung in this way will hold more liquid and do much better work than one which is tacked all around the frame. This method of straining is particularly useful in collecting precipitates which require washing.

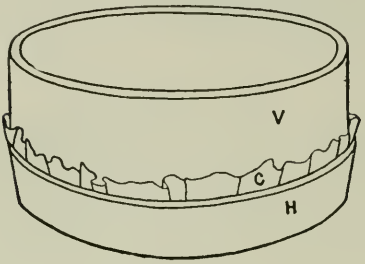
FIG. 280



Strainer and frame (tenaculum)

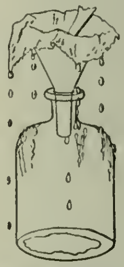
Colation in Smaller Operations.—When solid particles are to be separated from liquids in the operations of the dispensing counter, several methods may be used. One of the most convenient is to insert a plug of absorbent cotton in the neck of a funnel and then pass the liquid through ; a funnel with a circle of brass wire gauze soldered in it two thirds of the way down is sometimes used, although not recommended, because of the difficulty of cleaning it. A better small strainer is made by using the hard rubber sieve, V, H (see Fig. 281). The muslin gauze, C, is easily replaced, and the sieve may be placed in a funnel. The cotton cloth used by the makers of cheese, called cheese cloth, is admirably adapted for many kinds of straining. When coarse muslin strainers are used for the first time, they are prepared by soaking them in hot water and placing them in a funnel carefully so as to line the inside. Care should also be taken to see that the strainer is not too large, for if the wet strainer projects over the edge of the funnel, a syphon action may be set up and more of the liquid delivered outside of the bottle than inside. Fig. 282 shows the action of such a strainer.

Fig. 281



Prescription strainer

Fig. 282



Careless straining

CHAPTER XI

FILTRATION

Filtration is the process of separating liquids from solids with the view of obtaining the liquids in a transparent condition. The intervention of porous substances, called *filters,* to intercept the solid particles, is necessary in performing this process. These are usually made from paper, paper pulp, sand, asbestos, ground glass, charcoal, porous stone, etc. The liquid which has passed through the filter is called the *filtrate.*

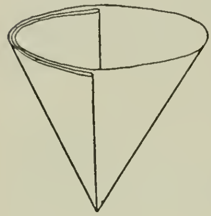
Paper filters are the most useful of all kinds for the pharmacist, and they are employed in all the finer operations requiring filtration. The solid particles are much more completely separated by filtration through good paper filters than through strainers, owing to the pores of the paper being smaller and more numerous. The paper used for this purpose is especially prepared, and is called *filtering paper.* It is made now upon a large scale, and can be had of excellent quality. Unlike a strainer, it is never used more than once; its cost is so trifling, and it is so easily ruptured when wet, that it is not worth while to attempt to save filters for subsequent use. Filtering paper is found in commerce in two forms,—in large, nearly square sheets, and in circular sheets. The former is used for large filters, and has some advantages, if the waste pieces can be put to use; but it is usually more convenient for the pharmacist to rely for constant use upon the circular sheets of different sizes. The difference in price between the two is now so trifling that the latter is almost always preferred. Two kinds of square sheet filtering paper are commonly found,—German white, a rather thin, but good paper, and heavy French, the latter very thick and porous, having a rough surface; it is the more expensive paper, but is better for special purposes. Of the round filters, the French, Swedish, German, English, and Scotch are among those best known in America. For pharmaceutical purposes the French filters are almost universally used, the "Prat Dumas" brand being the most common, the gray paper being made from a mixture of cotton, flax, wool, etc.; this paper answers sufficiently well for filtering colored liquids, fluidextracts, or tinctures, but, owing to the coloring matter it contains, it should never be used for any solution containing free alkali.

It is safer to form the habit of never using it for liquids that are intended to be colorless when filtered; of course, it is entirely unfitted for analytical work. The "Prat Dumas White" is of good quality, and it or some other good quality of white paper should always be on hand for special purposes, for filtering alkaline or alkaloidal solutions, and for the nicer operations. Very good filtering paper of English and Scotch manufacture may occasionally be procured; that made in Sweden, however, by Munktell, is preferred for the processes of ignition and analytical work; it yields the smallest amount of ash, and is practically free from soluble salts and impurities. At least a small stock should be kept by pharmacists for especially accurate work.

Methods of folding Filtering Paper.—Two kinds of paper filters are used, the *plain* and the *plaited.*

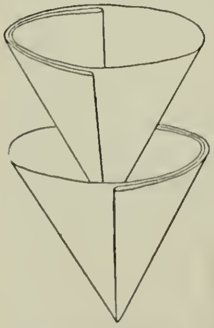
1. *The Plain Filter.*—This filter is used habitually by the analytical chemist, and is preferred by the pharmacist where precipitates are to be collected, and in some other operations (see Fig. 283); it is made by exactly doubling a circular sheet of filtering paper upon itself, and then folding this directly in the middle, so that, when opened, four equal divisions or sectors appear; the filter is used by separating one of the sectors from the other three, and placing the cone formed, into a funnel; the liquid is then poured upon the filter, and the process of separating the solid from the liquid commences. The advantages of the plain filter are, 1, simplicity and rapidity in folding, no skill being required to make one; 2, in collecting precipitates, but one-half of the surface of the filter (two sectors) is in contact with the moist precipitate, which is often closely adherent, and therefore but one-half of the surface has to be cleaned. In some cases there may be a disadvantage in the use of the plain filter, owing to the unequal rate of flow,—the tendency of the three folds being to attract the liquid to the side of the funnel upon which they rest, and thus the precipitate may be unequally washed. A stronger and more rapid filter may be made by placing one plain filter inside of another, so that the three sides of the upper one shall be in contact with one side of the lower one, and *vice versa* (see Fig. 284). If the sides of the funnel have an angle of 60°, the plain filter made as described will fit the funnel properly; but it frequently happens that the angles of funnels vary, and if an ordinary plain filter is placed in a funnel not having an angle of 60°, a portion of the filter is left unsupported, and the weight of the liquid is apt to rupture the moist paper. This difficulty may be overcome by making a fresh crease in the outside fold of the plain filter; if this is made to the right of the original crease of the 60° filter, and the inside fold pushed around a corresponding distance, a filter having a smaller angle is produced, while if the fresh crease is made to the left of the original crease a larger angled filter may be made. Rother's method of making a plain filter has the ad-

Fig. 283



Plain filter

Fig. 284

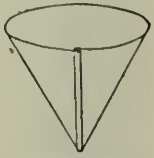


Double plain filter

Fig. 285

Rother's filter (first step)

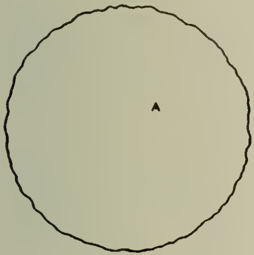
Fig. 286



Rother's filter

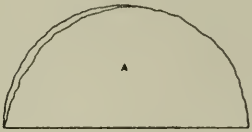
vantage of furnishing two filters from the same sheet that is usually required for one filter. To make it, the circular disk of filtering paper is cut through in the line of its diameter, and half of the disk is folded into two equal parts; the double edge of the cut sides is turned down and folded over on itself narrowly several times (see Fig. 285), and with the blade of a spatula the fold is compressed so that it will retain its shape (see Fig. 286). This filter may be used in collecting precipitates.

Fig. 287



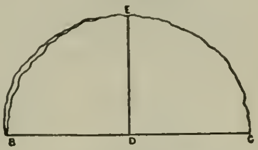
Filter

Fig. 288



Folding plaited filter

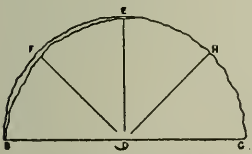
Fig. 289



Folding plaited filter

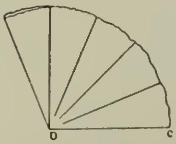
The plaited filter may well be called the "pharmacist's filter," for it is the form almost exclusively used in ordinary filtering operations.

Fig. 290



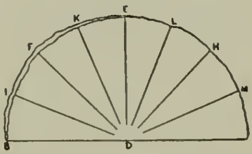
Folding plaited filter

Fig. 291



Folding plaited filter

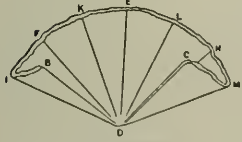
Fig. 292



Folding plaited filter

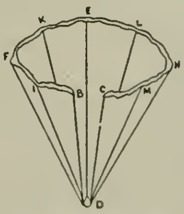
Figs. 287 to 297 show the progressive steps in the folding of a plaited filter. It is made by folding a circular sheet of filtering paper twice, as in making a plain filter.[1] The edge B D, Fig. 290, is then laid upon E D, and the crease F D is formed; in like manner C D is laid upon E D, and H D is formed. Then D B is laid upon F D, and I D is formed, and by rolling over the fold in the same direction once more until F D is laid upon E D, the crease K D is made (see Fig. 292). Now in the same way C D is laid upon H D and H D

Fig. 293



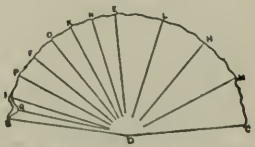
Folding plaited filter

Fig. 294



Folding plaited filter

Fig. 295



Folding plaited filter

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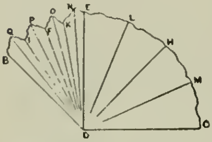
[1] It will be observed that in the first folding of French filters, "Prat Dumas," the disks are not perfect circles. This causes one edge to project (see Fig. 288), and facilitates the opening of the filter.

upon E D, and it will be noticed that the folded semicircle has been creased into eight equal spaces, and that the direction of each crease is the same, so that if the paper is lifted it will appear as shown in Fig. 294.

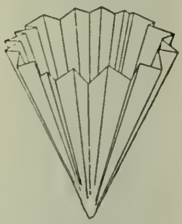
The next step is to fold each one of these spaces *back on itself* (Fig. 295). B D is laid upon F D, and then B D is turned upward and back until it is laid upon I D. This makes the crease Q D, which is the first fold in the opposite direction. Taking both folds between the forefingers and thumbs of both hands, the edges B D and I D are folded upward and back upon F D, and the crease P D is formed; then these three edges, B D, I D, and F D, are taken all together and folded back upon K D, and the crease O D is formed, and so on, each space in turn being folded back in the opposite direction, until the last one is reached. The folded filter is then held at the apex with the left hand upon a table or flat counter, and pressed and smoothed out with the right hand in order to emphasize the folds. It should then be placed in the funnel, while still *unopened*, to see whether it needs trimming; if the rough edges of the filter project above the top of the funnel, the filter must be removed, and they must be cut off neatly with a sharp knife or a pair of scissors so that the whole of the filter may be placed inside of the funnel. Having satisfied this requirement, the filter should be carefully opened out (see Fig. 297) and placed in the funnel.

Fig. 296



Folding plaited filter

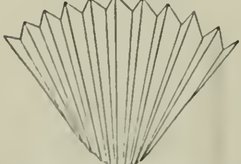
Fig. 297



Plaited filter

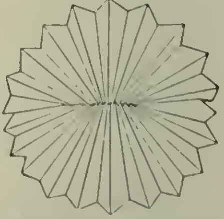
Another method of folding a plaited filter is illustrated in Figs. 298 and 299. A plain filter is folded as in Fig. 283, and the quadrant, consisting of four thicknesses of paper, beginning at the left hand side, is folded at once into narrow parallel plaits backward and forward. Fig. 298 represents the filter after being once opened, and Fig. 299 shows the inside of the filter. It will be observed that the creases do not converge to a point as in the plaited filter (see Fig. 297), and hence the apex is less likely to be weakened.

Fig. 298



Plaited filter, parallel folds

Fig. 299



Plaited filter, parallel folds

Maxims.—1. In folding a filter, care should be observed not to extend the creases entirely to the apex, but to end them at a distance of about half an inch from it, because the point at which all the creases converge would be thereby so weakened that the weight of the liquid would rupture the filter.

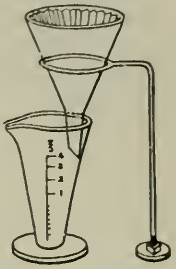
2. The filter should be moistened with water after introducing it into the funnel and before pouring upon it the liquid to be filtered (except, of course, in the case of a liquid immiscible with water).

This promotes rapid filtration, and washes the filter besides. If hot water is available, it is usually to be preferred.

3. If the liquid to be filtered contains free acid or alkali, or if it contains a very fine precipitate, or is very dense or hot, a double filter should be used. In the case of plain filters, they should be arranged as in Fig. 284. If plaited, two sheets of paper should be taken and folded as if they were single. A filter may be also strengthened by placing a small capping filter or plain filter, a piece of well washed linen or muslin folded like a plain filter, or a plug of absorbent cotton, into the funnel before introducing the filter. The apex is always the weakest, the most exposed, and yet the most important part of the filter.

4. In pouring the liquid into the filter, the stream should never be delivered directly upon the apex, but upon one of the sides, so that the force of the fall will be broken before the weakest point is reached.

Fig. 300



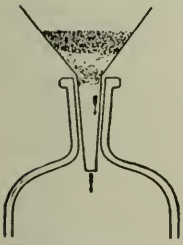
Arrangement of funnel in filtration

5. The filter should be entirely within the funnel. If the edges of the paper project above the funnel, waste from evaporation in volatile liquids, also from the increased and unnecessary absorption due to the excess of filtering paper, ensues, and in addition an untidy and careless habit is encouraged.

6. The end of the funnel should touch the side of the receiving vessel, so that the filtrate will trickle down its inside edge. By this expedient splashing will be avoided (see Fig. 300).

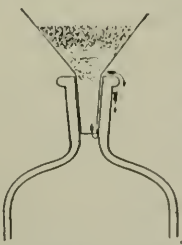
7. In filtering into a bottle, care should be observed to leave sufficient space between the neck of the funnel and the mouth of the bottle for the escape of air, otherwise filtration will be retarded or prevented ; a piece of twine placed between the two surfaces generally serves a good purpose. *The end of the funnel should project below the lowest part of the neck of the bottle* (see Fig. 301). If the diameter of the end of the funnel is too large to admit of this, or if it is only half inserted, the filtrate will be very apt to fill the intervening space and flow over the outside of the bottle, as shown by the arrows in Fig. 302.

Fig. 301



Filtering into a bottle (proper method)

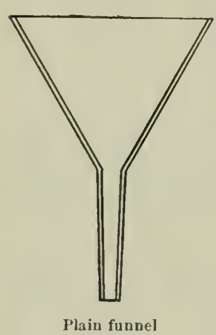
Fig. 302



Filtering into a bottle (improper method)

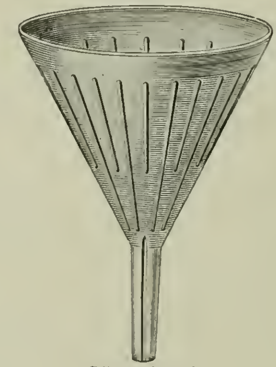
Funnels, sometimes called *tunnels*, are conical shaped instruments intended to facilitate the pouring of liquids into narrow mouthed vessels, and, as they have also an important service to perform for the pharmacist in supporting filters, they will be considered in this place. Funnels are made of tinned copper, tinned iron, hard rubber, Berlinware, porcelain, queensware, granite or agateware, earthenware, or glass. Metallic funnels have an advantage in point of durability over porcelain and glass, but a disadvantage in being acted upon chemically by liquids and in being more difficult to clean. The triangle formed by the sides of a funnel, and the line joining them, should be equilateral (see Fig. 303). The angles being each 60°, a funnel having this shape will accurately support a plain filter made in the usual way. Funnels are frequently fluted, grooved, or ribbed on the inside for the purpose of facilitating the downward flow of the filtrate (see Fig. 304), or wire frames, either fixed or folding, are arranged in a plain funnel with the same object. These aids are of doubtful utility, however, while the tendency of the raised ribs is to form a lodgement for foreign substances. *A well made plaited filter* in a plain funnel will perform as much work in the same time, and if the habit is once formed of always carefully and skilfully folding a filter, its importance in saving time and labor will be appreciated ever afterwards. One of the ribbed funnels in the market has an improvement in the neck, which, instead of being round, is triangular. This permits the free escape of air from the interior of the bottle, and is much superior to the indistinct groove which is often made on the outside surface of porcelain funnels. Plain glass funnels are more generally useful to the pharmacist than any other kind. They are easily cleaned, and dirt upon them may be quickly seen. They are very useful as percolators, and the whole process of filtration or percolation may be observed without trouble. Their only disadvantage is the ease with which they are fractured. The next kind in point of usefulness is the plain tinned copper funnel. The neck should be grooved, square or triangular, instead of round. Copper funnels are far superior to those made from tinned iron, and the difference in cost is greatly in favor of tinned copper, if true economy is considered (see Fig. 305). Hard rubber funnels are light in weight, and are not very easily broken, for they may be often dropped upon the floor without injury (see Fig. 306). They are not acted upon by chemical substances, and with ordinary care will last a lifetime. They lack one advantage of those made from glass, however, in their absence of transparency. A hard rubber funnel divided, to hold a strainer, may be used at the dispensing counter (see Fig. 307). Porcelain, queensware, or Berlinware funnels are, of course, not transparent, and they have the disadvantage, at least in the larger sizes,

Fig. 303



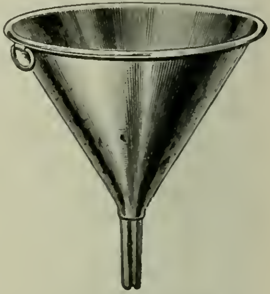
Plain funnel

Fig. 304



Ribbed funnel

Fig. 305



Tinned copper funnel

of being heavy. They are, however, not affected by liquids, but their advantages over glass are so slight (being somewhat less fragile) that they are not often employed. Earthenware funnels, if well glazed, are very useful in filtering *hot liquids.* Enamelled funnels, called granite or agateware, etc., are made from sheet iron having the surface entirely covered with a glazed composition which resists the action of most chemical substances. If carefully used, they answer for many purposes. Their greatest objection arises from the brittleness of the enamel, which is apt to chip off if the funnel is dropped upon the floor or subjected to a blow, and at the point where the neck of the funnel is joined to the body, the enamel coating is so thin that by constant use and knocking about it is soon chipped off, the exposed iron quickly rusts, and the neck breaks off from the body. Tinned iron funnels are most largely used, and are popular because of their cheapness; but it is quite possible for a pharmacist to ruin in one operation a preparation worth ten times the cost of the funnel by filtering it through a tinned iron funnel and allowing it to come in contact with the iron exposed by the wearing off of the tinned surface.

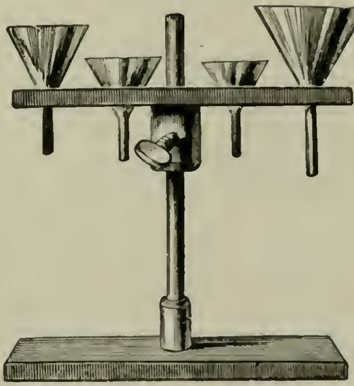
Fig. 306

Hard rubber funnel

Fig. 307

Dispensing counter funnel

Fig. 308



Funnel stand

Fig. 308 shows a funnel stand useful for small filtering operations in the laboratory or at the prescription counter.

Fig. 309 shows Bartlett's funnel, which has a perforated sleeve around the spout to permit the escape of air from the bottle in which it is placed, when the liquid is running through the funnel.

Fig. 310 shows a funnel designed for filling bottles, in which the flow of the liquid is controlled by the valve operated by the thumb. This is convenient when filling a gross of bottles arranged in rows, and if carefully used the bottles need not be soiled on the outside through overrunning, and the quantity in each bottle can be nicely adjusted.

Filters for Special Purposes.—In the course of laboratory work it frequently happens that large quantities of liquids require filtering, and the methods suitable for smaller operations cannot be profitably employed. The filtration and purification of water often become necessary. Charcoal in some form is frequently employed, not only on account of its porous character, but also because of its power of absorbing odors and depriving liquids of color. Sand, powdered glass, or asbestos forms an excellent filtering bed. A very practical and inexpensive charcoal filter is shown in Figs. 312 and 313. It was devised by Dr. Hadden, and is illustrative of a principle in filtration not heretofore treated of in this work,—*i.e.*, *upward filtration.* It is believed by the advocates of upward filtration that great economy is secured by passing the cloudy liquid upward through a filtering bed, the principle of action being that impurities settle away from the filtering medium by force of gravity, instead of accumulating upon it and clogging the pores. Figs. 312 and 313 show an external and a dissected view of the filter. A gallon tin can has a short pipe soldered to it near the bottom; the pipe has a piece of perforated tin or gauze soldered over the opening into the can, to keep it from being filled up. This can is filled with clean gravel. The smaller quart can is connected with the lower one by a raised perforated tin diaphragm, and small pieces of charcoal are packed upon the diaphragm; the upper perforated diaphragm is movable, and is intended to keep the charcoal in place. A disk of coarse cotton flannel should be placed on top of the charcoal, to keep the fine charcoal dust from working through the top to the upper tin can. This is kept in place by a screw joint and washer such as is often seen on fruit cans. About an inch from the top of the can is a small piece of pipe for delivering the filtered water. This filter is, of course, intended to be used in cities and towns, or where water is supplied under pressure. Both the supply and the exit pipe should be of proper diameter to permit the use of a rubber tube for connecting with the water supply and delivering the filtered water. The filtration of oils is often effected in a similar manner, one of the earliest applications of this principle being the oil filter or strainer of Wm. R. Warner, of Philadelphia (see Fig.

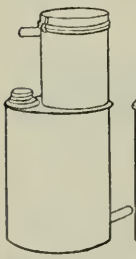
Fig. 309

Bartlett's funnel

Fig. 310

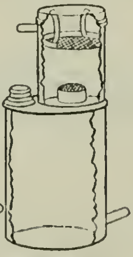
Valve funnel

Fig. 312



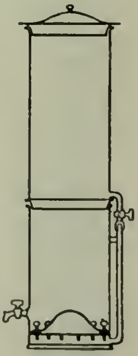
Hadden's filter

Fig. 313



Hadden's filter (interior)

Fig. 314



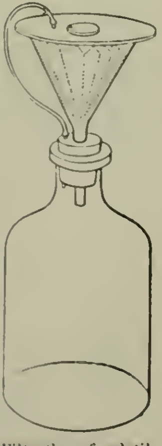
Warner's filter

314). This filter or strainer consists of an upper cylindrical tinned iron vessel, about twenty-two inches high and ten inches in diameter, with a flange rim soldered on the bottom, of rather less diameter, and about an inch wide, so as to fit firmly into the open top of another cylindrical tin vessel of the same diameter and eighteen inches high. The upper vessel is furnished with a lid, and with a tube and stopcock; this tube penetrates the side close to the bottom, and fits into another tube, which opens into the lower vessel close to its bottom and is secured to the side by a strong tubular stay. The filtering medium is a cone of hat felt projecting upward from near the bottom of the lower vessel, and secured by thumb screws passing through two tinned iron rings and the felt, which are all properly pierced for the purpose. The stopcock being closed, the upper vessel is fitted in its place, and the tube joint rendered tight by wrapping twice around it a strip of isinglass plaster well moistened. When this is dry, the upper vessel is filled with the crude oil and the stopcock opened, that the oil may flow into the open space below the filter. A heat of 120° F. is preferred to facilitate filtration or colation, and the filtered oil, as it accumulates, should be drawn off, as any large amount greatly retards the process by decreasing the force of the column bearing on the filter. For a pressure filter or strainer, Prof. B. S. Proctor uses a quadrangular cloth filter bag securely tied to the end of a tin tube five feet long. The extremity of the tube has a wire ring soldered to it, to keep the bag from slipping off.

Continuous Filtration.—Most of the expedients used in continuous washing (see page 199) are applicable to continuous filtration.

Filtration of Volatile Liquids.—It is evident that the ordinary methods of filtering liquids will not be practicable for very volatile liquids, because of the loss through evaporation, and the liability to explosion, in the case of inflammable volatile liquids, if brought in contact with flame. Funnels must be covered, and provision made for the escape of the confined air in the receiving vessel. The following method is preferred to the elaborate expedients usually recommended. A glass tube (one of those usually sold as julep tubes answers very well) is arranged in a glass or metallic funnel, so that the tube will lie close to the side of the funnel and allow one end to project above the filter, but not above the edge of the funnel. It may be held in its place by a ring of absorbent cotton gently thrust into the throat of the funnel. Or a rubber cover perforated to admit a tube is placed on top, and connection between the bottle and funnel effected as shown in Fig. 315. For larger operations, Dr. Hadden's water filter or Warner's oil filter (see pages 211 and 212), slightly modified to suit the liquid, might be used. A very neat method of filtering volatile liquids is provided in the apparatus contrived by E. H. Hance, of Philadelphia. This consists of a cylindrical vessel, provided with a tubulure and stopcock below, and a ground glass cover above; a flange near the top affords support for a perforated filter support or funnel containing a filter.

Fig. 315

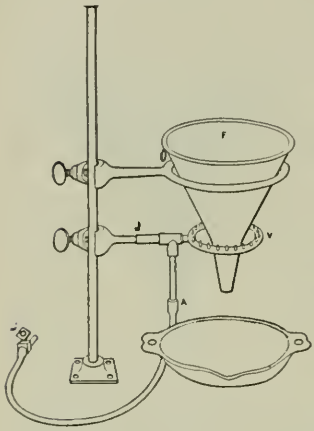


Filtration of volatile liquids

When not needed for filtration, the receiving vessel is very useful for many other purposes.

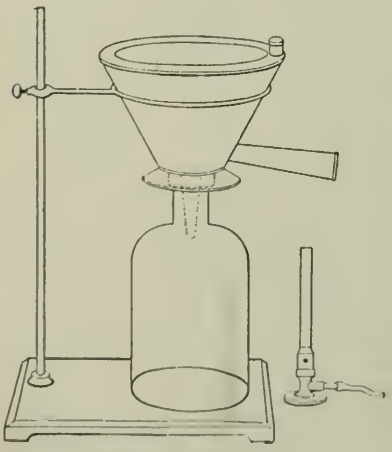
Hot Filtration.—This process is not resorted to as frequently as it might be with advantage, because of the difficulties which are asserted to attend it. These have been greatly overestimated, for by the use of simple, properly contrived apparatus many preparations which heretofore have been dispensed, bearing an unsightly cloudy appearance, can be greatly improved. Yellow wax is frequently full of mechanical impurities; ordinary straining will not deprive it of these, but it may be filtered through paper and thoroughly purified. Jellies, benzoinated lard, petrolatum, cerates, ointments, etc., may thus be filtered. One of the simplest and most easily managed forms of apparatus (see Fig. 316) is made by filing off the ring from one of the ring supports of a retort stand, J, and slipping on to the arm a brass circular jet, V, attached to a tee carrying the gas supply pipe, A. A tinned copper or tinned iron funnel is supported by an appropriate ring at a suitable distance above the jet. The filter is placed in the funnel, a receiving vessel adjusted below, and the hot liquid poured into the filter. It is plain that the liquid can be heated to almost any degree, and the filtration conducted at a much higher temperature (if need be) than by the jacketed hot water funnel (see Fig. 317), and, on the other hand, the heat may be regulated so that it will be very moderate. The hot water funnel is an old device, and consists simply of a jacketed funnel having a wide tube soldered at the lowest point, and an opening in the upper edge for the water supply. A burner or lamp flame will heat the water contained between the funnels, and a regulated heat not exceeding that of boiling water is obtained (see Fig. 317).

Fig. 316



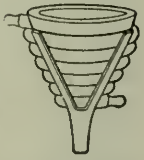
Hot filtration

Fig. 317



Jacketed hot water funnel

Fig. 318



Hot filtration (use of coil)

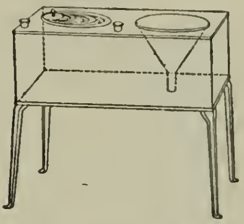
Fig. 318 shows another form of funnel to be used for hot filtration, the coil of pipe may be used for steam or hot water, by connecting it with a suitable supply.

A modification of Dr. Hare's hot water filter, which permits the use of glass funnels of different sizes, is shown in Fig. 319. It is simply a tinned copper box, with two sides shaped like a trapezoid, and supported upon four legs. There are three one-inch tubulures in the bottom, and the top has three openings which centre with the tubulures; beginning with the deepest, the diameters are four, three, and two inches. Three glass funnels of different sizes are selected, and the corks for the tubulures in the bottom, having been chosen, are perforated so as to permit the necks of the funnels to pass through and form perfectly tight joints. Water is placed in the box and heated by the burner, as shown in the cut. When not needed for hot filtration, solid corks may be used to close the tubulures, and the box used as a water bath, covers being placed over the openings which are not in use. Fig. 320 shows a combined water bath and hot water filter.

FIG 319

Hot filtration

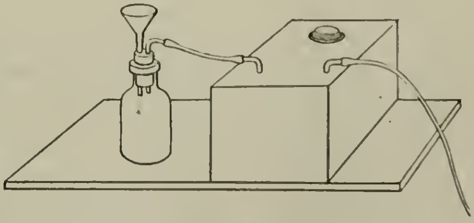
FIG. 320



Hot filtration (water bath)

Rapid Filtering Apparatus.—Of late years much attention has been given to methods for increasing the rapidity of filtration. Most of the plans suggested depend upon the principle of filtering into a partial vacuum, but the means used to obtain this vacuous space are very varied. A simple method, applicable to operations on the small scale, consists in fitting a good cork to a wide mouthed bottle and perforating it so that the neck of a funnel will accurately pass through it; another perforation permits the insertion of a piece of glass tube of small diameter. A plain filter of well washed coarse linen or muslin cloth is then carefully adjusted in the funnel, and a plain filter of paper placed upon it. The liquid is poured upon the filter, and, a rubber tube having been fitted to the glass tube, suction is applied by the mouth. By pinching the rubber tube a partial vacuum is maintained in the bottle, and filtration is hastened. An improvement upon this would be to use a rubber stopper instead of cork, and instead of pinching the rubber tube to use a screw pinchcock.

FIG. 321



Rapid filtration

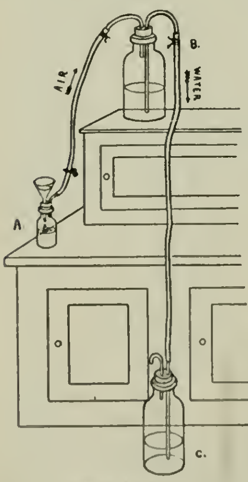
Water Pumps acting by a Fall of Water.—One of the first practical efforts made in the direction of using water power was seen in Bunsen's pump. The action depends upon the principle that a column of water descending through a tube from a height is capable of sucking with it the air contained in a lateral tube, if the latter is properly arranged. A cheap home made apparatus, which depends upon a fall of water for its usefulness, is shown in Fig. 321. It consists of a common wide mouthed half-gallon jar, and a tinned iron can holding three, four, or five gallons; a castor oil can answers very well. The screw cap is for readily filling the can; the exhaust pipe on the right reaches inside of the can, nearly to the bottom, the other tube is soldered on the head of the can connecting with the interior. The jar, having a funnel fitting into it through an airtight stopper, is connected with the can by means of a bent glass tube and rubber tube. The can is filled with water, and the solution to be filtered is placed in the funnel. The exhaust pipe is connected with a rubber tube eight or ten feet long and a quarter of an inch in diameter (the longer the tube the more rapid is the filtration). When the syphon thus formed is started, the flow of the water from the can carries with it the air from the bottle.

Fig. 322

Lux's aspirator

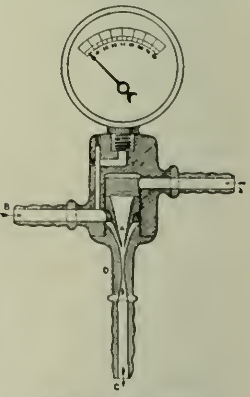
Lux's aspirator (see Fig. 322) is constructed by fitting two accurately perforated rubber stoppers to the ends of a piece of wide glass tubing; four short glass tubes are inserted in the stoppers, as shown in the cut. One of the tubes is for the supply of water, another carries it off, the third tube is connected with the vessel to be exhausted, while the fourth tube may be put to the same use, or connected with a vacuum gauge or closed with a stopper. If the air is to be aspirated by one of the lower tubes, the vessel to be exhausted must stand on a higher level than the aspirator. The length of the exit tube determines the power of the aspirator. It should have a bore of one-fifth of an inch and be at least ten feet long, and it should be provided with a screw pinchcock to regulate the flow of water. A very simple apparatus is shown in Fig. 323. A very moderate fall of water is needed here. It is, however, adapted only to small operations. Two rather large bottles, of equal capacity, are selected; these are connected by rubber tubing as shown in the illustration. Into the neck of each a tightly fitting stopper is adjusted carrying a glass tube. A bottle, provided with a tightly fitting stopper carrying a small bent tube and a funnel, is attached to a rubber tube provided with a con-

Fig. 323



Rapid filtration

Fig. 324

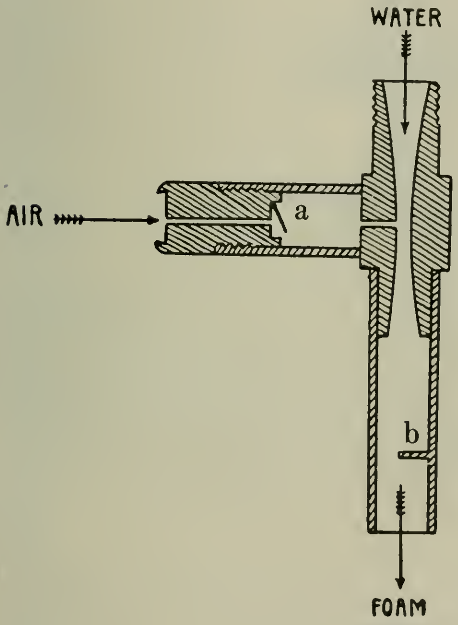


Fisher's vacuum pump

veniently situated pinchcock. One of the large bottles is filled with water and placed on an elevated shelf, when the water will flow down to the other bottle. And if the connections are made as shown in the cut, it will aspirate through the funnel; and if the funnel is full of liquid, it will cause the latter to run through quite rapidly. When the lower bottle is full, it is substituted for the upper one, and the connection with the vessel to be exhausted, transferred to it.

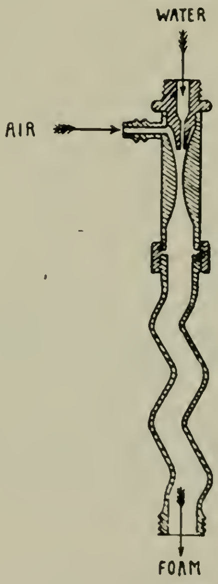
Water Pumps acting by Pressure.—It is usually inconvenient to operate aspirators which depend upon a fall of water through a long tube, except in high buildings. Hence, water pumps which are operated by pressure are generally preferred in cities and towns, or in localities where water is supplied under pressure. The following are selected from the great variety in use as being good illustrations of the principle. Those made of glass are not recommended, because of their extreme liability to breakage. Fisher's vacuum pump is well shown in Fig. 324. A, B, C, are intended to receive rubber tubing, and the neck, D, may be fastened by a clamp to a retort stand or other upright fixture. Water from the hydrant enters at A, passes through the nipple at *a*, and, being forced through the contracted portion, *b*, draws with it the air from the tube, B, which is attached to the filter. A communication is also made with the vacuum gauge, as shown in the cut, to mark the degree of exhaustion. Fig. 325 shows another modification of a vacuum pump. The valve at a pre-

Fig. 325



Chapman's pump

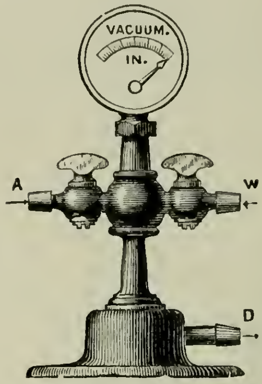
Fig. 326



Richards's pump

vents the water from flowing into the bottle which carries the filter when the pressure of water ceases or is reduced. Fig. 326 illustrates a form of pump largely used in analytical laboratories for hastening filtration. The zigzag form of the tube serves the same purpose as the projection in the lower portion of the outlet tube of the Chapman pump,—*i.e.,* to break the direction of the solid stream of flowing water and assist in drawing the air from the bottle. Schutté and Goehring, of Philadelphia, have contrived an apparatus which is somewhat more convenient from their having placed it upon a base and deflected the lower tube laterally. This permits the use of the apparatus in many places where Fisher's pump could not be used. It is shown in Fig. 327. W represents the water supply tube, D the outlet, and A the aspirating tube.

Fig. 327



Vacuum pump

CHAPTER XII

CLARIFICATION AND DECOLORATION

Clarification is the process of separating from liquids, without the use of filters or strainers, solid substances which interfere with their transparency. The processes of clarification and decoloration from a pharmaceutical point of view have declined in importance of late years, owing to the fact that chemical and other substances requiring the processes are supplied in a purified condition so cheaply that it is absolutely impossible for the pharmacist to compete with the manufacturer who operates on the large scale and uses apparatus and methods which are thorough and economical. This is particularly the case with sugar and the alkaloids. Formerly the apothecary bought raw sugar and clarified the syrup; now the difference in price between raw sugar and that which is pure is so slight that no one ever makes syrup from raw sugar. The decoloration of alkaloidal solutions and the manufacture of alkaloids cannot be economically attempted on the small scale by the pharmacist, because of the want of continuity of the process; the manufacturer, on the other hand, can use the animal charcoal repeatedly until its power is exhausted, and in other ways practise economy not possible to the apothecary. It is, nevertheless, very important to comprehend thoroughly the principles underlying both processes.

Clarification may be effected in several ways:

1. By the application of heat. 2. By increasing the fluidity of the liquid. 3. Through the use of albumin. 4. Through the use of gelatin. 5. Through the use of milk. 6. Through the use of paper pulp. 7. By fermentation. 8. By subsidence through long standing.

1. *By the Application of Heat.*—When a viscid liquid is heated, its specific gravity is diminished, and frequently particles which were suspended in it, and interfered with the transparency of the liquid, will separate, the heavier ones falling to the bottom, and the lighter ones rising; in the latter case, ebullition facilitates the separation, the minute bubbles of steam becoming enveloped in the viscid particles rise through their buoyancy, and a scum is formed which may be readily separated. The official process for the clarification of honey (Mel Depuratum) is a good illustration of the use of heat in this connection.

2. *By increasing the Fluidity of the Liquid.*—Clarification by this method depends upon decreasing the specific gravity of the liquid by the addition of water, alcohol, or other liquid lighter specifically than the one to which it is added; this causes the suspended particles to subside, and the clear liquid may then be decanted.

3. *The Use of Albumin.*—The property possessed by albumin of remaining liquid at ordinary temperatures and becoming coagulated by heat renders it one of the most useful substances that can be em-

ployed in the process of clarification. Its action is mechanical, and where albumin exists naturally in the liquid, as in many fruit and vegetable juices, the simple heating of the liquid suffices to coagulate the albumin, which envelops the particles that render the liquid cloudy, and these rise to the top and are skimmed off. Albumin, or white of egg, is frequently added to liquids to clarify them ; in such cases it should always be added before the liquid is heated. This is best accomplished by adding about an equal bulk of the liquid to the albumin, then introducing the mixture into a muslin strainer and squeezing it through the meshes of the cloth by gathering up the corners and spirally twisting the strainer, when the organization of the albumin is destroyed, and a smooth mixture results ; the strained solution is then added to the liquid to be clarified, and the whole heated gradually (usually until it boils), without stirring, until coagulation is effected. In most cases the white of one egg is sufficient for a gallon of liquid. The error most frequently made by operators is the use of an excess of albumin. Care must be taken not to use albumin as a clarifying agent in those cases where the active principle of a liquid forms a precipitate by combining with it.

4. *The Use of Gelatin.*—Gelatin is used when tannin is present and is the cause of cloudiness, or when it is desirable for other reasons to remove it. Its action depends upon the fact that gelatin forms with tannin an insoluble compound ; this is, indeed, the basis of leather. Isinglass, one of the purest kinds of gelatin, is the preferred form ; it is frequently employed for clarifying infusions containing tannin, such as tea and coffee, etc. It is used by adding a weak solution of the gelatin in hot water to the liquid before it is heated, and allowing the liquid to cool. The insoluble compound formed must always be strained or filtered out.

5. *The Use of Milk.*—The presence of casein in milk, and the fact that acids precipitate it in the form of a curdy precipitate, are taken advantage of in the use of milk as a clarifying agent. It is employed particularly for vinous preparations, sour wines, etc., and should not be used in excess.

6. *The use of paper pulp* does not depend upon chemical combination, its action being purely mechanical. Paper pulp for filtering is best prepared by placing filtering paper (the saved trimmings and scraps left from making filters answer well) into a mortar or other vessel, and pouring enough solution of sodium or potassium hydroxide on it to saturate it, then stirring it with the pestle until it is reduced to a pulp. This should then be washed by placing a loose plug of absorbent cotton in a funnel and pouring in the mixture. When it has drained, hot water should be poured upon it until all traces of alkalinity are washed out ; the dried purified pulp may then be placed in stoppered wide mouthed bottles until needed. It is used as a clarifying agent by adding a portion to the cloudy liquid, agitating the mixture, and allowing the whole to stand quietly until the liquid is clear ; or, as a filtering agent, after the addition of the pulp, the mixture may be thrown upon a wetted muslin strainer, and if the liquid which passes through at first is not clear, it may be returned until it becomes so. It will be found that particles of pulp will partially fill up the meshes of the strainer, and an excellent filtering bed is

thus formed. Care should be taken, therefore, not to stir up the mixture after it is placed on the strainer.

7. *By Fermentation.*—The changes in the composition of juices after they have been fermented usually lead to the deposition of those substances which previously interfered with the transparency of the juices; the generation of alcohol through fermentation produces a liquid in which the substances are insoluble, hence the formation of a deposit. The preparation of syrup of raspberry affords a good illustration of the principle of clarifying juices by fermentation, while in the manufacture of wines the principle has been known and practised for centuries. (See Fruit Juices, Chapter LIV.)

8. *By Subsidence through Long Standing.*—This method involves the least possible amount of labor and expense, and it is resorted to very frequently (particularly upon the large scale) when haste is unnecessary, and whenever the liquid keeps well enough to withstand the tendency to spoil during the time necessary to effect complete separation. The deposit formed is called a *sediment.* This term is not synonymous with *precipitate. Sediment is solid matter separated merely by the action of gravity from a liquid in which it has been suspended. A precipitate, on the other hand, is solid matter separated from a solution by heat, light, or chemical action.* The fixed oils are clarified by subsidence; in the vegetable oils the sediment consists principally of albuminous and gummy substances which have been separated with the oil during the process of expression.

Decoloration is *the process of depriving liquids or solids in solution of color by the use of animal charcoal.* Decoloration is used in the abstraction of coloring matter from fatty bodies, oils, petrolatum, syrups, honey, etc. Animal charcoal, or bone black, which is produced by heating bones in close vessels out of contact with air, and then grinding them, is generally preferred in decolorizing operations. Wood charcoal possesses but little power in this direction. It has been generally settled that the decolorizing property is owing to the formation of insoluble compounds of the coloring matter when it is brought in contact with porous charcoal. Animal charcoal varies greatly in its power. The official purified animal charcoal is often not so powerful as a decolorizer as the animal charcoal from which it was made; but bones contain calcium phosphate and calcium carbonate, and the object of the purifying process is to separate these salts, because, in many of the delicate operations of pharmacy, particularly the decoloration of vegetable acid solutions, these salts would be dissolved by the acids, and the solutions thus contaminated. The most powerful animal charcoal is produced by calcining dried blood and other animal matter with pearlash, and afterwards washing out the pearlash with water, and subsequently with an acid solution. The charcoal need not be dried before using. For other information about the properties of charcoal, see *Carbo Animalis* and *Carbo Animalis Purificatus*, U. S. Dispensatory, 18th edition, page 326. For most decolorizing operations of the pharmacist on the small scale, the solutions, melted fats, oils, etc., can be introduced directly upon the animal charcoal, which is placed in a funnel and prevented from falling through by the insertion of a plug of absorbent cotton, or it may be arranged in an ordinary percolator, and the cold liquid percolated through the charcoal, or the liquid simply agitated with the charcoal and the mixture filtered. It is very important to remember that charcoal absorbs a number of valuable principles used in medicine,—*e.g.*, *bitter substances*, like gentiopicrin, aloin ; *astringents*, like tannin ; *alkaloids*, like quinine, morphine, strychnine, cocaine, etc. Charcoal has even been used as an antidote for poisoning with the alkaloids. It should always be used, in decoloration, with discrimination and judgment, or it may be found that in striving to improve the appearance of a preparation by lessening the color its value has been sacrificed.

CHAPTER XIII

SEPARATION OF IMMISCIBLE LIQUIDS

THE separation of liquids which are mutually soluble is usually effected by distillation, if one or both of the liquids are volatile (see page 140) ; but the separation of liquids which do not mix with each other is generally a simpler process, and the object of this chapter is to show the methods at present in use.

Use of the Pipette.—This simple instrument consists of a narrow tube with its lower end drawn out to a capillary orifice, and a bulb, either globular or elongated, blown in it near the top ; the upper edge is usually surrounded by a smooth glass ring to strengthen it. It is used by dipping the lower orifice into the liquid that is to be separated and applying suction with the mouth at the upper end ; the liquid rises, fills the bulb, and, if the end of the moistened forefinger is applied to the top, the liquid may be carried some distance without running out. Fig. 328 shows the ordinary form of the instrument. Fig. 329 can be readily made from a glass syringe tube, a perforated cork, and a piece of tube, by one unskilled in glass blowing. Fig. 330 shows a pipette which has a piece of sheet rubber tied over the thistle shaped top. If pressure is applied to the rubber, the air is partially expelled ; if the point of the pipette is then applied to the liquid and the pressure relaxed, the liquid will rise, and it may be transferred to another vessel. A modification of this, where a rubber bulb is attached to the pipette and used in a similar manner, is seen in Fig. 42.

FIG. 328

Plain pipette

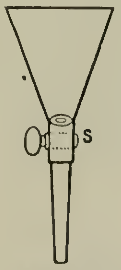
FIG. 329

Syringe pipette

FIG. 330

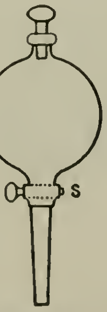
Pipette (sheet rubber top)

FIG. 331



Separating funnel

FIG. 332



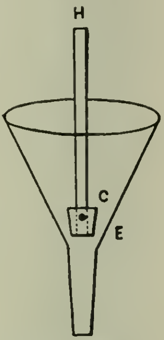
Globe separator

Use of the Glass Syringe.—The glass ear syringe, having a bulb blown near the orifice, is very useful in collecting a small quantity of oil floating on top of a liquid contained in a beaker or open vessel. The piston of the syringe should be well soaked in warm water before attempting this simple but delicate operation.

Fig. 333

Pear shaped separator

Fig. 334



Mitchell's separator

Use of the Separating Funnel.—This instrument, as indicated by its name, is used to facilitate the separation of immiscible liquids. It is generally a funnel having a glass stopcock in its neck (see Fig. 331). The mixed liquid is poured into the funnel, which is placed in position where it can come to rest, and the lower liquid is then allowed to run off by opening the stopcock. With careful use, liquids can be separated with great accuracy in this way. Where the liquid is valuable or very volatile, as in some of the oils, the globe separator (see Fig. 332), or the pear shaped separator (see Fig. 333), which can be securely stoppered and evaporation prevented, is preferred. In the assay processes, when immiscible liquids are to be separated, this latter form is invaluable, because, on account of the narrowing of the lower portion, the point of separation of the liquids can be more accurately fixed.

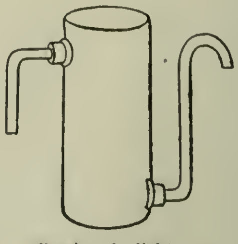
Mitchell's Separator.—Dr. Mitchell devised a cheap but efficient substitute for the separating funnel (see Fig. 334). A good, well pressed cork, C, is fitted into the throat of a funnel, E, and the end of a penholder handle, H, or other suitable wooden rod, is whittled to a flat wedge, and this forced into the cork tightly. The lower portion of the holder is notched, and the upper part of the cork is tied securely to it, or a wooden pin may be driven through it and the cork, to fasten it. It is used by forcing the cork C into the neck of the funnel, pouring in the liquids, and, when they have separated, lifting the handle H carefully until the lower liquid has entirely escaped, and then pushing it down tightly to stop the flow.

Florentine Receiver.—The separation of volatile oils from the water which usually accompanies them during distillation is a very important part of their process of manufacture. Where the volatile oil is lighter than water, the form shown in Fig. 335 is used. The mixed oil and water collect in the glass receiver during distillation, the oil floating on the top, while the water ascends the bent tube from

Fig. 335

Florentine receiver

Fig. 336



Receiver for light and heavy oils

the bottom ; further addition of distillate causes an overflow, and the water from the bottom of the receiver is discharged through the tube into a suitable vessel ; then the receiver becomes filled again gradually as distillation progresses. The process of separation is continued automatically. Where the oil is heavier than water, the method is reversed, and provision must be made for the escape of the water near the top of the receiving vessel. Labor may be saved by the use of a long necked funnel, or by placing a funnel in a wide tube, so that the mixed oil and water may be conveyed at once to the bottom without the liability of some particles of oil being carried over through the lateral tube and necessitating a second separation.

Fig. 336 shows a receiver which can be used for either light or heavy oils, one or the other tube being stopped with a cork, as the case requires.

CHAPTER XIV

PRECIPITATION

PRECIPITATION is the process of separating solid particles from a solution by the action of heat, light, or chemical substances. The separated solid is termed a *precipitate;* the added liquid or substance which produces the precipitate, the *precipitant;* the liquid which remains in the vessel above the precipitate, the *supernatant liquid.*

The precipitate usually falls to the bottom of the vessel. It may, however, remain suspended or rise to the top.

The objects of precipitation in pharmacy are,—

1. To obtain conveniently solid substances in the form of fine powder. Example, the precipitation of calcium carbonate.
2. To effect the purification of solids. Example, the precipitation of pepsin from its solution by sodium chloride.
3. To obtain through chemical reaction substances which are insoluble in the supernatant liquid. Example, the official preparation of red mercuric iodide.

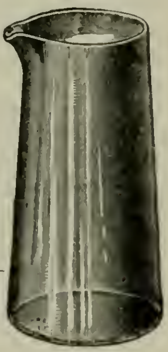
Precipitation is largely used in testing, as it frequently affords the most ready means of recognizing chemical substances or of ascertaining their purity. A great many pharmacopœial tests are based upon this process. The color, quantity, and character of the precipitate are all taken into account. The terms *curdy, granular, flocculent, gelatinous, crystalline, bulky,* and others, which are sufficiently distinctive, are used to define the peculiar form which the precipitate assumes when thrown out of solution. A *magma* is a thick, tenacious precipitate left after the liquid is decanted.

Methods of Effecting Precipitation.—Precipitation may be produced in many ways. If solutions containing albuminous matter be *heated*, a flocculent precipitate of coagulated albumin will be thrown down; while if solution of the silver salts be exposed to the *light*, precipitation is apt to take place. Precipitation will usually occur when a hot saturated solution of an amorphous substance is allowed to cool, as in the preparation of antimony oxysulphide, or when to a solution is added a liquid in which the dissolved substance is insoluble, as when strong alcohol is added to a small quantity of mucilage of acacia, or water to an alcoholic solution of guaiac.

Precipitation is most generally effected by the reaction of chemical substances, and some of the most interesting processes in pharmacy are the results of this method of producing precipitates. When acid solutions are brought in contact with alkaline solutions, insoluble precipitates are sometimes formed, as the solution of oxalic acid with lime water, forming calcium oxalate. By far the most common method is to mix a solution of one salt with a solution of another, thereby producing an insoluble precipitate, as in the official process for preparing red mercuric iodide, where solution of mercuric chloride and solution of potassium iodide are together poured into water. The methods of producing precipitates are numerous, and will be noted in detail under the head of the respective substances.

Vessels used in Precipitation.—Precipitating vessels should be deep, comparatively narrow, and broader at the bottom than at the top (see Fig. 337). This construction permits the precipitate to occupy less height in the vessel, by causing it to spread out upon the bottom; thus the supernatant liquid can be more thoroughly decanted, the particles of the precipitate will lie in closer contact, and a better opportunity is given for the escape of imprisoned air or gas, which frequently exercises a buoyant effect on the particles and prevents their subsiding rapidly and closely. Upon the large scale, cedar tanks, of the shape just described, may be used; these may have wooden spigots introduced, a foot or so apart, so that the supernatant liquid may be conveniently run off.

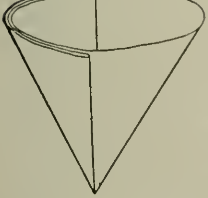
Fig. 337



Precipitating jar

Manner of conducting the Process.—If two solutions are used, and it is known that they contain the exact quantity of solid substance to react mutually without leaving an excess of one or the other, the order in which the liquids are mixed is immaterial; but when this is not the case, and the precipitant is to be added until precipitation ceases, it is necessary to proceed with caution. The precipitant is then added gradually, and, where acid or alkaline solutions are used, litmus paper is useful in indicating the approach of an excess. In other cases the precipitate may be allowed to subside, and the precipitant slowly dropped into the clear liquid above until it is noticed that further addition is without effect. If the precipitate is too bulky to subside quickly, the whole may be vigorously stirred until thoroughly mixed, a small portion transferred to a small plain filter (see Fig. 338), and the filtrate tested by a further addition of precipitant. If this small portion is weighed, or measured, or is a known proportion of the whole, a simple multiplication will determine about the quantity necessary to complete the precipitation. Ammonia water is one of the most useful of alkaline precipitants, because an excess is at once noticed by the odor. This is easily done by blowing the air from the surface of the liquid, thoroughly stirring up the mixture, and then noting whether it smells of ammonia.

Fig. 338

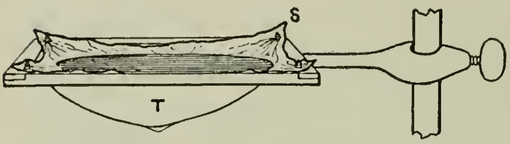


Filter (for precipitates)

The Production of Heavy and Light Precipitates.—Hot, dense solutions usually produce heavy precipitates, and such precipitates are more readily washed from adherent contaminating salts than those which are light and bulky. An additional advantage is, that they occupy less space, and consequently their dose is less bulky. A good example of this is found in the manufacture and use of heavy and light magnesium carbonate.

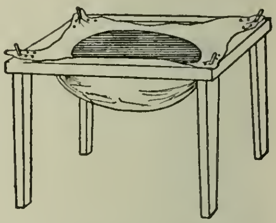
Collecting and washing Precipitates.—In small operations precipitates are collected upon plain filters (see Fig. 338). The special advantages of such filters in this respect have been already pointed out on page 206. On a larger scale muslin strainers are generally used. These are suspended on frames, as shown in Figs. 339 and 340. In washing precipitates which are placed on strainers of this kind, care must be observed to close up the fissures which usually appear in the magma after it has been allowed to stand a short time, by stirring the precipitate thoroughly before adding more water. (See Lotion, Decantation, pages 198 and 199).

Fig. 339



Collecting a precipitate

Fig. 340



Frame and strainer for precipitates

CHAPTER XV

CRYSTALLIZATION

Crystallization is the process whereby substances are caused to assume certain determinate forms called *crystals.* These are distinctive, and when perfect are bounded by geometrical surfaces. Those substances which are *not* crystallizable are termed *amorphous.* The objects of the process are to increase the purity and to enhance the beauty of chemical substances. The descriptions of the crystalline forms assumed by bodies form the basis of the interesting science of *crystallography.* In a work of this kind it is impossible to give more than a very brief sketch of the outlines of the classification, since the practical process of crystallization must receive the most attention. (See Dana's Mineralogy, Kopp's Kyrstallographie, Miller's Mineralogy, etc.). Every crystallizable body invariably assumes its own characteristic form, or in some form directly derived from it or related to it by a simple law, and in order to classify them crystallographers recognize at the present time six systems, to one or other of which every crystal is referred. A seventh system is sometimes conceded, but the occurrence of crystals belonging to it has not been demonstrated with certainty.

The following definitions should be well understood : The plane surfaces bounding a crystal are termed *faces;* when two contiguous faces intersect, an *edge* is formed ; an *angle* is formed when three or more faces intersect.

The faces, edges, or angles of a perfect crystal have equal faces, edges, or angles opposite to them, and if the middle points of the opposite faces or edges, or the opposite angles, be joined by straight lines, the point at which these lines intersect will be the centre of the crystal. The lines drawn through this point are called *axes.*

When *the same* body crystallizes in two or more forms belonging to different systems, it is said to be *dimorphous, trimorphous, polymorphous,* etc. When *different* substances crystallize in the same form, they are said to be *isomorphous.*

Prismatic (or prism-like) *crystals* are those which are extended principally in the direction of their longest axis. *Tabular crystals* are those crystallizing in flat plates ; *laminar,* those crystallizing in thin plates ; *acicular,* those which are needle shaped, etc.

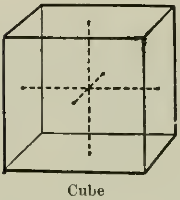
Other terms are used to describe the physical characters of crystals, which are readily understood and are not technical in their meaning.

The systems of classification are based upon the length and relative position of the axes of the crystal. Those in which the three axes intersect at right angles are termed *orthometric ;* and when the angles caused by their intersection are oblique, they are called *clinometric.*

Systems in Crystallography

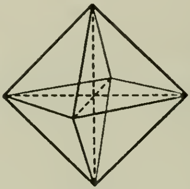
I. Monometric, or Regular System.—The crystals have three axes of *equal* length intersecting at right angles (see Figs. 341, 342, 343, and 344).

Fig. 341



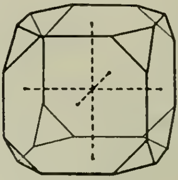
Cube

Fig. 342



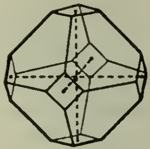
Octahedron

Fig. 343



Truncated cube

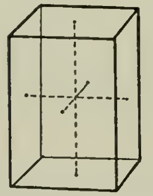
Fig. 344



Truncated octahedron

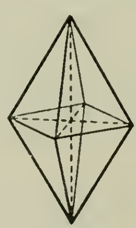
II. Dimetric, or Quadratic System.—The crystals have three axes, two of which are *equal*, the other *different* in length, all intersecting at right angles (see Figs. 345, 346, 347, and 348).

Fig. 345



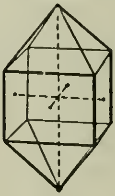
Right square or dimetric prism

Fig. 346



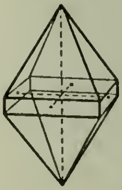
Dimetric octahedron

Fig. 347



Square prism, pyramidal summits

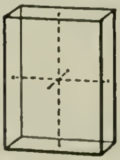
Fig. 348



Square prism, pyramidal summits

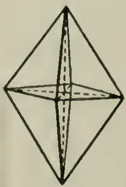
III. Trimetric, or Rhombic System.—The crystals have three axes of *unequal* length, all intersecting at right angles (see Figs. 349, 350, 351, and 352).

Fig. 349



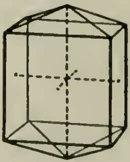
Rhombic prism

Fig. 350



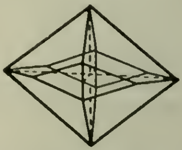
Rhombic octahedron

Fig. 351



Rhombic prism, pyramidal summits

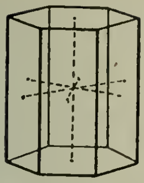
Fig. 352



Rhombic octahedron (partially truncated)

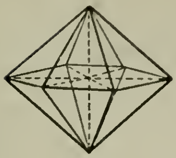
IV. Hexagonal, or Rhombohedric System.—The crystals have four axes, three of *equal* length, in the same plane, and inclined to one another at angles of 60°. The fourth axis is *different* in length, and intersects the plane of the other three at right angles (see Figs. 353, 354, 355, and 356).

FIG. 353



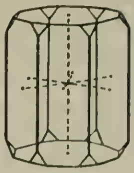
Hexagonal prism

FIG. 354



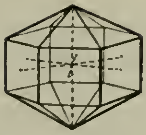
Double hexagonal pyramid

FIG. 355



Hexagonal prism (truncated)

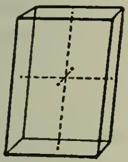
FIG. 356



Hexagonal prism, pyramidal summits

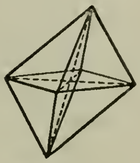
V. Monoclinic, or Oblique Prismatic System.—The crystals have three axes of *unequal* length, two of which are obliquely inclined to each other, the other axis forming right angles with these two (see Figs. 357, 358, 359, and 360).

FIG. 357



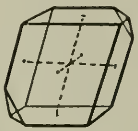
Monoclinic prism

FIG. 358



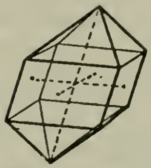
Monoclinic octahedron

FIG. 359



Monoclinic prism (partly truncated)

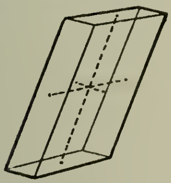
FIG. 360



Monoclinic prism, pyramidal summits

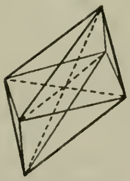
VI. Triclinic, or Doubly Oblique Prismatic System.—The crystals have three axes of *unequal* length, all obliquely inclined to one another (see Figs. 361, 362, 363, and 364).

FIG. 361



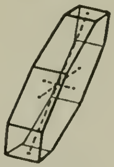
Triclinic prism

FIG. 362



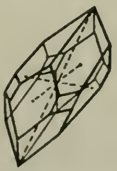
Triclinic octahedron

FIG. 363



Triclinic prism (truncated)

FIG. 364



Triclinic octahedron (partly truncated)

The Diclinic System, if recognized, would have three axes, two at right angles to each other, the third oblique to the other two.

Determination of Crystalline Form.—The method of determining the position of a crystal in one or other of the systems above noted is to measure the inclination of the angles which the faces of the crystal make with one another. From the data obtained the length and inclination of the axes are calculated. The hand goniometer or Wollaston's reflecting goniometer is used to measure the angles.

Cleavage.—If a crystal of potassium ferrocyanide or a piece of mica is broken and examined, it will be noticed that the cohesion of the particles is less in one direction than in any other, and if the blade of a knife is inserted in the edge, the crystal may be easily split or cleft. Other crystals possess this property, but to a greatly varying extent. Perfect crystals may sometimes be formed by cleavage.

The process of crystallization generally takes place when a body passes from a liquid or a gaseous condition into the solid state. A few instances are known where amorphous solids become crystalline without becoming liquefied, as in iron or brass wire, sulphur, barley sugar.

Methods of Obtaining Crystals.—1. By fusion and partial cooling. 2. By sublimation. 3. By deposition from supersaturated solutions as they cool. 4. By deposition from solutions during evaporation. 5. By deposition from solutions upon passing through them a galvanic current. 6. By precipitation. 7. By the addition of a substance having a strong affinity for water.

1. **By Fusion and Partial Cooling.**—Substances which have low melting points, like sulphur, camphor, and iodine, and some of the metals, like bismuth, antimony, etc., may be crystallized in this way. To obtain crystals of a substance like sulphur, it should be melted in a deep vessel and then allowed to cool, so that a crust will be formed; a hole is then made in the crust, and a smaller one on the opposite side; the vessel is now inclined toward the side having the larger hole, and the melted substance runs off; when the surfaces inside are examined, they will be found studded with crystals. If the quantity of material used is large, and the mass has been gradually cooled, the crystals will be large and distinct. The crust should be perforated as soon as it is fairly formed, and the fluid contents quickly removed.

2. **By Sublimation.**—This is one of the most useful methods of obtaining crystals (see Sublimation, page 161).

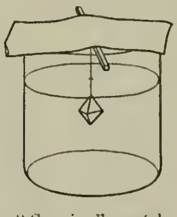
3. **By Deposition from Supersaturated Solutions.**—This is the method by far most frequently employed to obtain crystals. The solution of the substance is generally effected by the use of heat (see Solution). This solution should be filtered, and evaporated to the proper degree, and this latter part of the operation is the most important in determining the size and beauty of the crystals. As a rule, concentrated solutions produce small, ill defined crystals, while comparatively dilute solutions, provided they are supersaturated, produce crystals of more perfect form. The proper degree of concentration must always depend upon the solubility of the substance. If very soluble, the solution should not be saturated at the boiling temperature, or the crystals will be very small and so thoroughly interlaced that it will be difficult to wash them; if a portion of the evaporating solution is transferred to a glass or porcelain plate and allowed to cool, the rapidity with which the small quantity of solution crystallizes, and the amount of crystals obtained, form a basis for judgment. Upon the large scale, in order to secure a uniform product, it will be found that the specific gravity of the solution at a definite temperature, the temperature of the air, and the quantity of the solution must be considered. These points, however, can be obtained only by experience, and after a practical trial with each substance. It is a good habit to keep a record at each operation of the specific gravity and temperature of the solution which is set aside to crystallize, and note the character of the product. If the substance

is not very soluble, the solution should be evaporated until a *pellicle* or crust is formed upon the top, and then set aside.

Perfect rest for a solution designed for crystallization must be secured, if well defined crystals are wanted, and the solution must not be cooled quickly. When small crystals are desired, as in the case of magnesium or zinc sulphate, the solution should be cooled quickly, with constant agitation. This produces a great many nuclei, and prevents the gradual deposition of the particles in regular order upon one nucleus, which is so essential to the formation of the perfect crystal. There are several plans to choose from, for preventing rapid cooling. If the liquid is placed in an evaporating dish, and heated in a sand bath or water bath until evaporated to the proper point, the whole may be set away without disturbing them, to cool slowly together; or the dish may be placed in a warm room which is slowly cooled; or it may be embedded in a blanket or in woollen cloths, covered, and set aside. Having arranged the dish, it must be left absolutely undisturbed until all the crystals have separated. If jarred or knocked after the crust has once formed, the crystals will be mere confused masses.

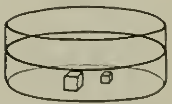
Use of Nuclei.—It has long been known that if a smooth glass rod having a single scratch upon it be placed in a solution ready to crystallize, crystals will first attach themselves to the scratched part, and the smooth part of the rod will frequently not have any separate crystals upon it. Rough surfaces, by offering more points of adhesion, attract the nuclei upon which the crystalline body is subsequently deposited. It is for this reason that strips of wood or lead are frequently suspended in liquids intended for crystallization, while in the manufacture of rock candy, threads are usually strung across the crystallizing tubs at regular intervals, columnar masses of fine crystals being thus produced. Perfect geometrical crystals may be obtained by the practice of "nursing," which consists in selecting from the ordinary stock as perfect a crystal as can be found for the nucleus, and then suspending it by a horsehair or piece of sewing silk in a warm saturated solution of the salt. Prof. J. U. Lloyd contributed to New Remedies, in 1879, pages 98, 133, 162, some interesting notes on the production of perfect crystals. Figs. 365 and 366 illustrate the method of "growing" perfect crystals.

FIG. 365



"Growing" crystals

FIG. 366



"Growing" crystals

Retarded Crystallization.—Warm saturated solutions of various salts, particularly if contained in chemically clean vessels, protected from the dust, and left at absolute rest until cooled, usually fail to crystallize. If the receptacle is shaken or jarred, or if a crystal from which the solution has been made, or any other solid substance, is dropped into it, crystallization sometimes takes place in an instant, and considerable heat is evolved. This is particularly noticed with salts capable of crystallizing with more than one molecule of water, as sodium sulphate, sodium carbonate, etc.

4. **By Deposition from Solutions during Evaporation.**—This process is not so frequently resorted to as that of cooling from hot saturated solutions, but it is especially useful where the liquid is more volatile than water, as alcohol, ether, petroleum benzin, chloroform, and upon the small scale for experimental purposes, or in the processes of original investigation. There are some instances in manufacturing pharmacy where the method is used, but in the case of volatile liquids the expense attending their loss, if spontaneously evaporated, is great, and, as a usual thing, rapid evaporation or recovery of the solvent by distillation cannot be used where large and distinct crystals are desired. Beautiful crystals are often made from aqueous solutions of substances that are allowed to evaporate slowly in a warm room for several months. The quantity of liquid and the amount of solid in solution have a great influence in enhancing the beauty of the product. For this reason it is usually impossible for the pharmacist operating on the small scale to vie with the manufacturer in producing massive crystals ; there is compensation, however, to the pharmacist in obtaining increased knowledge of the properties of medicinal chemicals and absolute knowledge of their purity.

5. **By Deposition from Solutions upon passing Feeble Electrical Currents through them.**—This method is mentioned in this connection because Becquerel and others have produced crystals of metals and metallic oxides by the slow but continuous action of feeble electrical currents through the solutions, kept up for months, sometimes for years. Gold and copper may be beautifully crystallized in this way.

6. **By Precipitation.**—Crystals are produced in some cases by the precipitation resulting from the mixture of certain solutions, and in other ways. (See Precipitation.) The crystals formed by this method are granular, and, on account of their rapid growth, are not well defined. A crystalline precipitate of acid potassium tartrate is produced when solution of potassium hydroxide is added to a strong solution of tartaric acid.

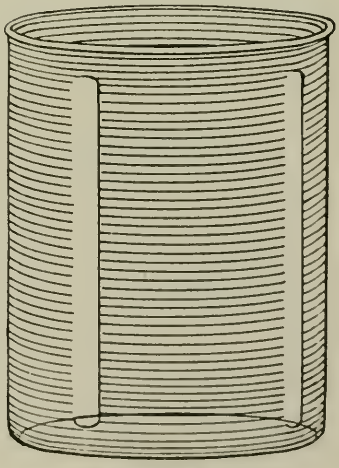
7. **By the Addition of a Substance having a Strong Affinity for the Liquids of the Solution.**—This method of effecting the crystallization of a solid is resorted to in some special cases. If calcium chloride is added to an aqueous solution of sodium chloride, the latter crystallizes out. Alcohol mixed with a solution of potassium nitrate causes the crystallization of the salt, because alcohol and water unite, and the potassium nitrate is not soluble in the mixture. The crystallization of sugar is frequently observed in syrups to which alcohol in the form of a tincture or fluidextract has been added, and this is often a source of annoyance to the pharmacist.

Water of Crystallization.—Many substances in the act of crystallizing combine with water, and the water so combined is termed *water of crystallization.* The same substance does not always contain the same number of molecules of water of crystallization. Sodium carbonate, for instance, usually contains ten molecules. At higher temperatures it may be made to crystallize with eight or with but five molecules, and under some circumstances it contains but one molecule of water. This combination with water must be carefully distinguished from the mechanical retention of water in the interstices of crystals, which takes place particularly where the crystals are large and have been formed rapidly. Water retained in this way is termed *interstitial water*, or *water of decrepitation*, because it is the cause of the *decrepitation* of bodies when exposed to heat. The sudden expansion of the water causes the substance to crackle and burst into fragments. Crystals containing combined water lose part of it on exposure to the atmosphere, and the transparency noticed when the crystal was fresh is replaced by opacity and the formation of a dry powder on the surface. This change is termed *efflorescence*. There are very few substances which will part with all their water of crystallization at ordinary temperatures, nearly all requiring a high heat to effect the object. The act of driving off the water and reducing the crystals to the form of a dry powder is called *exsiccation*. Some substances absorb water from the atmosphere, and, instead of becoming dry, grow moist, and in some cases are converted entirely into liquids. Such substances are said to be *hygroscopic*, and the act is termed *deliquescence*. A good example is found in potassium carbonate which has been exposed to moist air.

Mother Liquor.—The liquid remaining after the crystals have formed is called mother liquor, and still contains some of the salt in solution. This liquid retains as much of the solid as the solubility of the latter and the temperature will permit. It may be evaporated, and another crop of crystals obtained, if desired. Where two salts are in solution, it is obvious that the more soluble salt must exist in largest proportion in the mother liquor. Hence salts are frequently separated from each other by taking advantage of their difference in solubility. Thus cinchonine is separated from quinine. The process is termed *fractional crystallization*.

Crystallizing vessels should be deep, and made of rough glazed stoneware or porcelain. On the large scale, wooden tanks or vats are employed. The Appert glass tanks with heavy glass covers are very useful, as they cannot color the crystals or liquid (see Fig. 367). In the crystallization of alum the staves of the vats are retained in place by iron hoops, which may be tightened or loosened by screw bolts. After the solid crust of alum is formed around the sides and bottom, the hoops are loosened, the staves removed, and a hole chiselled through the side crust near the bottom, to permit the mother water to escape.

FIG. 367



Appert glass tank

Collection, Draining, Washing, and Drying of Crystals.—Upon the small scale it is usually sufficient, after the mother water is decanted, to break the crust of crystals, and, having dropped a few pieces of clean broken glass in the throat of the funnel, to place the crystals upon them and drain thoroughly. They are then to be washed by pouring water carefully and sparingly upon them. If the crystals are very soluble in water, and it is necessary to free them entirely from mother liquor, they must either be washed with alcohol or some liquid in which they are not so soluble, or with ice cold water, used very carefully but quickly by pouring it drop by drop upon the crystals, so that the smallest quantity will suffice. After draining, they may be transferred to a double sheet of filtering paper, placed on a bed of two or three newspapers or cloths, loosely covered, and removed to a dry atmosphere. If the crystals are liable to effloresce, they should be turned several times, and bottled as soon as fairly dry. Deliquescent crystals, like those of chromium trioxide, may be dried by spreading them on a clean, red pressed brick in a dry room. The mother water will be gradually absorbed by the brick, and as soon as the crystals are dry they are transferred to a close vessel.

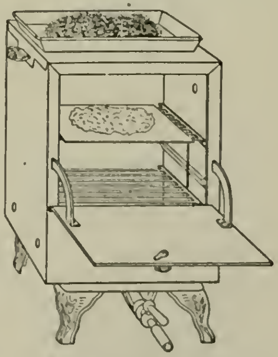
Intermediate crystallization is a term used to define the process of crystallizing a substance which is comparatively insoluble in simple solvents, by causing it to dissolve in a hot solution of another substance. Of course the latter should be very soluble. The whole of the ordinarily insoluble salt will entirely crystallize out at the first attempt. Red mercuric iodide may be made to crystallize in this way in brilliant scarlet crystals by dissolving it in a hot solution of sodium chloride, potassium iodide, or mercuric nitrate.

CHAPTER XVI

GRANULATION AND EXSICCATION

By granulation is meant the process of heating the solution of a chemical substance, with constant stirring, until the moisture has evaporated, and a sabulous, coarse grained powder is produced. It is a convenient method of obtaining many substances in the form of powder. Indeed, the practical advantages of granulated powders are so well recognized now at the prescription counter, that their use in preference to large crystals is rapidly extending. This is particularly the case with salts which are not very soluble in water, or which are commonly found in commerce in hard, tough, crystalline lumps or masses. The process of granulation is one which requires care, but no great amount of skill. The solution of the substance is generally evaporated rapidly until a pellicle forms upon the surface. Then the heat is moderated, in order to prevent spurting and caking. Great care must be exercised at this stage of the process to stir the mass constantly, as the tendency to form a crust on the bottom is very great, and when this hard crust is broken up by the stirrer it is very difficult to avoid the formation of lumps; but if the crust is not allowed to form, by keeping the bottom of the dish clean through constant stirring, the salt will separate in distinct grains, which will not adhere to each other. Toward the end of the process the heat should be very moderate, and the product should be introduced at once into a clean, warm, dry bottle.

Fig. 368



Oven for drying granulated effervescent salts

Granulated effervescent salts were formerly made by mixing the dry powders with dry tartaric acid and sodium bicarbonate and moistening the mixture with strong alcohol. The pasty mass was passed through a sieve, and the granules dried quickly in a hot room, sifted, and filled into bottles, which were hermetically sealed to prevent the access of moist air.

The use of alcohol in making granulated effervescent salts is expensive, and an improvement was made by using citric acid to replace a part of the tartaric acid. The molecule of water of crystallization in citric acid is liberated when heated in contact with the sodium bicarbonate, and this furnishes just sufficient water to make a pasty mass, without causing much loss of carbonic acid; by quickly drying the granules further chemical action is prevented.

In 1903 E. Fullerton Cook improved this method by mixing the powders on a glass plate and gently heating in an oven. When the mixture becomes moist, it is manipulated with a wooden spatula to make it uniform in consistence, and rubbed through a coarse tinned iron sieve and the granules dried in the oven. Fig. 368 shows a convenient oven for this use. A gas stove or wickless blue flame stove may be employed, and it is possible for a pharmacist to make granulated effervescent salts on the small scale.

Exsiccation is the process of depriving a solid crystalline substance of its water of crystallization or moisture by heating it strongly.

The product is usually a fine powder, and the original crystalline condition of the substance may be restored by redissolving it and evaporating the solution. The process is conducted by exposing the crystals to the air or a warm temperature until they are effloresced, and then gradually heating, with stirring, until they cease to lose weight; the residue is then powdered and kept in well stoppered bottles. The object of exsiccation is to increase the strength of substances and thereby fit them for special applications. For instance, exsiccated ferrous sulphate is preferred as an ingredient in pills, because sixty grains contain as much ferrous sulphate as one hundred grains of crystallized ferrous sulphate, and the pills can therefore be made one-third smaller. The mass is also much more readily formed from the finely powdered exsiccated salt.

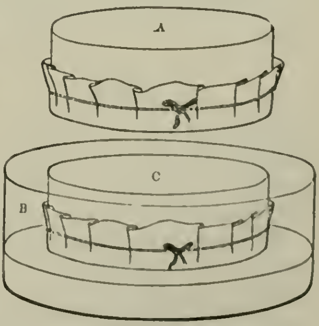
CHAPTER XVII

DIALYSIS

DIALYSIS is the process of separating crystallizable substances from those which do not crystallize, by placing a mixture of their solutions upon a porous diaphragm which has its under surface in contact with water. This remarkable process was discovered by Graham in 1861. He termed the substances which had the power of passing through the septum or diaphragm *crystalloids*, because they always have the crystalline form, and those which remained upon the diaphragm *colloids*, from their resemblance to gelatin and because they never crystallize. He also pointed out the differences between the two classes. Crystalline bodies, or crystalloids, are diffusible, brittle, hard, with clearly defined angles and flat faces. Their solutions are free from viscosity, and their reactions energetic and quickly effected. (Example, strychnine.) Colloidal bodies, on the other hand, are not diffusible. They are tough, with more or less softness of texture. The mathematically arranged angles and faces of crystals are replaced in colloids by rounded, irregular outlines, the fracture often being curved or conchoidal. Water of crystallization is replaced by water of gelatination, and the solution of colloids is, when concentrated, viscous or gummy, and their reactions are sluggish or inert. (Examples, gum, glue, starch, dextrin, gelatin, albumin, extractive matter.)

A thin layer of gelatin interposed between two liquids offers no obstacle to the passage of the crystalloids from one to the other, while it completely prevents the passage of the colloids. This property belongs not only to gelatin, but to other substances having a similar molecular constitution, as bladder, parchment, etc., of which the most convenient is the texture known as *parchment paper*, prepared by immersing unsized paper in a *cold* mixture of two measures of sulphuric acid and one of water, and subsequently washing it thoroughly to free it from acid.

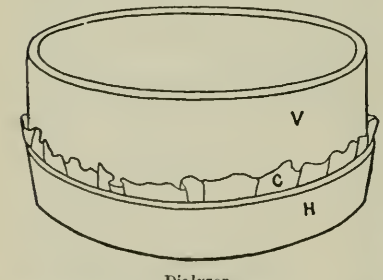
FIG. 370



Dialyzer

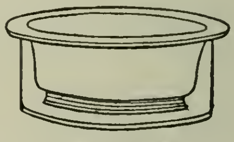
Upon the principles stated above Prof. Graham contrived a very simple apparatus which he called the dialyzer (see Fig. 370). It consists of two parts, one a circular glass recipient (B), about a foot in diameter and six inches deep, the other (A) a similar circular vessel, from six to ten inches in diameter and about two inches deep, made of hard rubber, celluloid, glass, or some similar substance, and the bottom of a circular piece of parchment paper, the edges of which are brought over the lower rim of the inner vessel nearly to the top, and fastened securely outside of it by a string or by a narrow rubber band. The first part, or circular basin, is to receive distilled water, and should contain from five to ten times the quantity of the liquid that may be introduced into the smaller vessel. The latter is to float upon the surface of the water in the former, and is to receive the liquid to be submitted to dialysis, which should not be more than half an inch deep on the paper bottom. It is important that the parchment paper employed should have no rent or aperture, and should be brought well up and secured on the outside of the inner vessel to prevent the liquid from passing between them. If any liquid containing a mixture of colloidal and crystalloidal matter be placed in the floating vessel, after some hours it will be found that a portion of the latter has passed through the parchment paper, and is held in solution by the distilled water of the larger vessel, while the colloidal matter remains. The distilled water thus impregnated is called the *diffusate.* The parchment paper, or any similar material used as the septum, is applicable to the dialysis of substances held in aqueous solution only, and will not answer for alcoholic or ethereal liquids. The hard rubber sieve, which has been already noticed (see Fig. 371), makes an excellent dialyzer if floated upon pure water in an evaporating dish or beaker. Fig. 372 shows another form, in which the glass dialyzer has its upper edge expanded into a flat shoulder which rests upon the upper edge of the round dish, sometimes called the "exarysator," containing the water. This has the advantage of keeping the diffusate covered while the dialysis is progressing. It is obvious that very different arrangements might be made to accomplish the same ends. Thus, a thoroughly clean bladder three-fourths filled with a mixture, suspended in a jar of distilled water, would yield similar results. Graham's apparatus is preferable to others only for its convenience.

Fig. 371



Dialyzer

Fig. 372



Dialyzer (glass)

The following applications of the process of dialysis have been made: 1. It facilitates in many instances to a considerable extent the separation of the active matter of any artificial or natural mixture from the inert and useless, the former being very often crystalline and the latter colloidal. Thus, infusions or decoctions of medicines, such as opium, belladonna, aconite, etc., submitted to dialysis might give up more or less completely their crystalline principles, such as the salts of morphine, atropine, aconitine, etc., to the water, while the gummy, resinoid, extractive, and coloring matters, etc., might remain behind. In effecting the analysis of organic bodies, one of the most embarrassing problems is to get rid of the inert principles which interfere with the action of chemical reagents, and the process of dialysis may here often be brought to the aid of the operator. 2. In searching for poisons in organic mixtures, as in the contents of the stomach, in which the application of tests is often rendered abortive by the colloidal matter present, the problem of the presence of the poison may sometimes be solved by submitting the suspected matter to dialysis. The poison will often be found in the diffusate separated from the other matters, and may then be detected by the ordinary tests. 3. In pharmaceutical operations it often happens that salts and other crystallizable substances are thrown away as refuse matter because they would not repay the cost of time and material necessary for their recovery. It is possible that by this simple, inexpensive process these substances may be separated from the useless matters and thus saved. 4. An economical application has been made of the process, by the restoration of salted meat to the fresh state. If some salt beef with its brine be enclosed in a bag of material suitable for dialysis, as of untanned leather, and the bag be immersed in sea water, in the course of some days the beef will have been rendered sufficiently fresh for use, the salt having passed out into the sea water. B. F. McIntyre, of New York, gave a great deal of attention to the practical applications of dialysis, and introduced a class of preparations called *Dialysates.* These were prepared from various drugs by dialysis, and it was claimed that they contained the active crystallizable constituents in their original combination, deprived of inert colloidal substances.

Dialyzed iron, or *Ferrum Dialysatum*, is a colloidal preparation made by placing a mixture of basic ferric chloride and ammonium chloride upon a septum. The crystalloids (ammonium chloride and ferric chloride), with any free acid, pass into the diffusate, leaving the neutral colloidal liquids upon the septum.

CHAPTER XVIII

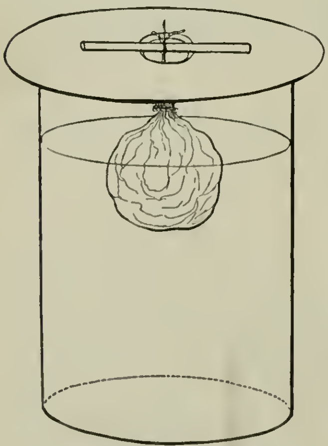
EXTRACTION

UNDER this head are included those operations which have for their object the separation of the soluble principles from drugs by treating them with a liquid capable of dissolving them, which is called the *menstruum.* Extraction differs from solution in the fact that the presence of insoluble matter is implied in the former, and the soluble constituents must therefore be *extracted* or separated, by appropriate methods, from those which are insoluble. The principal modes of extraction employed in pharmacy at present are as follows: 1. Maceration and expression. 2. Percolation. 3. Digestion. 4. Infusion. 5. Decoction. Maceration and expression are old processes, and they will be considered first; percolation is much more important and useful, and will be treated of in a separate chapter; digestion is merely a modified form of maceration. Infusion and decoction are processes which are used in producing separate classes of official preparations. Hence they will be considered in Part II.

Maceration

The process of *maceration*, which is of ancient origin, consists simply in soaking the properly comminuted drug or substance in the menstruum until it is thoroughly penetrated and the soluble portions softened and dissolved. The usual method is to introduce the drug or substance into a bottle with the menstruum, cork it tightly, and agitate it occasionally for a period ranging from two to fourteen days; then to pour off the liquid, express the residue to avoid waste, and filter the mixed liquids. An advantage is sometimes gained by suspending the ground drug, tied in a bag, in the upper part of the menstruum (see Fig. 373). This is sometimes termed *circulatory maceration.* Maceration is the process directed by the German Pharmacopœia in preparing tinctures. The drugs are ordered in all cases to be macerated in definite weights of alcohol for a week in a closed bottle, in a shady place, with frequent agitation, at a temperature of about 15° C. The liquid is then separated by straining or expressing from the insoluble residue, and, after having been allowed to settle, it is filtered. Evaporation during filtration is to be avoided as much as possible. Maceration has no advantages over percolation in making the greater number of

FIG. 373



Circulatory maceration

liquid preparations from drugs, except in the hands of the careless or unskilful. If an operator possesses no knowledge whatever of the process of percolation, it is safer to trust to maceration, for here no particular skill or judgment is necessary; the soaking process is completed in due time, and the separation of the absorbed liquid, while laborious and uncleanly, has at least the merit of leaving the tincture uniform in strength; if the process of expression is not thoroughly performed, pecuniary loss results, but the finished preparation is uniform. On the other hand, in percolation, if the operator has, through careless packing, failed to exhaust thoroughly the drug with the amount of menstruum used, a portion of the activity of the drug remains in the residue, which is thrown out, and the preparation is thus deficient in strength. In making tinctures by maceration, the practice of weighing liquids, as directed in the German Pharmacopœia, is seen to the best advantage, although, of course, the principal objection to preparations made from weighed liquids still exists,—the necessity for a calculation to determine the dose as compared with that of the drug. The tincture must always be administered by measure, and hence a teaspoonful or a fluidrachm should bear a certain relation to the drug, which is readily ascertained without resorting to a problem in specific gravity.

Digestion is that form of maceration which consists in the application of a gentle heat to the substance which is being treated. It is used in those cases where a moderately elevated temperature is unobjectionable, the heat increasing the solvent powers of the menstruum.

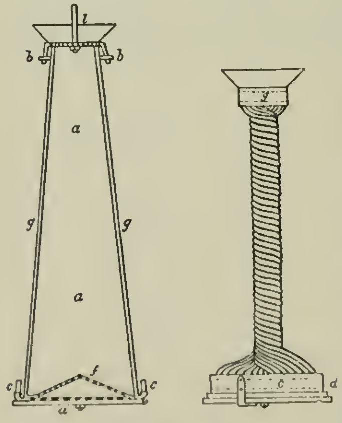
CHAPTER XIX

EXPRESSION

Expression is the process of *forcibly* separating liquids from solids. It is generally effected by the use of a press, although for many pharmaceutical operations, upon the small scale, the use of straining cloths with hand pressure suffices. Pressing cloths are generally employed but they are troublesome, and of late years strong efforts have been made to construct presses which could be used without them. At least six mechanical principles are recognized in the operation of expression as now practised: namely, by the use of—1. The spiral twist press. 2. The screw press. 3. The roller press. 4. The wedge press. 5. The lever press. 6. The hydraulic press.

1. **The Spiral Twist Press.**—The principle of this press is best and most practically illustrated in the usual process of expressing a substance contained in a cloth with the hands. The mixture to be expressed is placed in a bag or a cloth held in one hand by the four corners, which are gathered together, and the lower portion, or bag, is rotated with the other hand, so that, beginning at the top, the point of smallest diameter, the strainer is spirally twisted, the pressure forcing the liquid between the meshes of the cloth. Figs. 374 and 375 show Gigot's press, in which this principle is used upon a larger scale. Upon the left hand is shown a sectional view of the press as it appears when filled with material. The perforated cone, *f*, forms the bottom of a conical strong cloth tube; the upper end is connected with a funnel, *l*, which is so constructed that none of the material that has passed down into the bag can leak back. The lower portion of the cloth is secured to a ring, which may be fastened, so that it will not rotate when the press is used. If the upper end of the cloth is twisted, the space occupied by the material is contracted, and the liquid oozes through the meshes of the cloth. The dry residue is discharged by untwisting the cloth and unhinging the bottom, which opens downward.

Fig. 374 Fig. 375



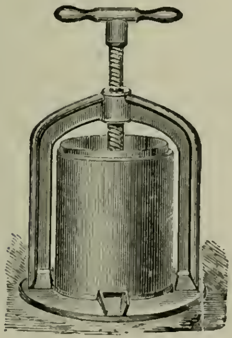
Gigot's press

2. **The Screw Press** is the most useful of all forms for pharmaceutical work where very great power is not desired. The screw is always used in combination with one or more levers, and this form of press is employed in great variety to accomplish special purposes. There are two forms of screw presses: 1. Single screw presses. 2.

Double screw presses. Each of these forms may be subdivided into those in which the position of the screw or screws is *vertical*, and those in which the position of the screw or screws is *horizontal*.

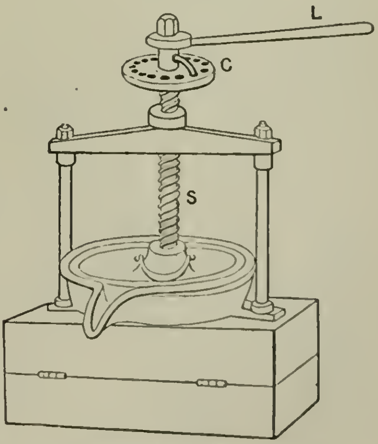
Single Screw Presses.—In this form of press the single screw is generally used in a vertical position, and operated with a lever or a combination of levers. It is the simplest kind of press, and if well made will admirably answer the general purposes of the pharmacist. The screw should have a square faced thread, and be well made. The plunger should be disconnected from the end of the screw, or else move freely around it. The parts of the press which come in direct contact with the material to be pressed should be coated with tin or porcelain, so that liquids containing acid or tannin shall not be affected injuriously. Fig. 376 shows a press of this description, made by H. Troemner, of Philadelphia. A perforated tin case accompanies the press. This may be used when pressing bulky drugs, like arnica flowers, and press cloths may be abandoned. The best material for press cloths is that which is especially made for the purpose. It is twilled and elastic in one direction, and, if proper care be taken when enveloping the material and introducing it into the press, the same cloth may be used many times, as the pressure causes the meshes to open without breaking the threads. The manufacturers of linseed oil use press cloth largely. For small operations, in the absence of press cloth, which is very expensive, new Russia crash may be used. The press cloth should be moistened, if possible, with some of the same liquid expressed at a previous operation. Water answers very well if the liquid is aqueous. The substance to be pressed is laid upon cloth and one corner of the cloth laid over it. The opposite corner is then placed upon the first; next one of the remaining corners is laid in the same way upon the first two, followed by its opposite. The corners should be folded over so that a square, somewhat flat package is produced, in size somewhat smaller than the press plate, especial care being observed to suit the quantity of material to the capacity of the press. If too much is taken, the

Fig. 376



Troemner's press

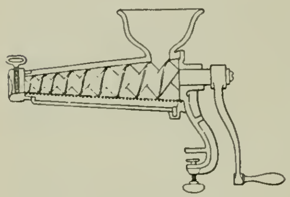
Fig. 378



German single screw press

press cloth will be too small to permit of folding it over sufficiently; the corners of the package will therefore not withstand the pressure, portions of the material itself will ooze out, and the whole operation must be repeated. The principal objection to the single screw press is, that unless the material in the press is nearly homogeneous, so that the press cake is equally pressed upon at all points, unequal action results, the press block is pressed against one side of the case, causing violent friction and resistance, and the thread of the screw binds upon one side, full pressure thus being defeated; while the main objection to the vertical screw is that the press block and plate must be in a horizontal position, so that the liquid pressed out adheres to the cloth, and cannot be collected readily without tilting the press. Fig. 378 is an illustration of a German single screw press which is well adapted to pressing the residues from macerated tinctures. The large lip of the containing vessel is a practical convenience, while the lever, L, in combination with the catch, C, gives unusual power and ease in working, for a small press. In the horizontal screw press, the jaws being vertical, there can be no obstruction to the dropping of the expressed liquid, which may be caught in a vessel placed immediately under it. Oberdoffer, of Hamburg, Germany, makes a very powerful horizontal screw and compound lever press. Fig. 379 illustrates a horizontal screw press, made by the Enterprise Manufacturing Company, of Philadelphia, which is operated without a press cloth. It consists essentially of a tapering cylinder, with a hopper on the upper side at its large end, and a strong screw fitting closely to the inner surface of the case, the thread of which diminishes in size as the screw becomes smaller. Along the under side of the cylinder is formed a channel adapted to receive a perforated brass plate. This latter has a transverse concavity corresponding to that of the inner surface of the cylinder, and the perforations allow the escape of the expressed fluids into the channel or gutter beneath, from which it escapes by a proper outlet. The substance to be expressed is placed in the hopper, and, the crank attached to the screw being turned in the proper direction, the thread of the screw compresses the substance into a smaller and smaller space, until finally it is discharged at the farther end of the cylinder in a comparatively dry state. A large screw, passing through a removable end of the conical cylinder, regulates the size of the outlet, and serves to increase or diminish the amount of pressure to which the mass is subjected by the screw. The brass plate in the bottom of the machine can be replaced by others having perforations of different sizes. Clogging of the holes by bits of wood, stems, or seeds is prevented by the shear-like action of the edge of the screw thread, which shaves off the protruding fragment, while the rest is forced through the perforation. To increase the power of the press upon slippery substances, the inside of the casing has a few longitudinal or spiral grooves at a greater or less angle to the direction of the screw thread. Arrangements are provided for detaching the casing from the screw, and for attaching

Fig. 379

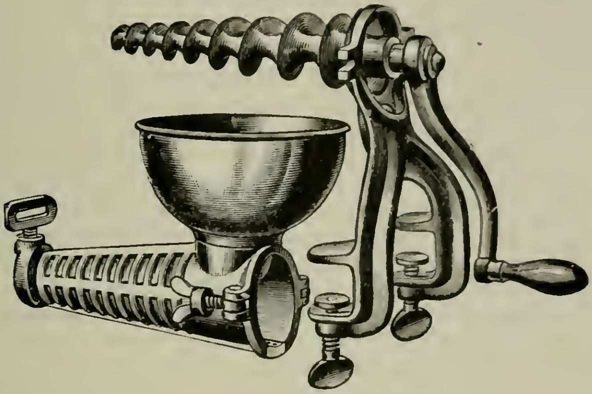


Enterprise press

the whole to the edge of a table or bench. Fig. 380 shows the press as taken apart.

Double screw presses are preferred by many. These are always of the horizontal screw form, and in Fig. 381 is shown one made as proposed by Chas. T. George, of Harrisburg, Pa. A strong and substantial framework, made of ash wood, forms the base. Two pieces of timber rest upon this frame, one firmly attached by an iron rod and keepers to one end of the frame or table, and the other free or movable, both blocks being bored at the same distance from the end with smooth holes to receive the two iron screws.

Fig. 380



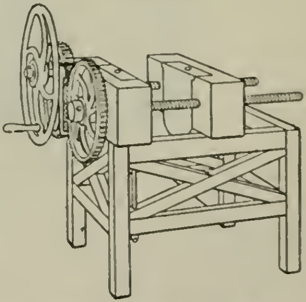
Enterprise press

Upon the movable block, and opposite the holes, a female nut of bell metal is firmly fixed. Upon the inner face of the two timber blocks, iron castings, saddle shaped and hollow, are inserted, flush with the face of the block, each capable of holding six pints of boiling water, and each casting having a hole on top to receive hot water or steam. A brass petcock is fixed at the bottom to discharge the chilled water.

The two iron screws pass through the holes of both blocks of timber, the head of each screw having an iron cogwheel attached to it; into the cogs of each wheel a pinion wheel is firmly fixed, which in turn is fastened to a short shaft having at its end an iron flywheel.

By turning this wheel both screws are evenly and rapidly rotated without danger of bending or breaking, and consequently one block is drawn surely and with great power against the other, thus expressing whatever drug may be placed in a sack of strong linen towelling between the two blocks of timber.

Fig. 381



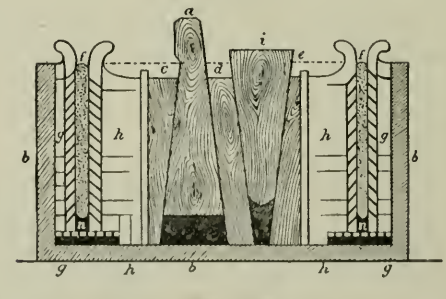
George's double screw press

It is apparent that the double screw press is very powerful, and, the pressure being equalized, good results are obtained.

3. **The Roller Press** is used upon the large scale for pressing oily seeds, fatty substances, etc. Its principle is thoroughly shown in the well known clothes wringer, which, although made for the laundry, serves as a very efficient press for many substances. Care must be taken to apply the force gradually to the bag containing the berries or other material to be pressed, and not to use it upon substances which will soften or dissolve the rubber rollers.

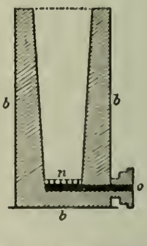
4. **The Wedge Press.**—This form of press is powerful, economical, and inexpensive. It is objectionable principally on account of the noise necessarily made in driving the wedges. Fig. 382, taken from Knapp's Technology, illustrates the wedge press. The filled cloths are laid between strong plates, *h* and *g*, and placed in a square space cut in a solid block of oak wood or in a cast iron case, *b*, and the plates are forced nearer and nearer to each other by driving in the wooden wedges which occupy the remaining space. One of these wedges, *a*, serves to facilitate the disconnection of the apparatus, the strokes which drive in the wedge *i* tending, from the reverse position of *a*, to drive the latter out; *c*, *e*, and *d* are intermediate pieces to prevent the wedges from coming into immediate contact. The pressing plates are each provided with three side ribs. The immovable ones, *g*, *g*, press against the sides of the case, and the movable ones, *h*, *h*, against the intermediate wedges, *c*, *c*, and are pierced with numerous holes to allow the liquid to flow out more easily. On filling the press, the wedge *a* must be suspended (by a string) at a distance from the bottom, so that the apparatus may be easily taken to pieces. The liquid trickles from the pressing plates through the pierced horizontal plates, *n*, *n*, upon which these rest, into the pipe *o*. Both *a* and *i* are driven by separate stampers, which are raised by a toothed wheel, or mallets may be used.

Fig. 382



Wedge press

Fig. 383



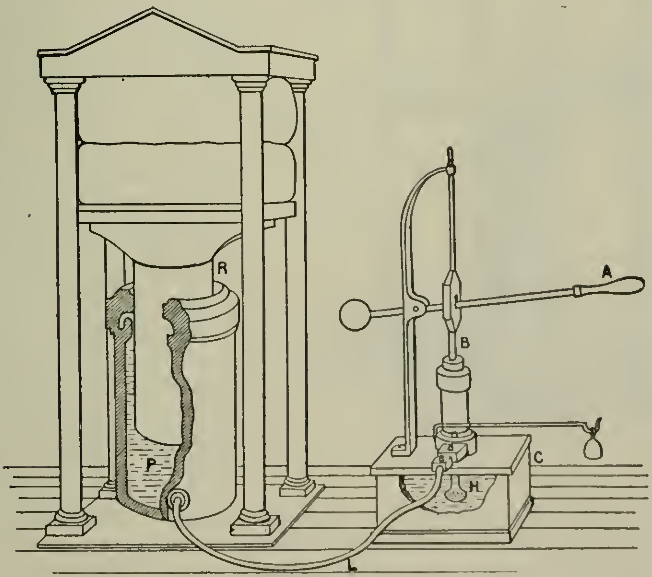
Wedge press (end view)

5. **The Lever Press.**—The only advantages possessed by this press over those previously noticed are its cheapness, and that it may be made by any one possessed of even moderate mechanical abilities. Prof. Procter recommended the following method of construction. "A piece of timber twelve feet long, and with lateral dimensions sufficiently great to be inflexible with the force to be applied to it, has *one* of its ends securely attached to a wall or upright post in such a manner as to admit of the motion of the other end. The pressing

box being placed about one foot from the fixed end, on a firm block of wood, is subjected to the action of the lever by placing a piece of wood vertically between the piston block of the pressing box and the lever. It is obvious that a weight of one hundred pounds at the opposite end causes a downward pressure equal to eleven hundred pounds at the box. The pressing box most usually employed is a cylinder, closed at one end, made of thick tinned iron, secured with bands of the same material, which are soldered on, and between these, numerous holes are perforated. This cylinder is set in a tin dish with a lateral spout. The piston block is constructed of hard oak wood with the grain running transversely to its axis." The objection to this press is that, compared with other presses, it yields but little power in proportion to the space occupied; but as an offset to this it can be made to work simply and quickly.

6. **The Hydrostatic or Hydraulic Press.**—Of the presses heretofore mentioned, each has some especial advantage or use, but each has also some fault or objectionable feature. The spiral twist is not powerful, and its action is limited. The screw presses of both varieties have friction to contend with. The friction of a screw increases with the intensity of the pressure applied, and when a certain limit is reached all further force applied is wasted, and, if persisted in, involves the destruction of the press. The roller press is very limited in its action; the lever press is unwieldy and not powerful; the wedge press is noisy and can be used only for special purposes. The hydrostatic press is costly, but after the first cost it is the most economical, because the greatest power is obtained at the expense of

FIG. 384

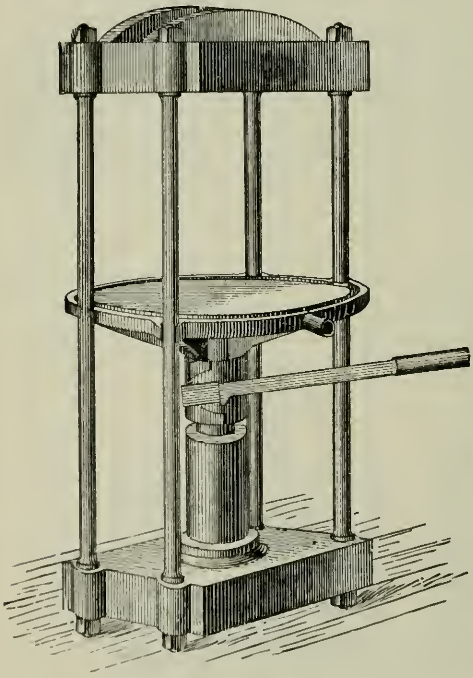


Hydraulic press

the least labor. The principle is shown in Fig. 384. It must be remembered that the molecules of fluids move freely in contact with one another almost without friction, and, according to Pascal's law, "Pressure exerted anywhere upon a mass of liquid is transmitted undiminished in all directions, and acts with the same force on all equal surfaces and in a direction at right angles to those surfaces."

Although it has been proved that liquids are to a slight extent compressible, it has also been shown that they are *perfectly elastic;* so that if a plug be forced into a liquid which entirely fills the vessel, the pressure is felt equally upon every square inch of the surface of the vessel and upon every square inch of the surface of any body immersed in the liquid, and if the pressure is removed from the plug it will be immediately forced out of the vessel and the liquid will at once regain its original volume. Now, if a vessel is constructed having two columns communicating at the bottom, as in Fig. 384, and if water or other fluid is placed in it, it will be found that a pressure of one pound applied at the piston in the tube, B, will be communicated to every portion of the lower surface of the ram, R. If the area of R is ten times greater than that of B, it follows that a pressure of one hundred pounds on A, conveyed through the lever, exerts an upward pressure of one thousand pounds on R. By increasing the area of the ram the power may be greatly multiplied, so that pressure applied by one man on the lever may be communicated to the liquid and made to exert an upward pressure of several tons. Fig. 385 shows a pharmaceutical press made by R. Dudgeon, of New York, constructed on the principle of hydrostatic pressure. In order to economize space, by an ingenious system of valves one of the cylinders is contained within the other, and by pumping the oil into the outer vessel the ram carrying the platen is forced upward. The platen has a groove around its edge communicating with a spout for carrying off the expressed liquid. Press cloths may be used to contain the material to be pressed, or a very strong perforated case is supplied. The upper plate is very strongly secured by bolts and nuts, and press blocks covered with tinned iron are employed to fit into the perforated case if desired. The weight of one man, one hun-

Fig. 385



Dudgeon's press

dred and fifty pounds, applied to the end of the lever will produce an upward pressure equivalent to ten tons. This is the most powerful press available for pharmaceutical purposes, and, although expensive, its first cost will be more than offset by its durability and by its economy of power whenever pressure greater than that afforded by the smaller presses is needed.

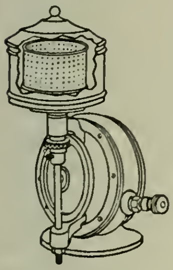
The following maxims should be observed in operating presses:

1. All moving parts of the press should be well lubricated before attempting expression.

2. Pressure should be *gradually* increased; sudden strains should always be avoided. If this precaution is neglected, either the press cloth or press bag will burst, the finer solid particles will be forced through the meshes, or breakage of press plates or press will result.

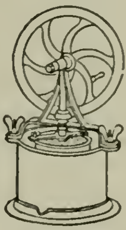
3. Pressure, to secure the best results, should be unrelaxed, but intermittent. After apparently reaching the limit of compression, the action of the press should cease, and if the pressure be maintained unrelaxed it will be found that in a short time further pressure may be applied and more liquid separated. In this way, by alternately exerting pressure and resting, the utmost limit of the power of the press may be gradually reached without undue strain. Screw presses have more ability to retain pressure than hydraulic presses; the valves of the latter frequently leak slightly, and the pressure has to be continually renewed.

Fig. 386



Centrifuge (under driven)

Fig. 387



Centrifuge (over driven)

Centrifugal Machines or Centrifuges.—For separating liquids from solids the principle of centrifugal motion has been successfully used. The machine consists of a central, perforated cylindrical cage surrounded by a case; the cage is attached to a vertical shaft, which is capable of being speeded to several thousand revolutions a minute. The wet material is placed in the cage, the machine started, and the liquid forced by the rapid motion through the perforations into the space between the outer case and the cage. Figs. 386 and 387 show two kinds of centrifuges, Fig. 386 illustrating the "under driven" type, which is run by water power, and Fig. 387 showing the "over driven" type.

CHAPTER XX

PERCOLATION

Percolation, or **Displacement,** is the process whereby a powder contained in a suitable vessel is deprived of its soluble constituents by the descent of a solvent through it. The importance of this process cannot be overestimated, as the progress made in pharmacy in America during the last century is largely due to the study and development of percolation, and the introduction of preparations which are the direct outgrowth of the process.

History.—The practice of exhausting wood ashes of their soluble constituents by pouring water upon them after their introduction into a conical shaped wooden vessel called a lye hopper is an ancient one, and the process is still practised and known as *lixiviation.* The first attempt on record to apply the principle to powdered drugs was made by Count Real, who about the year 1815 invented a press which consisted of a metallic cylinder with a stopcock in the bottom and containing a perforated diaphragm for supporting the substance, and with a tight cover at the top, to which was attached an upright tube, ten or twelve feet high, having a funnel soldered to its upper extremity. The cylinder was packed with the coarsely ground drug, and water poured into the tube. The pressure of the column of water was so great, however, that the principal difficulty in using the apparatus was in securing tight joints, and in preventing the incomplete exhaustion of the drug on account of the too rapid passage of the water through it. M. Robiquet subsequently made some experiments to determine the power of ether as a solvent in extracting the fixed oil from the bitter almond. He observed that ether poured on powdered bitter almond displaced the fixed oil without mixing materially with it, and he published his observation. It was reserved, however, for the Boullay brothers, of Paris, in 1833, to apply the ideas of Real and Robiquet to drugs and medicinal substances in general, and to them belongs the credit of first demonstrating the value of the process of percolation in its pharmaceutical applications. The researches of the Boullays at once attracted the attention of American pharmacists, and the labors of Duhamel, Procter, Grahame, Squibb, and others during the last century, and the adoption of the process in the Pharmacopœias of 1840, 1850, 1860, 1870, 1880, 1890, and in the 8th Revision, sufficiently show the character of the growth in favor of percolation. In Great Britain, France, and Germany the process is well known, and is practised to some extent, but maceration still holds in these countries the chief place as a means of extracting the soluble principles of drugs.

Principle of Action.—*When a powder placed in a cylindrical vessel with a porous diaphragm below, is treated from above with a liquid capable of dissolving a portion of its substance, that portion of the fluid first in* *contact, in passing downward, exercises its solvent power on the successive layers of the powder until saturated, and is impelled downward by the combined force of its own gravity and that of the column of liquid above it, minus the capillary force with which the powder tends to retain it.* If the quantity of liquid added is not more than enough to satisfy the capillarity of the powder, no liquid will pass the diaphragm; but the careful addition of liquid upon the top displaces that absorbed in the powder without mixing materially with it, and takes its place, to be in turn displaced by a fresh portion of liquid. The instrument used to hold the powder is called a *percolator;* the liquid poured on top of the powder, the *menstruum;* the liquid coming from the percolator impregnated with the soluble principles, the *percolate.* In order thoroughly to understand the process of percolation as applied to powdered drugs, it must be remembered that the soluble principles of vegetable substances are in a hard and dry condition, and are generally contained in cells which are more or less disintegrated by the process of grinding. If the soluble principles could be perfectly separated from the insoluble cellular substance by any means, and be deposited in the interstices of the ground particles, percolation would indeed be a rapid process, for the descending column of liquid would immediately dissolve the soluble principles, which would be found in the receiving vessel, while the insoluble substances would remain in the percolator, and the separation would then be easily accomplished. But the powdering of the drug only partially separates the soluble principles from the insoluble, and the finest dust of the powder always contains a larger proportion of the soluble principles than of the insoluble substance, because the latter, often being largely ligneous, offers the greatest amount of resistance to disintegration. Hence the first portion of the percolate is always the most dense, the most highly colored, and contains the largest proportion of the soluble principles, because the first portion of menstruum, in its descent through the powder, has the first opportunity to come in contact with the largest proportion of the soluble principles, which are to be found in the finer dust scattered through the powder, and in the thoroughly disintegrated particles, which offer but slight resistance to the passage of the menstruum. In every well conducted experiment in percolation it will be noticed that, as the operation proceeds, each succeeding portion of percolate is less highly colored and less active than the one preceding it; and in the case of drugs containing easily dissolved coloring matter, an examination of the percolate will show that the shading is very marked, the lowest portion being very dense and dark colored, the upper portion almost colorless, while in the intermediate liquid the gradations of the tint are clearly perceptible.

The directions of the United States Pharmacopœia upon percolation are as follows:

"*Percolation*, as directed in this Pharmacopœia, consists in subjecting a substance or a mixture of substances, in powder, contained in a vessel called a percolator, to the solvent action of successive portions of a certain menstruum in such a manner that the liquid, as it traverses the powder in its descent to the receiver, shall be charged with the soluble portion of it, and pass from the percolator free from insoluble matter.

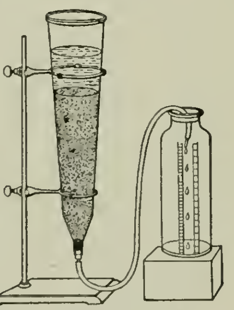
"When the process is successfully conducted, the first portion of the liquid, or percolate, passing through the percolator, will be nearly saturated with the soluble constituents of the substance treated; and if the quantity of menstruum be sufficient for its exhaustion, the last portion of the percolate will be nearly free from color, odor, and taste, other than those of the menstruum itself.

"*Percolators.*—The percolator most suitable for the quantities contemplated by this Pharmacopœia should be nearly cylindrical, or slightly conical, with a funnel shaped termination at the smaller end. (See Fig. 388.) The neck of this funnel end should be rather short, and should gradually and regularly become narrower toward the orifice, so that a perforated cork, bearing a short glass tube, may be tightly wedged into it from within until the end of the cork is flush with the outer edge of the orifice. The glass tube, which must not project above the inner surface of the cork, should extend from 3 to 4 Cm. beyond the outer surface of the cork, and should be provided with a closely fitting rubber tube, at least one-fourth longer than the percolator itself, and ending in another short glass tube, whereby the rubber tube may be so suspended that its orifice shall be above the surface of the menstruum in the percolator, a rubber band holding the tube in position.

Fig. 388

Official percolator

Fig. 389



Official percolation

"The shape of a percolator should be adapted to the nature of the drug to be operated upon. For drugs which are apt to swell, particularly when a feebly alcoholic or an aqueous menstruum is employed, a *conical* percolator is preferable. A *cylindrical* or only slightly tapering percolator may be used for drugs which are not liable to swell, and when the menstruum is strongly alcoholic, or when ether or some other volatile liquid is used for extraction. The size of the percolator selected should be in proportion to the quantity of drug extracted. When properly packed in the percolator, the drug should not occupy more than two-thirds of its height. The percolator is best constructed of glass, but, unless otherwise directed, may be made of any suitable material not affected by the drug or menstruum.

"The percolator is prepared for percolation by gently pressing a small tuft of cotton into the neck above the cork, and this may then be moistened by pouring a few drops of the menstruum upon the cotton, to facilitate the passage of the first portion of percolate, which is often very dense.

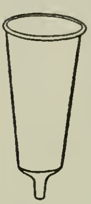
"*The Process.*—The powdered substance to be percolated (which must be uniformly of the fineness directed in the formula, and should be perfectly air dry before it is weighed) is put into a basin, the specified quantity of menstruum is poured on, and the powder thoroughly stirred with a spatula, or other suitable instrument, until it appears uniformly moistened. The moist powder is then passed through a coarse sieve—No. 40 powders, and those which are finer, requiring a No. 20 sieve, while No. 30 powders require a No. 15 sieve for this purpose. Powders of a less degree of fineness usually do not require this additional treatment after the moistening. The moist powder is now transferred to a sheet of thick paper and the whole quantity poured from this into the percolator. It is then shaken down lightly and allowed to remain in that condition for a period varying from fifteen minutes to several hours, unless otherwise directed; after which the powder is pressed, by the aid of a plunger of suitable dimensions, more or less firmly, in proportion to the character of the powdered substance and the alcoholic strength of the menstruum, strongly alcoholic menstrua, as a rule, permitting firmer packing of the powder than the weaker. The percolator is now placed in position for percolation, and, the rubber tube having been fastened at a suitable height, the surface of the powder is covered by an accurately fitting disk of filtering paper, or other suitable material, and a sufficient quantity of the menstruum poured on through a funnel reaching nearly to the surface of the paper. If these conditions be accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube and has reached, in this, a height corresponding to its level in the percolator, which is now closely covered to prevent evaporation. The apparatus is then allowed to stand at rest for the time specified in the formula.

"To begin percolation, the rubber tube is lowered and its glass end introduced into the neck of a bottle previously marked for the quantity of liquid to be percolated, if the percolate is to be measured, or of a tared bottle, if the percolate is to be weighed; and by raising or lowering this receiver the rapidity of percolation may be increased or decreased as may be desirable (see Fig. 389). A layer of menstruum must constantly be maintained above the powder, so as to prevent the access of air to its interstices, until all has been added, or the requisite quantity of percolate has been obtained. This is conveniently accomplished, if the space above the powder will admit of it, by inverting a bottle containing the entire quantity of menstruum over the percolator in such a manner that its mouth may dip beneath the surface of the liquid, the bottle being of such shape that its shoulder will serve as a cover for the percolator.

"When the dregs of a tincture, or of a similar preparation, are to be subjected to percolation, after maceration with all or with the greater portion of the menstruum, the liquid portion should be drained off as completely as possible, the solid portion packed in a percolator, as before described, and the liquid poured on, until all has passed from the surface, when immediately a sufficient quantity of the original menstruum should be poured on to displace the absorbed liquid, until the prescribed quantity has been obtained."

Shape of the Percolator.—In the U. S. P. 1880 the shape and size of the cylindrical percolator preferred for pharmacopœial operations were definitely fixed (see Fig. 388). There can be no question that the glass cylindrical percolators (see Fig. 390) commonly furnished by the manufacturers are proportionally too broad for use in percolating drugs for fluidextracts where the quantity of drug is large in proportion to the quantity of menstruum; but for ordinary tinctures, where the conditions are reversed, they answer admirably. The inference then is obvious, the pharmacist should have percolators not only of different sizes, but also of different shapes. Fig. 391 shows the narrow percolator recommended by Prof. Oldberg. It is narrower than the cylindrical percolator directed by the U. S. P. (8th Rev.). The studies on percolation during the last half century have been directed toward simplifying the process, and the elaborate apparatus of Count Real and others has been replaced by the ordinary percolator and funnel. The conical percolator of the Pharmacopœia is understood to be a glass funnel (see Fig. 392).

Fig. 390

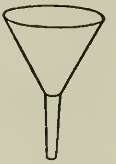


Plain percolator

Fig. 391

Oldberg's percolator

Fig. 392

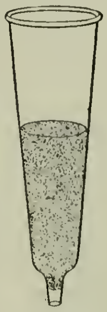


Conical percolator

Fig. 393

Narrow percolator (200 Gm. of powder)

Fig. 394



Ordinary percolator (200 Gm. of powder)

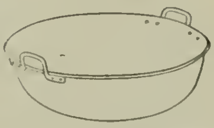
Fig. 395

Conical percolator (200 Gm. of powder)

Judgment is required in selecting a percolator for an operation. In making a fluidextract a comparatively narrow percolator should be chosen, because it is desirable that the menstruum should traverse a higher column of powder, for every drop of the menstruum must be economically applied. The rate of flow of the percolator is thereby proportionally diminished, the percolate becomes saturated more rapidly, and thus the operation is more easily controlled, provided the limit has not been exceeded. *The character of the drug influences the limit.* For instance, one which contains a large quantity of soluble matter, like kino, could not be successfully percolated in a narrow percolator, because the percolate would soon become so dense that it would cease to descend. In making tinctures and weaker preparations, a wider percolator is to be preferred, because the quantity of menstruum is greatly in excess of the quantity necessary to exhaust the drug, and more rapid action is desirable. Figs. 393, 394, and 395 show three percolators of the same height, but of very different shapes. Exactly the same weight of powder is represented in each. The great difference in the height of the columns of powder will be readily noticed, and illustrates the necessity for judgment in selecting percolators. If a fluidextract from the drug is to be made, the tall percolator, Fig. 393, should be selected; if a strong tincture, Fig. 394 indicates the shape; while for a weak tincture, the funnel shown in Fig. 395 would be preferred; it being understood that in each case the drug is not an exceptionally difficult one to percolate.

Comminution.—The degree of comminution proper for each substance must depend upon the physical structure of the drug, the ease with which the menstruum dissolves the active or desirable constituents, the length of time required to exhaust the powder, and the relative proportion of menstruum to drug. Nux vomica and ignatia are drugs having a tough, horny structure, in which the soluble constituents are embedded. If these drugs are to be quickly exhausted of their soluble principles, they must be in fine powder. On the other hand, gentian and rhubarb are drugs which part easily with their active constitutents, because their structure is loose and quickly penetrated by the menstruum. Therefore these may be readily exhausted when in coarse powder. The relative proportion of menstruum to drug also has a bearing in determining the fineness of the powder, for it is clear that if a fluidextract is to be made in which one hundred volumes shall represent *one hundred* parts by weight of the drug, the powder should be a finer one than would be required for a tincture where one hundred volumes are used to exhaust *ten* parts by weight of the drug. In all cases, whether coarse or fine powder is directed, the powder should be *uniformly divided;* and where the degree of fineness is specified, but a small proportion of the powder should be capable of passing through a sieve of the next higher grade of fineness, and this small proportion should be thoroughly distributed through the powder. The object of this is to permit the uniform descent of the liquid, for fine particles offer more resistance to the passage of the menstruum than coarse ones; and if the powder is not uniform, and the finer particles are deposited upon one side of the percolator, imperfect exhaustion may occur, through the passage of the greater portion of the menstruum upon the side of least resistance,—*i.e.*, through the coarser particles.

FIG. 396



Pan for moistening powders

Moistening of the Powder.—The general rule in percolation is to moisten the powder, and there are very few instances in the official processes where it is not directed. The object of moistening the powder is very apparent. If a perfectly dry sponge is held in the hand and a gentle stream of water poured upon it, it will be noticed that very little water is absorbed by it; but if the sponge is thoroughly soaked, and all the water squeezed out that possibly can be, it will be found that it will greedily absorb water. Most drugs are vegetable substances which in their natural state were moist. The process of desiccation has hardened and dried the tissues, so that, like the sponge, they do not absorb moisture quickly, and when compressed, as they are when packed in a percolator, the resistance is still greater. If a dry powder, like ground orange peel, is tightly packed in a glass percolator and water poured upon it, it will be noticed that the water will penetrate the powder but a short distance. Its further passage is prevented by the particles which are immediately in contact with the water, which have become swollen to such a degree that they press tightly against the sides of the percolator, and thus entirely overcome the gravitating force and penetrating power of the water. If, on the other hand, the powdered orange peel is moistened *with sufficient water to satisfy its tendency to swell, before it is packed* in the percolator, the addition of water is followed by its slow percolation through the mass without stoppage, and the utility of moistening the powder is thus proved.

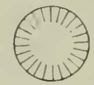
Fig. 396 shows a copper pan having a nearly flat bottom which is used by manufacturing pharmacists for moistening powders. The powdered drug is placed in the pan and the proper quantity of menstruum poured upon it, the whole is then thoroughly mixed by rubbing between the hands, or by using a scoop. After the powdered drug is moistened it should be passed through a riddle or coarse sieve several times, to render it uniform. The sifter shown in Fig. 258 has been found very efficient for this purpose where small quantities of drugs are to be percolated.

The special cases in which the powder should not be moistened are those in which the addition of menstruum would produce adhesiveness and cause the powder to form lumps that could not be easily penetrated, those in which the moistened powder would offer too little resistance to the passage of the menstruum, and those in which the menstruum is too volatile or too inflammable to render moistening desirable or safe. An instance of the first case is found in the so-called cold percolation of sugar in making syrups; instances of the second and third cases, in the preparation of the oleoresins where acetone is used as the menstruum.

Fig. 397

Notched cork

Fig. 398



Scored paper

Packing the Powder.—The official directions with regard to this important part of the process of percolation vary continually. Where the degree of pressure is immaterial, no special directions are given. Where there is a likelihood of too much pressure being exerted, so that percolation would cease before it should, the directions are, "pack it moderately;" on the other hand, if there is danger of the operator allowing the menstruum to pass through too rapidly, so that the drug would not be exhausted of its active principles, the directions are, "pack it firmly." The proper degree of pressure can be judged only from the character of the drug and the nature of the menstruum. If a porous, spongy drug is to be percolated with a menstruum largely aqueous, it must be moderately packed; but if the menstruum is alcoholic, it must be firmly packed. Before beginning to pack the powder, the throat of the funnel or of the percolator must be obstructed by a loose plug of absorbent cotton or a deeply notched cork (see Fig. 397), or by some other method. The manner of inserting this obstruction is not very material. The cotton, however, should be dry and loosely inserted, and the cork either dry or moistened with the menstruum, care being taken not to moisten the cotton or cork with water unless the menstruum is aqueous, because if the drug to be percolated is resinous, the first portions of percolate which come through will be precipitated by the water in the cotton or on the cork. Instances have occurred where the percolation has been stopped from this cause. Where the notched cork is used, it is well to place over the top of the cork, when it is in place, a small circle of scored filtering paper (see Fig. 398). This is slightly larger in diameter than the cork, and the edges are therefore reflected up the sides. A small quantity of the moistened powder will keep the cotton or the filtering paper and cork in place.

The moistened powder should be carefully deposited in the percolator in layers, each succeeding layer being packed according to the directions, "moderately" or "firmly," as the case may be, care being taken to use the same degree of pressure with each layer. Fig.

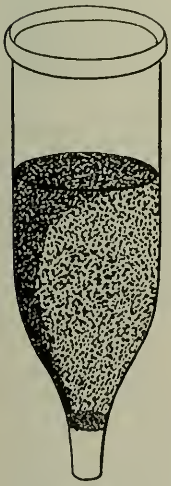
399 shows a convenient utensil for packing a percolator. It should be made of hard wood, preferably lignum vitæ; for the narrow percolators a longer packer must be used. The skill used in this part of the process will be proved by the manner in which the menstruum permeates the moistened powder. If the descent is regular and uniform, it is shown in a glass percolator by the line marking the descent of the menstruum being perfectly horizontal. If the line is irregular, it is easy to point out just where the pressure was insufficient or too great. Fig. 400 shows loose and irregular packing, too much pressure being made on the right side, the menstruum descending upon the left side unequally and escaping unsaturated. Fig. 401 illustrates a percolator which has been properly packed, the liquid descending uniformly.

FIG. 399

Packer

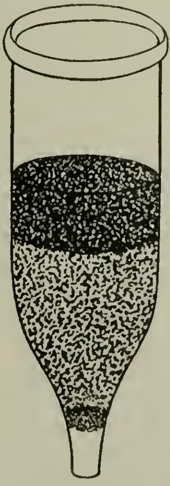
Adding the Menstruum.—When the last portion of moistened powder is introduced into the percolator, a sheet of filtering paper, scored at the edges and slightly larger in diameter than the surface of the powder, should be laid upon it, for the purpose of causing the even distribution of the menstruum. A weight of some kind is usually placed upon the paper, to keep it from floating out of place. Clean pebbles, a bottle stopper, or a small glass funnel may be used, but in Fig. 402 is shown a glass percolating weight, which has been made for this purpose by the Whitall Tatum Company. It is easily cleaned, is not readily broken, and does not take up much room. Where the percolator is large enough to hold the whole of the menstruum, it may be at once added carefully. When this is not the case, and the menstruum must be added in divided portions, care must be observed to follow with the succeeding portion before the first has entirely disappeared, or otherwise fissures may appear in the powder, and the menstruum will of course then seek the outlet offering the least obstruction, and will leak through the fissures instead of percolating through the powder. This is more apt to occur in percolating very fine powders than in percolating coarse ones, although liable to take place in either. Where a large quantity of menstruum is required, a contrivance for continually supplying the menstruum should be used, in the form of an inverted bottle or flask (see Fig. 269), or any of the methods for continuous washing may be employed.

FIG. 400



Imperfect packing

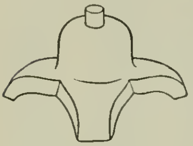
FIG. 401



Proper packing

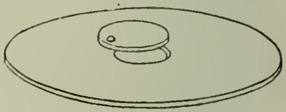
Previous Maceration.—This is recommended when the structure of the powder is tough, when the soluble principles are not easily extracted by the menstruum, or when a comparatively large quantity of powder is to be exhausted by a small quantity of menstruum. It is obvious that maceration is going on constantly while the menstruum is traversing the powder during its gradual descent, and when the amount of menstruum is more than sufficient to exhaust the drug, previous maceration is merely a waste of time. Nevertheless, the framers of the Pharmacopœia, in order to prevent the possibility of an unskilful or ignorant operator failing to exhaust a drug with the quantity of menstruum directed, have adopted in most cases the precaution of ordering previous maceration for a short time. This is best performed by moistening the drug, introducing it loosely into the percolator, and covering it closely to prevent loss by evaporation. This course has the additional advantage of allowing the drug to swell at the same time.

Fig. 402



Percolating weight

Fig. 403



Sheet rubber cover

A cover made of sheet rubber (see Fig. 403), with a circular opening, is very useful in this connection. No attempt should ever be made to produce fluidextracts on the small scale without previous maceration.

Finishing the Process.—The official directions are frequently definite in fixing the quantity of percolate to be received from a given quantity of powder, but the oft repeated direction to "add the menstruum until the substance is exhausted" at once raises the question, When is a drug exhausted of its activity? This question can be properly answered only by knowing beforehand what the active principles of the drug are. A few examples will sufficiently illustrate this. The activity of nux vomica, opium, and cinchona resides in the bitter alkaloids. Hence the *absence of bitterness* in the percolate in such cases indicates exhaustion. Cochineal and saffron are valued in pharmacy for nothing but the coloring matter contained in them. Hence the *absence of color* in the percolate shows the close of the process. Nutgall, kino, krameria, etc., contain tannin, and this is the only valuable principle. The *absence of astringency* in the percolate in these cases, therefore, shows the operator that percolation can be stopped. The exhaustion of resinous drugs may be known by the absence of precipitation when the percolate is dropped into water. Where two or more active principles exist in a drug, the latter is not exhausted until the percolate is free from all of them. *The intelligent practice of the process of percolation, therefore, requires an accurate knowledge of the constituents and physical properties of medicinal substances.*

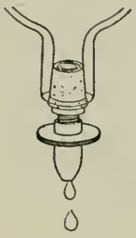
Choice of Menstrua.—Much labor has been bestowed by investigators in ascertaining the exact proportions of the usual solvents—water, alcohol, glycerin, etc.—that are best adapted for depriving drugs of such of their soluble principles as are desirable, and at the same time leaving untouched in the residue those principles which are either inert or objectionable. The special menstruum which is exactly adapted to the peculiar characteristics of the drug, and which will cause the retention of the soluble principles in a permanent form under the varying conditions of climate, and at the same time permit exposure to light, heat, and air without injury, can be determined only by experiment and experience. When new galenical preparations are proposed, the menstruum selected must therefore be merely tentative, and general principles must guide, until positive knowledge is secured. Alcohol would be indicated for active resinous drugs, diluted alcohol for simple bitter tonics, cathartics, etc., and diluted alcohol with glycerin for astringent drugs, etc. The selection of proper menstrua will be noticed, as occasion demands, in the chapters upon infusions, tinctures, extracts, fluidextracts, etc.

Absorbed Menstruum.—The amount of menstruum which a powder will absorb and retain after percolation ceases can never be accurately predetermined. If it is important to know beforehand the percentage of menstruum capable of being absorbed, a practical trial should be made upon the small scale, using the same powder and menstruum.

Substances possess very different capacities for retaining menstruum. Those having a light, spongy structure hold more than hard ligneous drugs, and even the same drug will often vary in its capacity in this respect, while the amount of moisture present in the drug before it is percolated is never a constant quantity, varying sometimes as much as 8 to 20 percent. The advantages of percolation over maceration are very apparent in respect to the character of the liquid left in the residue. In maceration the liquid left in the residue is finished tincture. In percolation it is merely menstruum, the active portions of the drug having been dissolved in the preceding percolate. In large operations, from an economical point of view, it is desirable to recover absorbed menstrua when the residues contain sufficient alcohol to make it worth the necessary time and labor. Distillation is then resorted to, or the residue is treated with weak alcohol and subsequently with water. Where water causes swelling of the substance and a stoppage of the percolation, the residue may be mixed with clean sawdust, rice chaff, or other inert dry substance, and then percolated with water. Recovered distilled alcohol may be purified by treating it with potassium permanganate ; twelve grains dissolved in a gallon of the percolate, and allowed to stand a few days, are usually sufficient. The purified alcohol may be decanted or filtered. Care must always be taken not to use unpurified recovered alcohol which is odorous on account of containing volatile oil obtained from a drug, or which may be otherwise impure.

Controlling the Flow of the Percolate.—The necessity for some method of controlling the flow of the percolate is apparent. In simple percolation this is effected by the degree of pressure used in packing the moistened drug. Judgment and experience are absolutely necessary to guide the operator. Various mechanical expedients have been used to accomplish the same purpose. The official method has been described (see Fig. 389). In metallic percolators stopcocks have been employed. A narrow homœopathic vial, having a one-eighth inch hole in the side, a half inch from the bottom, is passed through a perforated cork fitting tightly in the neck of the percolator ; by pulling the vial down, the hole is stopped by the encircling cork ; by pushing it up, the hole is exposed so that the percolate runs through the vial, and thus the flow may be controlled. Fig. 404 illustrates a method of controlling the flow of a percolate which has proved in the author's experience very useful. The well known sprinkler, made of white metal, used for liquid dentifrice bottles was first tried, and subsequently the form shown in Fig. 404 was selected. It is made by A. H. Wirz, Philadelphia. The flow of liquid can be perfectly controlled by its use. In the U. S. P. (8th Rev.) the following directions are found :

Fig. 404



Sprinkler controller

"*Rate of Flow.*—It is obvious that the success of the process of percolation largely depends upon the regulation of the flow of the percolate ; if this should be too rapid, incomplete exhaustion will result, but if too slow, valuable time may be wasted. The rate of flow for extracts and fluidextracts for 1000 Gm. of powder should range from two to five drops a minute ; for official quantities of tinctures and preparations of about the same strength, from eight to fifteen drops a minute, and the word "slowly" throughout the text is understood to mean a rate of flow corresponding to this ; it is evident that the proper rate of flow should vary with the quantity and character of the drug employed and the density of the menstruum."

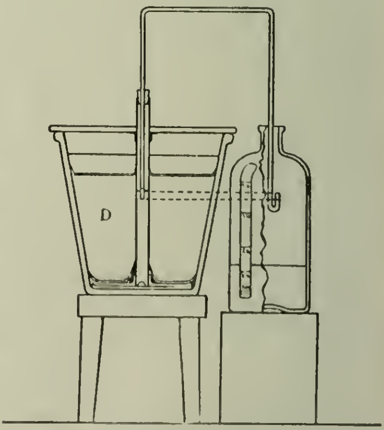
Special Percolators

Stoppered Percolator.—Many modifications in the ordinary cylindrical or conical percolator have been suggested from time to time to suit special requirements. In Fig. 405 is shown a glass percolator proposed by Dursse, the special merit of which lies in the manner in which evaporation is prevented. This is effected by means of the ground glass cover. The upper part of the percolator, R, is strengthened by a deep band ; the glass cover, C, is carefully ground so as accurately to fit the percolator and make a nearly tight joint, which can be improved by moistening the edge with glycerin. If the percolate should flow too freely, it can generally be checked by screwing in the cover of the percolator ; should it flow too slowly, a small piece of twine inserted between the cover and the side will permit the necessary pressure of the atmosphere. The graceful outlines of this percolator, and the evident care used in its manufacture, may be mentioned as points in its favor.

Fig. 405

Dursse's percolator

Fig. 406



Well tube percolator (Squibb)

Well Tube Percolator.—An excellent method of percolation which was used by Dr. E. R. Squibb for a number of years, and is still employed, is shown in Fig. 406. It is based upon the principle of drawing water from a well automatically as fast as it accumulates.

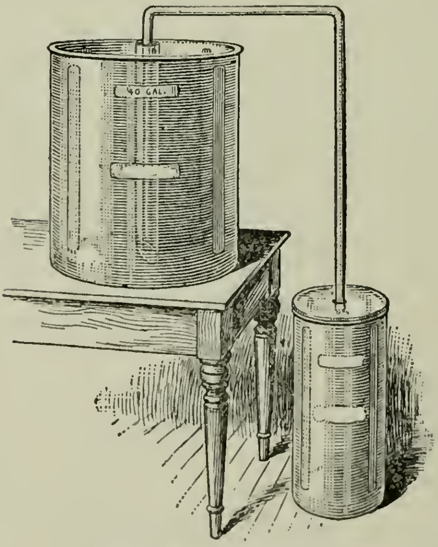
This is effected by the use of a well tube placed in the centre of an ordinary jar or pot and held in its place by the powdered drug which is packed around it. The menstruum is poured upon the drug, and, after percolating through, collects in the well tube, from which it is drawn off by an ingeniously constructed syphon. The practical value of this method warrants a detailed description. It may be used for either large or small operations.

The percolator is a stoneware pot of about two gallons' capacity, capable of holding six pounds of most drugs, and mounted on a suitable stand. A disk of blanket is cut of such a size and shape as to lie flat upon the bottom and cover it entirely. Another disk, of the same material, but a little larger, is made with a crucial incision (X) in the centre, so that it may be stretched over the end of the well tube. This is a piece of glass tube about twelve inches long, having an internal diameter of half an inch, and irregularly notched or gnawed off obliquely at the lower end. One end of this well tube is pushed through the crucial cut in the centre of the upper disk of blanket, and this blanket is pushed to the other end of the tube, so that the corners made by the crucial cut are reflected up against the outside of the tube. These corners are then tied firmly to the tube by passing twine around them, or are secured by a stout rubber band, made of a section of rubber tubing of proper size. A disk of filtering paper, larger than the upper blanket, with a crucial cut in the centre, and scored round the edge so as to lie flat against the sides of the percolator where reflected up against them, is pushed down upon the upper blanket, the well tube passing through the cut in the centre. If now a cork be temporarily placed in the well tube to keep out the moistened powder, the percolator is ready to receive its charge, which is packed around the well tube and upon the disks of paper and blanket so as to occupy the main body of the percolator. When the charge, having been properly moistened, rubbed, and sifted, so as to be entirely uniform and free from wet lumps, is packed around the well tube loosely or firmly according to the nature of the substance and the menstruum, its surface is covered by a disk of muslin or paper, cut so as to lie flat and smoothly upon the surface. The object of this is to distribute the menstruum as it is poured on, and to prevent the stream from breaking up and deranging the surface. Should this paper disk show a tendency to float in the stratum of menstruum, it may be held down by a few fragments of glass. The percolator is then ready to receive the menstruum or weak percolate, and a stratum of the liquid should be carefully kept covering the entire surface until the whole mass of the substance to be percolated is saturated. The cork is to be taken from the well tube before the liquid is poured on, and then the liquid will flow down into the substance like a piston, pushing the interstitial air before it, the air passing out through the blankets and the well tube; finally the liquid will rise in the well tube until its surface is within an inch or so of the surface of the liquid outside.

The whole substance is now in a perfect condition for maceration, and the surface should be left covered with the liquid to the depth of at least half an inch. A short section of rather thick rubber tubing should be stretched over the upper end of the well tube, and slipped down so as to support the centre of the cover. A tightly fitting cover, made of sheet rubber a quarter of an inch thick, with a hole in the centre for the well tube, is then put on. The syphon is made of glass tubing of about an eighth of an inch bore, bent twice at right angles, the two legs being each about twelve inches long. The outer leg is a little longer than the inner one, and turned up upon itself for about three-quarters of an inch, as shown in Fig. 406. The legs should have only such a difference in length that the inner one will reach the bottom of the well tube when required, and when measured upon the outer one will reach to about midway of its turned up end.

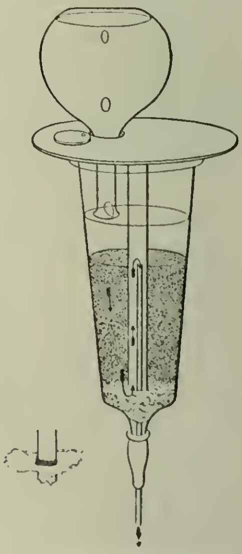
This construction prevents the syphon from emptying itself at any time, for when the liquid is drawn over by the syphon until the surface of liquid in the well tube falls to a level with the end of the turned up portion, as shown by the lines in Fig. 406, the columns of liquid in the syphon will be of equal length and will counterbalance each other, and the flow will cease without emptying the syphon. But as soon as the level of the liquid in the well is raised by fresh additions of menstruum on the substance, the flow will recommence at a rate proportionate to the difference of levels, and may be readjusted to the required rate by slipping the syphon up or down in the cork in the upper end of the well tube. This cork should be bored to fit the syphon so tightly as to hold it in any position, and should have a groove filed longitudinally on its outer side, to allow free exit of air. Fig. 407 shows the well tube percolator made of Appert glass, furnished by the Mississippi Glass Company, of New York.

Fig. 407



Appert glass well tube percolator

Fig. 408

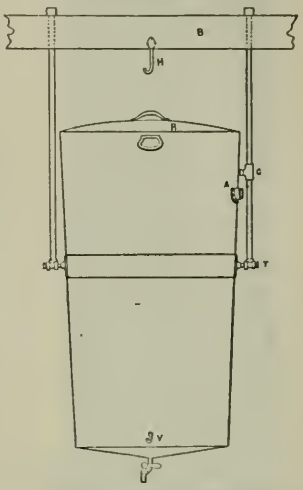


Double tube percolator

If it is desirable at any stage in the percolation to stop the process, the syphon may be gently lifted until the leg in the well tube is above the level of the percolate there, when the flow will cease. It may be started by simply pushing the leg down into the tube again. This is a practical convenience which is greatly appreciated. If the syphon should accidentally empty itself, the flow is easily started by attaching a short rubber tube to the curved end and applying suction.

Double Tube Percolator.—This differs from the well tube percolator just described in the use of an ordinary percolator, the absence of the syphon, and the substitution of a simple, straight tube which is free to move up and down inside of the well tube at the discretion of the operator. Fig. 408 illustrates its mode of action. A central well tube having the lower end irregularly broken is placed in an ordinary glass percolator, upon a tuft of absorbent cotton, or, as in Dr. Squibb's percolator, a circular piece of muslin is securely tied upon the tube a short distance from the bottom, as shown in the small cut in Fig. 408, and the end of the tube rests upon a perforated cork fitting tightly in the neck of the percolator, as proposed by W. S. Thompson in his description of a similar apparatus. The control of the flow of the percolate is effected by raising or lowering the small tube which passes into the well tube, and which is held in place by passing through the perforated cork in the neck of the percolator already mentioned, or through a perforated rubber nipple slipped over the end, as suggested by Windolph, or through a piece of rubber tubing. If previous maceration is directed, the narrow tube may be pushed up until the upper orifice is above the level of the menstruum, and of course above the level of the percolate in the well tube. When it is desirable to begin percolating, the tube is gently rotated with a downward movement until the level of the percolate is reached, and then percolation proceeds regularly, the course of the menstruum being indicated by the arrows in Fig. 408. The rapidity of the flow is increased by lowering the tube, and decreased by raising it.

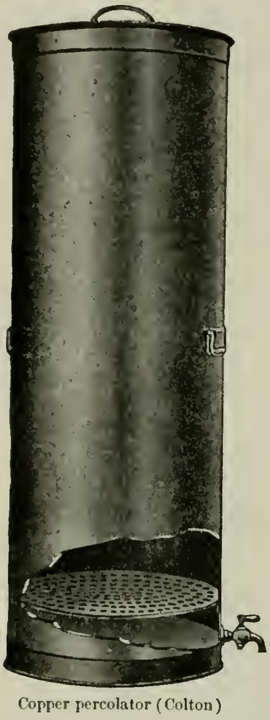
Fig. 409



Suspended percolator (Hance's)

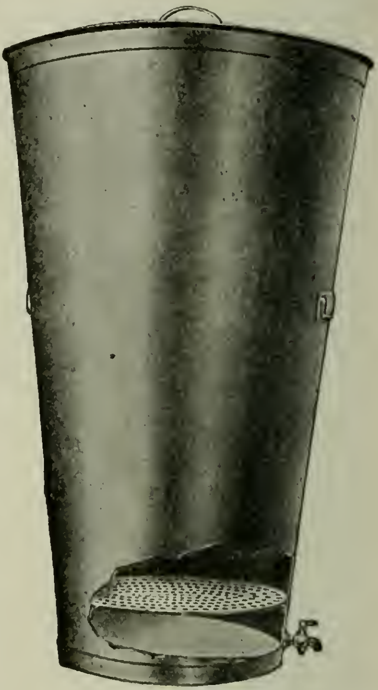
Suspended Percolator.—In large operations it is necessary to employ means to facilitate not only the percolation, but also the packing and emptying and other subordinate but essential parts of the process. Fig. 409 shows a percolator in use by Hance Brothers & White. The large percolator of tinned copper is suspended by trunnions, T, which are fastened to a stout band encircling the percolator slightly above the centre; two steam pipe supports are secured to a strong beam, B, above, and the trunnions rest in tees, which are screwed to the end of the pipe supports. The sliding tee, G, is dropped into the cup shaped catch, A, when it is desired to retain the percolator in an upright position. The special advantage in this arrangement is observed, however, when an operation is concluded. A residue car may then be wheeled opposite to the percolator, and the tee pushed up so as to permit the percolator to swing on the trunnions. The percolator may then be turned upside down with the greatest ease, and fastened by attaching the bottom to the hook H; its conical shape facilitates the discharge of the residue.

Fig. 410



Copper percolator (Colton)

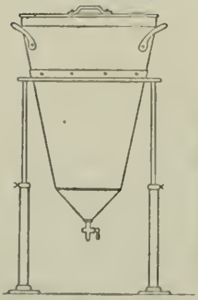
Fig. 411



Copper percolator (Colton)

Percolation on the Large Scale.—It is obvious that somewhat different appliances must be used in percolating large quantities of drugs. While ordinary glass percolators cannot be made of very large size, well tube percolation is well adapted for large operations, but tinned copper percolators are most frequently employed; in the latter brass stopcocks are mainly depended upon for controlling the flow of the percolate, but these are objectionable because of the difficulty in cleaning them, and on account of the liability of becoming enveloped in evaporated percolate it is often difficult to start or control the flow accurately. Figs. 410 and 411 illustrate copper percolators, made by Arthur Colton, of Detroit, with diaphragms for supporting the disk of flannel or cloth. They are intended to be placed upon counters or tables. Fig. 412 shows an ordinary copper percolator supported by a ring on two columns,

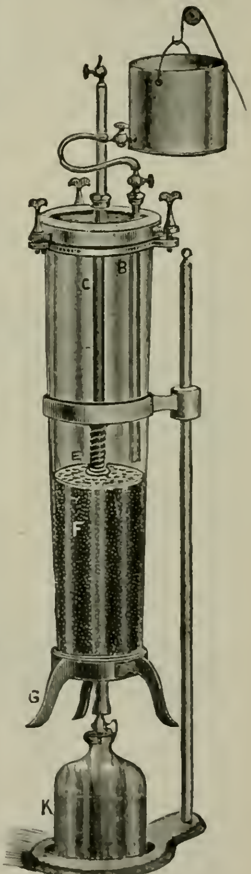
Fig. 412



Copper percolator

with sufficient space below to accommodate the receiving bottles. These may be made so as to be supported on trunnions (see Fig. 409). The exhausted powder or marc is then easily turned out into a vessel placed on the floor.

Fig. 413



Pressure percolator (Suits)

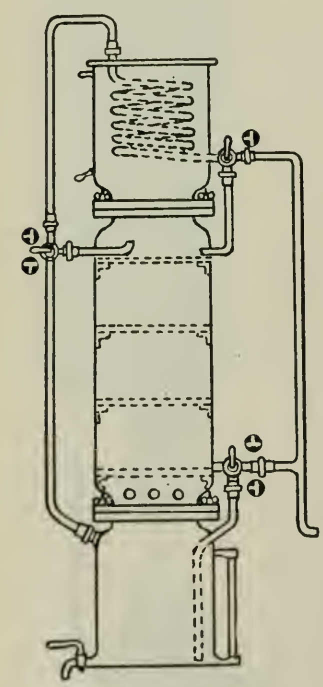
Pressure Percolators.—Percolation by pressure has come into vogue in various parts of the country, and there are at the present time several forms of pressure percolators upon the market, each one differing somewhat from the others in detail, but all based upon the same principle,—that of forcing the menstruum through the powder at a greater rate of speed than it would pass if it depended alone on the force of gravity.

The pressure is usually exerted through a column of menstruum entering the percolator at the top, the menstruum being supplied and the column sustained from a reservoir of the liquid suspended above it at a height of from three to ten feet. It will be noticed that Count Real's apparatus, invented in 1815, was based upon this principle (see page 252), and since then Stearns, Rosenwasser, Berry, Suits, Anderson, and others have advocated or introduced apparatus under various names by which percolation is carried on under pressure. It must suffice in this place to describe briefly one pressure percolator, that of Suits, full and detailed information being readily obtained from the manufacturers of any of them. Fig. 413 shows one of the best forms, the glass percolator B, protected by three iron bands, having at the top a tight cover made of plated sheet copper, having two stopcocks; the cover is made airtight by being clamped between two flat sheet rubber rings; the bottom of the percolator has a stopcock cemented in it; the moistened powder, F, is kept in place and some pressure exerted by means of the porous metal diaphragm, the spring E, and the metal tube, C, which passes through an air tight joint in the top. The tripod, G, is not used during the percolation, but is useful in supporting the percolator while packing. It is possible with this apparatus to macerate the powder under pressure, and at the end, after all of the menstruum has been run into the percolator and hydrostatic pressure is no longer available, a convenient rubber bulb airpump may be used to force air into the percolator to maintain the pressure. This apparatus may be used to great advantage in filtering oils under pressure, or as a bottle filler. After an extended practical trial of percolation by pressure, the author has reached the conclusion, that, while there are some percolating operations in which it can be used with advantage, for the great majority the pressure is unnecessary, just as perfect results being reached by the use of as simple a percolator as a glass funnel or cylinder of the well known form.

Percolation with Hot Extraction.—In some cases it is desirable to exhaust drugs with hot menstrua. Lewin's extraction apparatus is shown in Fig. 414. The lower vessel is a still; immediately above it is the percolator, having three movable sieves for the reception of the substance to be extracted; above the percolator is the condenser. By the use of the three-way stopcocks, the percolation, distillation, and extraction may be controlled at will.

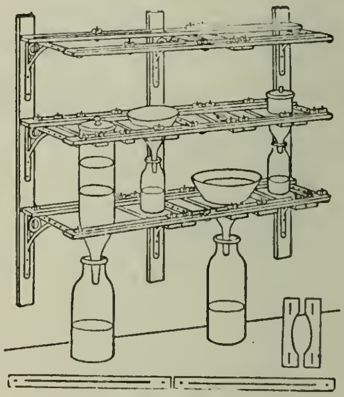
Methods of supporting Percolators.—The ordinary retort stands are often used to support percolators, but these are generally flimsy and unsatisfactory. The one shown in Fig. 187, particularly if used with split rubber tube sections, as seen in Fig. 190, is much to be preferred. The stand shown in Fig. 415 was devised by the author in 1875, and has been in constant use since. It is conveniently fastened to the wall in front of the working counter. Two long strips having slots down the centre are supported on brackets, and short cross strips having their inside edges hollowed out are fastened to the long strips by thumb screws. This arrangement permits the adjustment of the cross strips so that either a large or a small percolator or funnel can be supported, as shown in the cut, at any desired height. This stand is capable of enlargement by means of additional brackets and strips. If a wall counter is not available, a frame may be made extending over an ordinary counter, which will serve as well for a support, care being taken that the strips and frame are heavy enough to bear without strain any weight likely to be placed upon the stand. The special advantage of a percolating stand is, that it enables all percolating and filtering operations to be carried on with convenience in one place, thus saving time and labor.

Fig. 414



Lewin's extraction apparatus

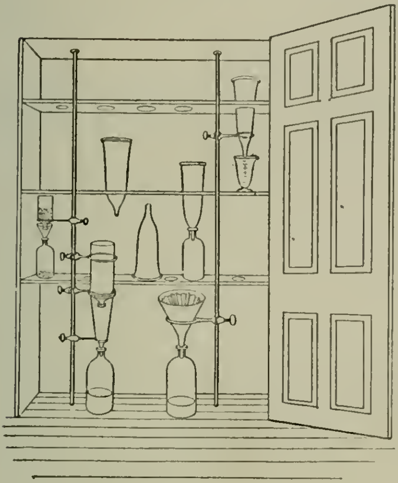
Fig. 415



Percolator stand

Percolation Closet.—The retort rings shown in Fig. 187 have been used by James T. Shinn in a convenient percolation closet, shown in Fig. 416. Two lengths of ordinary five-eighths-inch iron steampipe are fastened securely to the top and bottom of the closet, at a convenient distance from the shelves. The retort rings may be adjusted to the desired height, and it is thus possible to carry on several percolations or filtrations at the same time, away from the other operations of the store, in a closet with a closed door.

Fig. 416

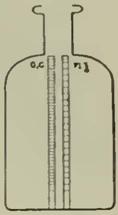


Percolation closet (Shinn)

Fig. 417

Receiving flask

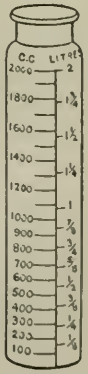
Fig. 418



Receiving bottle (paper scale)

Receiving Bottles.—A series of bottles of various sizes should be reserved for use in receiving percolates. Where especial accuracy is necessary, a flask with a double mark on the neck should be used (see Fig 417). Bottles with comparatively wide necks are to be preferred for receiving bottles. A paper strip may be pasted on the side, and accurately measured quantities of water poured in, carefully marking the height of each addition; upon the opposite side corresponding metric quantities may also be placed (see Fig. 418). J. M. Maris & Co. furnish narrow receiving bottles (metric and old form, and both systems on the same bottle) (Fig. 419). The graduations are accurately engraved on the glass, and arranged, at the author's suggestion, to suit the quantities usually made by the pharmacist. These, unlike the home made receivers, are permanently marked and of elegant appearance.

Fig. 419



Receiving bottle (all glass)

Repercolation.—This, as its name indicates, is the process of percolating substances with percolates, or, as defined by Dr. E. R. Squibb, the author of the process, "the successive application of the same percolating menstruum to fresh portions of the substance to be percolated." The principal object of repercolation is to effect the saving of alcohol and alcoholic menstrua by accomplishing the saturation of the menstrua, as nearly as possible, by passing the unsaturated or weaker percolate from one portion of the drug through another portion, and again passing the unsaturated or weaker percolate from this second portion through a third portion.

The weak percolate from this last portion is generally set aside, to be used in succeeding operations upon the same drug in the place of fresh menstruum. This process is useful only in those operations where the relative proportion of menstruum used is small, as in the fluidextracts and similar concentrated preparations. Practical illustrations of the use of this process may be seen by referring to the chapter on Fluidextracts.

Fractional Percolation.—This is a term employed by Prof. C. Lewis Diehl and others to define percolation when applied to two successive portions of powder, the principle of action being identical with that of repercolation.

PART II

OFFICIAL PHARMACY

THE various processes which are used in making the official preparations having been considered in Part I., as solution, filtration, digestion, percolation, maceration, expression, etc., it is most appropriate now to take up these preparations and classify them. Those which form natural groups will be brought together in such a manner as to facilitate the study of their general features. Each chapter will begin with a definition and description of the class of preparations of which it treats; then will follow a table giving a succinct view of the individual preparations forming the class; and after this, the official processes will be found arranged alphabetically. Detailed comments upon the preparations are reserved for the subsequent chapters, the object being at this time to familiarize the student with the *various forms* of official preparations and fix their general characteristics upon the mind. A table of abbreviated unofficial formulas will be found after each class, containing mainly preparations of the U. S. P. 1890 which were dropped at the last revision, and also those of the British Pharmacopœia (1898). The following diagram will serve to give a complete view of the classification; it should be carefully examined at the outset, and referred to again after the classes have been studied in detail:

OFFICIAL PREPARATIONS[1]

LIQUIDS

Made without percolation or maceration

Aqueous Solutions
- Waters
- Solutions

Aqueous Solutions containing Sweet or Viscid Substances
- Syrups
- Honeys
- Mucilages
- Emulsions
- Mixtures
- Glycerites

Alcoholic Solutions
- Spirits
- Elixirs

Ethereal Solutions
- *Collodions*

Oleaginous Solutions
- *Liniments*
- *Oleates*

Made by percolation or maceration

Aqueous Liquids
- Infusions
- Decoctions

Alcoholic Liquids
- Tinctures
- Wines
- Fluidextracts

Oleoresinous Liquids
- Oleoresins

Acetous Liquids
- Vinegars

SOLIDS

Made by percolation or maceration
- Extracts
- Resins

Made without percolation or maceration[2]
- Powders
- Triturations
- Masses
- Confections
- Pills
- Troches
- *Cerates*
- *Ointments*
- *Plasters*
- *Papers*
- Suppositories

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[1] Those used internally are in Roman type; those used externally, in italics.

[2] The preparations in this class are mostly extemporaneous, and will be considered under Part V.

CHAPTER XXI

AQUEOUS SOLUTIONS

Aquæ *Waters*

THE class of preparations termed *waters* are known also as medicated, aromatic, or distilled waters, and may be simply defined as *aqueous solutions of volatile substances.* The German Pharmacopœia and French Codex, however, recognize as waters solutions of non-volatile substances. The volatile substances used in the preparation of waters are either solid, liquid, or gaseous, and the following methods have been employed in effecting their solution: 1. Simple solution in cold water. 2. Solution in hot water. 3. Filtration through an absorbent powder. 4. Filtration through pulped or shredded filter paper. 5. Percolation through cotton saturated with the substance. 6. Distillation.

Most of the medicated waters are used as pleasant vehicles and solvents for the administration of various remedies, and are solutions of aromatic volatile oils. There are *eighteen* official waters, excluding ordinary water.[1]

1. Simple Solution in Cold Water.—This method is resorted to when the proportion of the volatile substance is small enough to dissolve *easily* in the quantity of water required. Where a volatile liquid is the medicating substance, the process consists in agitating it with the water until dissolved, and then filtering the solution. The method of making medicated waters by agitation with an excess of volatile oil, permitting the excess to remain and drawing off the water as required, is not recommended on account of the liability of the oil to deteriorate through exposure to light and air. In the case of the gaseous solutions, the gas is passed through the water until a solution of the desired strength is obtained. (See Solution of Gases, p. 196.) Of the eighteen official waters, four are distilled, three are solutions of gases, six are solutions of volatile oils, two are diluted distilled waters, one is a solution of a volatile solid, and two are solutions of volatile liquids.

Official Waters made by Simple Solution

Name	Proportion of Liquid dissolved	Use and Dose
Aqua Amygdalæ Amaræ	0.1 percent. of Oil of Bitter Almond	Pleasantly flavored vehicle, fʒi (4 Cc.)
Chloroformi	Saturated solution	Sedative and vehicle, fʒiv (16 Cc.)
Creosoti	1 percent. of Creosote	Antiseptic and used locally, fʒi to fʒiv (4 Cc. to 16 Cc.)

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[1] Chlorine water will be found under the official Latin title Liquor Chlori Compositus in the class Liquores, but as it is mainly composed of volatile substances it is also included in this table.

Official Waters made by passing Gases through Water

Name	Proportion of Gas dissolved	Use
Aqua Ammoniæ	10 percent. of gaseous Ammonia	Stimulant, caustic, 15♏ (1 Cc.)
Ammoniæ Fortior	28 percent. of gaseous Ammonia	Rubefacient, escharotic
Hydrogenii Dioxidi	3 percent. of pure Dioxide	Antiseptic, fʒi (4 Cc.)
Liquor Chlori Compositus[1]	About 0.4 percent. of gaseous Chlorine	Antiseptic, stimulant, fʒi (4 Cc.)

2. **Solution in Hot Water.**—This method is founded upon the fact that most of the volatile oils are much more soluble in hot water than in water of ordinary temperature ; hence, if the volatile oil is thoroughly agitated with hot water in a suitable vessel, such as a tin can or a bottle, and allowed to stand until the excess has separated, if care is used, the water will be found to be saturated ; it may then be decanted and filtered.

3. **Filtration through an Absorbent Powder** is the process which has been most frequently employed ; the object of using the powder is to divide thoroughly the oil, or volatile liquid, and expose a greater surface, so that the water in filtering through it may become completely saturated. The powder most frequently used is magnesium carbonate, but this is sometimes objectionable on account of being slightly soluble in water. Calcium phosphate, kaolin, powdered glass, silica, powdered pumice-stone, charcoal, paper pulp, precipitated chalk, sugar, etc., have been suggested as substitutes, but there are quite as forcible objections to be urged against these as against the magnesium carbonate. Where solutions of alkaloids or of silver nitrate are needed, distilled water alone should be used. The present official method directs the use of purified talc, but purified magnesium carbonate is preferable.

4. **Filtration through Pulped or Shredded Filter Paper.**—This process is permitted by the U. S. Pharmacopœia (8th Revision) and consists in dropping the volatile oil upon white filter paper, tearing this into shreds, transferring it to a flask or stoneware jug, adding boiling water in portions, and shaking thoroughly. When the liquid is cold, it is filtered and the quantity adjusted by pouring distilled water through the filter.

5. **Percolation through Cotton impregnated with the Substance.**—This was the process directed to be used in the U. S. P. 1880 ; it was abandoned in the revision of 1890 on account of its inconvenience and wastefulness. The oil or volatile liquid is distributed upon the fibres of cotton, which are then pulled apart in order to secure thorough division ; the saturated cotton is packed in a funnel, and the water poured upon it. In its passage downward the water dissolves the oil and passes out impregnated with the odorous substance. The presence of undissolved floating oily drops in the finished preparation has constituted one of the greatest objections to this process. It is an improvement to insert a plug of dry cotton in the throat of the funnel before placing the saturated cotton in position ; this prevents the oily drops which may escape solution from being

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[1] Chlorine water will be found under the official Latin title Liquor Chlori Compositus in the class Liquores, but as it is mainly composed of volatile substances it is also included in this table.

carried down by the water as it percolates through. Too much care cannot be exercised in selecting the volatile oils, which should be fresh and of the best quality.

Official Waters made by Filtration through an Absorbent Powder

Name	Proportion	Use and Dose
Aqua Anisi	0.2 percent. of Oil of Anise	Pleasant vehicle, f℥iv (16 Cc.)
Camphoræ	0.8 percent. of Camphor dissolved in Alcohol	Mild antispasmodic, f℥ii (8 Cc.)
Cinnamomi	0.2 percent. of Oil of Cinnamon	Pleasant vehicle, f℥iv (16 Cc.)
Fœniculi	0.2 percent. of Oil of Fennel	Pleasant vehicle, f℥iv (16 Cc.)
Menthæ Piperitæ	0.2 percent. of Oil of Peppermint	Pleasant vehicle, f℥iv (16 Cc.)
Menthæ Viridis	0.2 percent. of Oil of Spearmint	Pleasant vehicle, f℥iv (16 Cc.)

6. **Distillation.**—This is the best process for preparing medicated waters, and should be used wherever practicable. If the fresh drug can be procured, it should always be used in preference to that which has been dried, because in the process of desiccation there is usually a loss of the agreeable volatile constituents. Metallic distillatory apparatus is preferably employed (see page 151). If the drug containing the oil-cells has a loose structure and is quickly penetrated by hot water, so that the oil-cells are easily ruptured, the drug may be introduced without previous contusion or grinding; it will usually be found, however, most economical to cut or grind the drug coarsely. Most distilled waters acquire an unpleasant empyreumatic odor as soon as they are distilled; this passes off gradually upon exposure to air, if care has been taken not to expose the drug to the action of direct heat during distillation. If no precautions are taken to protect the drug from partial burning, the odor of the carbonized substance will always be noticeable in the distilled water, rendering the product worthless. Fig. 213 shows a copper wire cage contrived by the author to obviate the difficulty just described; the surface of the cage is hemispherical; it rests, after being partially filled with the drug, upon the flat bottom of the still, and thus the contact of the substance with the heated surface is avoided; the meshes of the cage are coarse enough to permit the free passage of vapors and the boiling water through them. Although distillation by the use of steam may be most convenient upon the large scale, Vuaflart and Machet have shown that rose and orange flower waters distilled over a naked fire keep better than those distilled by steam heat.

Preservation.—Distilled waters should not be made in larger quantities than can be used within a reasonable time, because they deteriorate when long kept, a flocculent precipitate forming in them, and ultimately they lose all traces of their usually agreeable odor. Microscopic plants belonging to the order Confervoideæ will often be found in medicated waters. These are usually tufts of articulated filaments, propagated by very minute spores from the atmosphere, which have found lodgement in the water. Their presence renders the medicated water unsightly, and when in large proportion they must be regarded as injurious. If the water is heated and introduced into a sterilized bottle with a side opening (like a douche-bottle) to which a sterilized rubber tube with a pinchcock is attached, and a tuft of cotton pushed into the *neck* of the bottle, any spores originally present in the water will be killed by the heat, and the future growth of confervæ will be prevented by the interception of the spores by the cotton. It usually suffices, however, to heat the medicated water and introduce it at once into small bottles, which are to be completely filled, tightly sealed, and kept in a cool, dark place. Alcohol is sometimes added as a preservative, but this generally serves its purpose only a short time, as it cannot be added in sufficient quantity to preserve the water permanently, on account of its interference with the therapeutic action. The small percentage of alcohol in the medicated water is converted into acetic acid when long kept, and thus the preparation is soured. Glycerin and syrup have been suggested as preservatives. In the writer's experience they are not of much value unless used in large and inadmissible quantities.

Official Waters made by Distillation

Name	Proportion of Material used	Use and Dose
Aqua Aurantii Florum Fortior	Water saturated with Oil of Fresh Orange Flowers	Used for making Orange Flower Water, fʒii (16 Cc.)
Aurantii Florum	Stronger Orange Flower Water, Distilled Water, each, 1 vol.	Mild sedative vehicle, f℥ss. (16 Cc.)
Destillata	800 parts distilled from 1000 of water	Solvent
Hamamelidis	8500 Cc. distilled from 10,000 Gm. Hamamelis bark with the addition of 1500 Cc. of Alcohol	Used as a lotion
Rosæ Fortior	Water saturated with Oil of Rose Petals	Used for making Rose Water fʒii (8 Cc.)
Rosæ	Stronger Rose Water, Distilled Water, each, 1 vol.	Pleasant vehicle, f℥ss (16 Cc.)

AQUA AMYGDALÆ AMARÆ. U.S. Bitter Almond Water

	Metric	Old form
* **Oil of Bitter Almond**	1 Cc.	15 minim
Distilled Water	999 Cc.	2 pints
To make	1000 Cc.	2 pints

Dissolve the Oil in the Distilled Water by agitation, and filte through a well-wetted filter.

Average dose.—1 fluidrachm (4 Cc.).

AQUA ANISI. U.S. Anise Water

	Metric	Old form
* **Oil of Anise**	2 Cc.	30 minims
Purified Talc	15 Gm.	220 grains
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Oil of Anise with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Anise Water is perfectly clear.

Average dose.—4 fluidrachms (16 Cc.).

AQUA AURANTII FLORUM. U.S. Orange Flower Water

	Old form
* **Stronger Orange Flower Water**	8 fl. oz.
Distilled Water, each, one volume	
To make	1 pint

Mix them immediately before use.

Average dose.— 4 fluidrachms (16 Cc.).

AQUA AURANTII FLORUM FORTIOR. U.S. Stronger Orange Flower Water

[Triple Orange Flower Water]

Water saturated with the volatile oil of fresh orange flowers obtained as a by-product in the distillation of the oil of orange flowers. It should be kept in bottles loosely stoppered with a pledget of purified cotton, and in a dark place.

Stronger Orange Flower Water should be neutral to litmus paper, and have a strong odor of fresh orange flowers.

It should be colorless and clear, or only faintly opalescent, not mucilaginous, and should give no reaction with hydrogen sulphide T.S. or ammonium sulphide T.S. (absence of *metallic impurities*).

Average dose.— 2 fluidrachms (8 Cc.).

AQUA CAMPHORÆ. U.S. Camphor Water

	Metric	Old form
* **Camphor**	8 Gm.	117 grains
Alcohol	8 Cc.	123 minims
Purified Talc	15 Gm.	220 grains
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Camphor in the Alcohol, triturate the solution with the Purified Talc, and, after allowing the greater part of the Alcohol to evaporate spontaneously, continue the trituration with the Water, gradually added; then pour the mixture upon a well-wetted filter, and pass the filtrate through the filter repeatedly until the Camphor Water is perfectly clear.

Average dose.— 2 fluidrachms (8 Cc.).

AQUA CHLOROFORMI. U.S. Chloroform Water

* **Chloroform,**
Distilled Water, each, a sufficient quantity

Add enough Chloroform to a convenient quantity of Distilled Water, contained in a dark amber-colored bottle, to maintain a slight excess of the former after the contents have been repeatedly and thoroughly agitated.

When Chloroform Water is required for use pour off the needed quantity of the solution, refill the bottle with Distilled Water, and saturate it by thorough agitation, taking care that there be always an excess of Chloroform present.

Average dose.— 4 fluidrachms (16 Cc.).

AQUA CINNAMOMI. U.S. Cinnamon Water

	Metric	Old form
* **Oil of Cinnamon**	2 Cc.	30 minims
Purified Talc	15 Gm.	220 grains
Distilled Water a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Oil of Cinnamon with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Cinnamon Water is perfectly clear.

Average dose.—4 fluidrachms (16 Cc.).

AQUA CREOSOTI. U.S. Creosote Water

	Metric	Old form
* **Creosote**	10 Cc.	154 minims
Distilled Water	990 Cc.	31 fl. oz. 5½ fl. dr.
To make	1000 Cc.	2 pints

Agitate the Creosote vigorously with the Distilled Water, and filter through a well-wetted filter. Creosote Water should be freshly prepared when dispensed.

Average dose.—2 fluidrachms (8 Cc.).

AQUA DESTILLATA. U.S. Distilled Water

	Metric	Old form
* **Water**	1000 Vol.	10 pints
To make	800 Vol.	8 pints

Distil the Water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first 100 volumes [old form 1 pint], and reject this portion. Then collect 800 volumes [old form 8 pints] and keep the Distilled Water in glass-stoppered bottles, which have been rinsed with hot distilled water immediately before being filled.

AQUA FŒNICULI. U.S. Fennel Water

	Metric	Old form
* **Oil of Fennel**	2 Cc.	30 minims
Purified Talc	15 Gm.	220 grains
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Oil of Fennel with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Fennel Water is perfectly clear.

Average dose.—4 fluidrachms (16 Cc.).

AQUA HAMAMELIDIS. U.S. Hamamelis Water

	Metric	Old form
* **Hamamelis Bark**	10000 Gm.	21 lb.
Water	20000 Cc.	40 pints
Alcohol	1500 Cc.	3 pints
To make	10000 Cc.	20 pints

Macerate the Hamamelis Bark in the Water during twenty-four hours; then distil until 8500 Cc. [old form 17 pints] of distillate are obtained, add the Alcohol, and mix thoroughly.

If 1 Cc. of Hamamelis Water be added to 5 Cc. of sulphuric acid containing a little salicylic acid in solution, no red color should appear (absence of *formaldehyde*)

Average dose.—2 fluidrachms (8 Cc.).

AQUA HYDROGENII DIOXIDI. U.S. Solution of Hydrogen Dioxide

[Solution of Hydrogen Peroxide]

A slightly acid, aqueous solution of Hydrogen Dioxide [H_2O_2 = 33.76], which should contain, when freshly prepared, about 3 percent., by weight, of absolute Hydrogen Dioxide, corresponding to about 10 volumes of available oxygen. It should be kept in a cool place. Upon removing the stopper from the bottle not more than a slight pressure should be observed.

(For tests, see Part III.)

AQUA MENTHÆ PIPERITÆ. U.S. Peppermint Water

	Metric	Old form
***Oil of Peppermint**	2 Cc.	30 minims
Purified Talc	15 Gm.	220 grains
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Oil of Peppermint with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Peppermint Water is perfectly clear.

Average dose.— 4 fluidrachms (16 Cc.).

AQUA MENTHÆ VIRIDIS. U.S. Spearmint Water

	Metric	Old form
***Oil of Spearmint**	2 Cc.	30 minims
Purified Talc	15 Gm.	220 grains
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Oil of Spearmint with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Spearmint Water is perfectly clear.

Average dose.— 4 fluidrachms (16 Cc.).

AQUA ROSÆ. U.S. Rose Water

	Old form
***Stronger Rose Water**,	
Distilled Water, of each, one volume	8 fl. oz.

Mix them immediately before use.

Average dose.— 4 fluidrachms (16 Cc.).

AQUA ROSÆ FORTIOR. U.S. Stronger Rose Water

[Triple Rose Water]

Water saturated with the volatile oil of rose petals, obtained by distillation.

Stronger Rose Water should be kept in bottles loosely stoppered with a pledget of purified cotton, and in a dark place.

Stronger Rose Water should be colorless and clear, not mucilaginous, and should have the odor of roses, free from empyreuma. It should give no reaction with hydrogen sulphide T.S. or ammonium sulphide T.S. (absence of *metallic impurities*).

Average dose.— 2 fluidrachms (8 Cc.).

Unofficial Waters

Name	Character of Preparation	Use and Dose
Aqua Anethi. Br.	A distillate obtained from an infusion of Dill Fruit	A pleasant vehicle
Carui. Br.	A distillate obtained from an infusion of Caraway Fruit	A pleasant vehicle
Lauro-cerasi. Br.	A distillate obtained from an infusion of Cherry-Laurel Leaves, containing one-tenth percent. of hydrocyanic acid	A sedative narcotic, 30 ♏ (2 Cc.)
Pimentæ. Br.	A distillate obtained from an infusion of Pimento.	A pleasant vehicle
Sambuci. Br.	A distillate obtained from an infusion of fresh Elder Flowers	A pleasant vehicle

Liquores *Solutions*

Under this head the U. S. Pharmacopœia places all aqueous solutions of non-volatile substances except such as naturally form separate distinctive classes, as the syrups, infusions, and decoctions.

This classification is adopted only in the U. S. Pharmacopœia, the British standard embracing, in addition, gaseous and saccharine solutions, as Liquor Ammoniæ, Liquor Calcis Saccharatus, etc., while the German Pharmacopœia does not adopt any definite method, solutions of volatile and non-volatile substances both being in the class Aquæ and also in the class Liquores, Aqua Rosæ and Aqua Plumbi together, and Liquor Ammonii Caustici and Liquor Natri Caustici in the same class. Liquor Formaldehydi was added to this class in the U. S. P. (8th Rev.) as upon heating, paraformaldehyde, a solid substance, is formed.

The official solutions constitute a most interesting group of preparations. They are usually very active medicinal agents, and some of them are powerful poisons. The number of official solutions is *twenty-five.* The following tables exhibit in condensed form a view of the class Liquores, U. S. P., arranged alphabetically in two classes: 1. Simple aqueous solutions, in which the solid dissolved is not altered in any respect, except so far as depends upon its external form. 2. Chemical aqueous solutions, or those in which the properties of the dissolved body or bodies are changed by chemical action or heat (see page 189).

LIQUORES, U. S. P.

1. Simple Solutions (aqueous)

Liquor Acidi Arsenosi	1 percent. As_2O_3, 5 percent. diluted HCl
Antisepticus	Hydroalcoholic solution of Boric Acid, Benzoic Acid, Thymol, Eucalyptol, and Oils of Peppermint, Gaultheria, and Thyme
Arseni et Hydrargyri Iodidi	1 percent. AsI_3, 1 percent. HgI_2
Calcis	Saturated solution $Ca(OH)_2$
Iodi Compositus	5 percent. I, 10 percent. KI
Plumbi Subacetatis Dilutus	4 percent. of Solution Lead Subacetate.
Potassii Hydroxidi	5 percent. Potassium Hydroxide.
Sodii Hydroxidi	5 percent. Sodium Hydroxide
Sodii Arsenatis	1 percent. Exsiccated Sodium Arsenate

2. Chemical Solutions (aqueous)

Liquor Ammonii Acetatis	7 percent. Ammonium Acetate (Ammonium Carbonate with Diluted Acetic Acid)
Chlori Compositus	0.4 percent. Chlorine ($KClO_3$ with HCl and Water)

Liquor Cresolis Compositus . . .	50 percent. Cresol with Linseed Oil and KOH
Ferri Chloridi	29 percent. anhydrous Ferric Chloride (Iron, HCl, HNO_3, and Distilled Water)
Ferri et Ammonii Acetatis . .	Ferric Chloride, Diluted Acetic Acid, Ammonium Acetate, Aromatic Elixir, Glycerin, and Water
Ferri Subsulphatis	13.57 percent. Metallic Iron (Ferrous Sulphate, H_2SO_4, HNO_3, and Distilled Water)
Ferri Tersulphatis	36 percent. normal Ferric Sulphate (Ferrous Sulphate, H_2SO_4, HNO_3, and Distilled Water)
Formaldehydi	37 percent. by weight absolute Formaldehyde
Hydrargyri Nitratis	60 percent. Mercuric Nitrate and 11 percent. free Nitric Acid (Red Mercuric Oxide, HNO_3, and Distilled Water)
Magnesii Citratis	Magnesium Carbonate, Citric Acid, Syrup of Citric Acid, Potassium Bicarbonate, Water
Plumbi Subacetatis	25 percent. Lead Subacetate (Lead Acetate, Lead Oxide, and Distilled Water)
Potassii Arsenitis	Potassium Arsenite corresponding to 1 percent. As_2O_3 (Arsenic Trioxide, Potassium Bicarbonate, Compound Tincture of Lavender, and Distilled Water)
Potassii Citratis	8 percent. anhydrous Potassium Citrate (Potassium Bicarbonate, Citric Acid, and Distilled Water)
Sodæ Chlorinatæ	2.4 percent. by weight available Chlorine (Chlorinated Lime, Monohydrated Sodium Carbonate, and Water)
Sodii Phosphatis Compositus .	Representing 100 percent. Sodium Phosphate (Sodium Phosphate, Sodium Nitrate, Citric Acid, and Distilled Water)
Zinci Chloridi	50 percent. by weight Zinc Chloride (Zinc, Nitric Acid, Precipitated Zinc Carbonate, HCl, and Distilled Water)

The official solutions vary so greatly in their properties and method of preparation, that no general formula or comments can be given here to aid the student in studying them individually which would compare in value with the careful consideration that should be given each separate formula. These processes will be found under the head of the bases entering into them in Part III. For general manipulations of solutions, see page 189.

Table of Unofficial Solutions[1]

Name	Ingredients	Preparation
Liquor Acidi Chromici. Br.	25 Gm. Chromic Anhydride; 75 Cc. Distilled Water	Dissolve
Ammonii Citratis. Br.	87.5 Gm. Ammonium Carbonate; 125 Gm. Citric Acid; Distilled Water to make 1000 Cc.	Dissolve the Citric Acid in five times its weight of Distilled Water; neutralize with Ammonium Carbonate; add Distilled Water to make 1000 Cc.
Atropinæ Sulphatis. Br.	1 Gm. Atropine Sulphate; 0.12 Gm. Salicylic Acid; Distilled Water to make 100 Cc.	Dissolve the Atropine Sulphate and the Salicylic Acid in enough recently boiled Distilled Water to make 100 Cc.

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[1] In this list are included preparations of the U. S. P. 1890, not included in the Eighth Decennial Revision and of the 1898 British Pharmacopœia. The British Pharmacopœia includes, under the title of Liquor, preparations made by percolation and maceration, and more properly classed with concentrated tinctures or 50 percent. fluidextracts.

Table of Unofficial Solutions—*Continued*

Name	Ingredients	Preparation
Liquor Bismuthi et Ammonii Citratis. Br.	70 Gm. Bismuth Oxynitrate; 70 Gm. Potassium Citrate; 20 Gm. Potassium Carbonate; 50 Cc. Nitric Acid; Ammonia Water and Distilled Water enough to make 1000 Cc.	Dissolve the Bismuth Oxynitrate in the Diluted Nitric Acid, add Distilled Water until the solution is slightly opalescent, and then add an aqueous solution of the Potassium Citrate and Carbonate, heat to boiling, cool, separate, precipitate, and wash, and while moist dissolve in just enough Ammonia Water and add Distilled Water to make 1000 Cc.
Calcis Chlorinatæ. Br.	500 Gm. Chlorinated Lime; 5 liters Distilled Water	Mix, shake occasionally during three hours, and filter
Calumbæ Concentratus. Br.	500 Gm. Calumba, No. 5 powder; 225 Cc. Alcohol; Distilled Water to make 1000 Cc.	Prepare a cold aqueous infusion by maceration, heat the liquid to boiling, add the Alcohol, filter, adding enough Distilled Water to make 1000 Cc.
Caoutchouc. Br.	50 Gm. India Rubber; 500 Cc. Benzol; 500 Cc. Carbon Disulphide	Cut the India Rubber into shreds and dissolve it in the mixed liquids
Chiratæ Concentratus. Br.	500 Gm. Chiretta, No. 40 powder; 20 percent. Alcohol to make 1000 Cc.	Percolate with the menstruum, after three days' maceration, until the liquid measures 1000 Cc.
Cuspariæ Concentratus. Br.	500 Gm. Cusparia Bark, No. 40 powder; 20 percent. Alcohol to make 1000 Cc.	Percolate with the menstruum, after three days' maceration, until the liquid measures 1000 Cc.
Epispasticus. Br.	500 Gm. Cantharides, No. 20 powder; Acetic Ether to make 1000 Cc.	Percolate with the Acetic Ether, after twenty-four hours' maceration, until the liquid measures 1000 Cc.
Ethyl Nitritis. Br.	3 percent., by weight, of Ethyl Nitrite in Absolute Alcohol 95 parts and Glycerin 5 parts	Mix them
Ferri Acetatis. U. S. P. 1890	1000 Gm. Solution of Ferric Sulphate; 260 Gm. Glacial Acetic Acid; 850 Cc. Ammonia Water; Distilled Water to make 1000 Gm.	Add the well diluted Solution of Ferric Sulphate to the diluted Ammonia Water, wash and collect the precipitate and add it gradually to the Glacial Acetic Acid, contained in a tared jar. When dissolved add enough Distilled Water to make the liquid weigh 1000 Gm.
Ferri Citratis. U. S. P. 1890	1050 Gm. Solution of Ferric Sulphate; 300 Gm. Citric Acid; 880 Cc. Ammonia Water; Water to make 1000 Gm.	Add the well diluted Solution of Ferric Sulphate to the diluted Ammonia Water, wash, and collect the precipitate and add it to the Citric Acid contained in a porcelain dish. Heat gently until dissolved and add enough Water to make the liquid weigh 1000 Gm.
Ferri Nitratis. U. S. P. 1890	180 Gm. Solution of Ferric Sulphate; 160 Cc. Ammonia Water; 71 Gm. Nitric Acid; Distilled Water to make 1000 Gm.	Add the well diluted Solution of Ferric Sulphate to the diluted Ammonia Water, wash and collect the precipitate and add it to the Nitric Acid contained in a porcelain dish. Stir until dissolved and add enough Distilled Water to make the liquid weigh 1000 Gm.
Ferri Perchloridi. Br.	250 Cc. Strong Solution of Ferric Chloride; Distilled Water to make 1000 Cc.	Mix them
Hydrargyri Perchloridi. Br.	1 Gm. Mercuric Chloride; 875 Cc. Distilled Water	Dissolve
Krameriæ Concentratus. Br.	500 Gm. Krameria Root, No. 40 powder; 20 percent. Alcohol to make 1000 Cc.	Percolate with the menstruum, after three days' maceration, until the liquid measures 1000 Cc.
Magnesii Carbonatis. Br.	40 Gm. Magnesium Sulphate; 50 Gm. Sodium Carbonate; Distilled Water a sufficient quantity to make about 400 Cc.	Add a solution of the Sodium Carbonate to a hot solution of the Magnesium Sulphate, collect and wash the precipitate, dissolve it in 400 Cc. Distilled Water, into which carbonic acid gas, under pressure, has been introduced, and store in tightly stoppered bottles

Table of Unofficial Solutions—*Continued*

Name	Ingredients	Preparation
Liquor Morphinæ Acetatis. Br.	1 Gm. Morphine Acetate; 2 Cc. Diluted Acetic Acid; 25 Cc. Alcohol; Distilled Water to make 100 Cc.	Mix the Diluted Acetic Acid with the Alcohol and an equal volume of Distilled Water; dissolve the Morphine Acetate in the liquid and add enough Distilled Water to make 100 Cc.
Morphinæ Hydrochloridi. Br.	1 Gm. Morphine Hydrochloride; 2 Cc. Diluted Hydrochloric Acid; 25 Cc. Alcohol; Distilled Water to make 100 Cc.	Mix the Diluted Hydrochloric Acid with the Alcohol and an equal volume of Distilled Water; dissolve the Morphine Hydrochloride in the liquid and add enough Distilled Water to make 100 Cc.
Morphinæ Tartratis. Br.	1 Gm. Morphine Tartrate; 25 Cc. Alcohol; Distilled Water to make 100 Cc.	Dissolve the Morphine Tartrate in the Alcohol, mixed with an equal volume of Distilled Water, and add enough Distilled Water to make 100 Cc.
Pancreatis. Br.	Fresh Pancreas of the Pig; 1000 Cc. 20 percent. Alcohol	Digest 250 Gm. of cleaned and finely divided pancreas in 1000 Cc. of 20 percent. Alcohol during seven days and filter
Picis Carbonis. Br.	200 Gm. Prepared Coal Tar; 100 Gm. Quillaia Bark, No. 20 powder; Alcohol to make 1000 Cc.	Percolate the Quillaia with Alcohol to make 1000 Cc. of tincture, to which add the Coal Tar, prepared by heating at 48.9° C. (120° F.) during one hour and digest, with occasional stirring, during two days. Finally filter
Potassii Permanganatis. Br.	10 Gm. Potassium Permanganate; Distilled Water to make 1000 Cc.	Dissolve the Potassium Permanganate in enough Distilled Water to make 1000 Cc.
Quassiæ Concentratus. Br.	100 Gm. Quassia Wood, No. 40 powder; 20 percent. Alcohol to make 1000 Cc.	Percolate with the menstruum, after three days' maceration, until the liquid measures 1000 Cc.
Rhei Concentratus. Br.	500 Gm. Rhubarb, No. 5 powder; 20 percent. Alcohol to make 1000 Cc.	Percolate with the menstruum, after three days' maceration, until the liquid measures 1000 Cc.
Sarsæ Compositus Concentratus. Br.	1000 Gm. Sarsaparilla, cut and bruised; 100 Gm. Sassafras Root; 100 Gm. Guaiacum Wood; both in shavings; 100 Gm. Dried Licorice Root, bruised; 50 Gm. Mezereon Bark, cut; 225 Cc. Alcohol; Distilled Water to make 1000 Cc.	Infuse the Sarsaparilla in 3 successive portions of 5000 Cc. each of Distilled Water at 71.1° C. (160° F.) Boil the other solid ingredients with Water until exhausted, and rapidly evaporate the mixed infusion and decoction until it measures 800 Cc. Add the Alcohol, set aside for fourteen days, and filter
Senegæ Concentratus. Br.	500 Gm. Senega Root, No. 20 powder; about 28 percent. Alcohol to make 1000 Cc.	Percolate with the menstruum, after three days' maceration, until the liquid measures 1000 Cc.
Sennæ Concentratus. Br.	1000 Gm. Senna; 125 Cc. Tincture of Ginger; 100 Cc. Alcohol; Distilled Water to make 1000 Cc.	Pack the Senna, divided into 3 equal portions, in separate percolators, macerate for twenty-four hours, then percolate the first with Distilled Water, using the liquid obtained as menstruum for the second, and the percolate from the second as menstruum for the third. Continue the operation until 800 Cc. have been obtained from the third percolator; heat the liquid to 82.2° C. (180° F.), cool, add the Tincture of Ginger and Alcohol, set aside for seven days, and filter
Serpentariæ Concentratus. Br.	500 Gm. Serpentary Rhizome, No. 40 powder; 20 percent. Alcohol to make 1000 Cc.	Percolate with the menstruum, after three days' maceration, until the liquid measures 1000 Cc.
Sodii Ethylatis. Br.	1 Gm. Sodium (clean and bright); 20 Cc. Absolute Alcohol	Cautiously dissolve the Sodium in the Absolute Alcohol, contained in a flask, the latter being kept cool by a stream of cold water
Sodii Silicatis. U. S. P. 1890	A nearly saturated solution	

Table of Unofficial Solutions—*Continued*

Name	Ingredients	Preparation
Liquor Strychninæ Hydrochloridi. Br.	1 Gm. Strychnine Hydrochloride; 25 Cc. Alcohol; Distilled Water to make 100 Cc.	Dissolve the Strychnine Hydrochloride in the Alcohol and sufficient Distilled Water to make 100 Cc.
Thyroidei. Br.	Fresh and healthy thyroid gland of the sheep; Glycerin and 0.5 percent. solution of Phenol in Distilled Water	Carefully select healthy and normal thyroid glands, bruise them in a mortar, and for each entire gland add 2 Cc. of Glycerin and 2 Cc. of 0.5 percent. solution of Phenol. Allow the mixture to stand in a flask during twenty-four hours, then strain with pressure, and add the solution of Phenol to make the liquid measure 6 Cc. for each gland used

CHAPTER XXII

AQUEOUS SOLUTIONS CONTAINING SWEET OR VISCID SUBSTANCES

Syrupi *Syrups*

Syrups are concentrated solutions of sugar in water or aqueous liquids. The liquids used sometimes contain acetic or other organic acids, and occasionally a small quantity of alcohol. When water *alone* is used in making the solution of sugar, the preparation is termed *syrup*, or *simple syrup*. When the water contains soluble principles from various medicinal substances, the syrup is called a *medicated* syrup. A *flavored* syrup is one which is not medicinal in its action, but which is made by the introduction of various aromatic or pleasantly flavored substances. Syrups are useful preparations, because their sweet taste facilitates administration, while the presence of a large percentage of sugar renders them permanent if they are properly made.

Selection of the Sugar.—The sugar which should be used exclusively in making syrups is clearly defined by the Pharmacopœia. It is described as in white, dry, hard, distinctly crystalline granules, permanent in the air, odorless, having a purely sweet taste, and a neutral reaction. This description applies to that known commercially as "granulated," and the official tests prescribed should be carefully observed. (See Saccharum.) Sugar must be free from ultramarine, Prussian blue, and insoluble substances, the presence of impurities, particularly ultramarine, has been proved to interfere with the stability and quality of syrups. The direction that the sugar should be dry is all-important, because the permanency of syrups largely depends upon their containing the correct proportion of sugar and water. If an insufficient amount of sugar is present, the syrups will ferment; if they contain too much, crystallization of the excess takes place at first, while the subsequent growth of the crystals is accompanied by an abstraction of sugar from the liquid, and the result is such a weakening of the syrup that fermentation results, as in the first instance. *Damp sugar* should never be used unless the amount of moisture has been carefully ascertained, and an allowance made for it.

Preparation of Syrups.—Syrups are prepared in various ways, and the choice of the proper method must always depend upon the physical and chemical characteristics of the substances entering into the preparation. Five methods are officially recognized, which may be summarized as follows: 1. By solution with heat. 2. By agitation without heat. 3. By the simple addition of a medicating liquid to syrup. 4. By digestion or maceration. 5. By percolation.

1. **By Solution with Heat.**—This is the usual method of making syrups when the valuable constituent is not volatile nor injured by

heat, and when it is desirable to make the syrup rapidly. The sugar is usually dissolved in the water or aqueous solution and heated until solution is effected, skimmed, strained, and the proper quantity of water added to make the desired weight or measure. If the syrup is made from an infusion, a decoction, or an aqueous solution containing organic matter, it is usually proper to heat the syrup to the boiling point, in order to coagulate albuminous matter; this is separated subsequently by straining. If the albumin or other impurities were suffered to remain in the syrup, fermentation would probably be induced in warm weather. Saccharometers (see page 82) are very useful in making syrups by the hot process where the specific gravity of the finished syrup is known. The saccharometer may be floated in the syrup *while boiling*, and thus the exact degree of concentration determined without waiting to cool the syrup and having to heat it again subsequently to concentrate it further.

2. **By Agitation without Heat.**—This process is directed by the Pharmacopœia to be used in those cases where heat will cause the loss of valuable volatile constituents. The aqueous solution is usually directed to be added to the sugar in a bottle, and the whole well shaken together until the sugar is dissolved. This is best effected by allowing the tightly corked bottle to lie upon its side when not being agitated. If a large quantity of syrup is required, it may be advantageously made in a churn.

3. **By the Simple Addition of Medicating Liquid to Syrup.**—This method is resorted to in those cases in which fluidextracts, tinctures, or other liquids are added to syrup in order to medicate it. Syrups made in this way usually show precipitates in time, owing to the fact that alcohol enters into most of the liquids thus used, and the resinous and oily substances dissolved by the alcohol often precipitate when mixed with the syrup, producing unsightly preparations.

4. **By Maceration or Digestion.**—In the U. S. P. 1880 but two official syrups were made by digestion,—senna and tolu. This method is not recommended as either accurate or efficient. A solution of a comparatively insoluble substance, like tolu, can always be effected in a more rapid and thorough manner by dissolving the substance in alcohol, suspending the resinous tincture in a mixture of absorbent powder and water, filtering, and dissolving sugar in the filtrate, as in the U. S. P. process (8th Revision).

5. **Percolation in making Syrups.**—This method originated with Orynski, and is conducted as follows: Into the lower orifice of an ordinary percolator is introduced a small piece of sponge or purified cotton, the sugar (granulated) is then poured in, and upon this the water, the apparatus being arranged as is usual in the process of percolation. The percolator may be covered loosely, and the operation will proceed without further attention, the syrup coming through drop by drop. If it should be necessary to use crushed sugar, the percolator must be corked at the lower orifice, and the sugar and water introduced and allowed to macerate until the former has dissolved down to *half its bulk*, when the cork may be removed and the liquid allowed to drop. If, after the liquid has all passed, there remains a quantity of undissolved sugar in the percolator,

enough percolate may be poured back to dissolve it, afterwards adding sufficient water to bring the whole up to the required measure.

To be successful in using this process, care in several particulars must be exercised : 1. The percolator used should be cylindrical or semicylindrical, and cone-shaped as it nears the lower orifice. 2. The sugar must be coarse, else it will form into a compact mass, which the liquid cannot permeate. 3. The sponge or purified cotton must be introduced with care. If pressed in too tightly, it will effectually stop the process; if inserted too loosely, the liquid will pass too rapidly, and will, in consequence, be weak and turbid (from imperfect filtration).

Preservation of Syrups.—Syrups should never be made in larger quantities than can be used within a few months, except in those cases where special facilities can be employed for their preservation. A low temperature is the best preservative for syrups; concentration without supersaturation is also a condition favorable to preservation. The addition of such substances as boric acid, salicylic acid, alcohol, fluorides, calcium sulphite, etc., to prevent the fermentation of syrups, is not recommended, for if used in sufficient quantity to act as preservatives they communicate their own flavor to the syrup or are otherwise objectionable. The practice of restoring syrups which have been spoiled through fermentation by heating them and "working them over" is a reprehensible one. The practice of good pharmacy demands the possession of sufficient moral courage to find a place for fermented syrups where they will do the least harm—*i.e.*, in the sink and gutter-pipe.

A simple and practical method of preserving syrups, which is very effective, is as follows : A number of bottles are provided holding not more than a pint each, even when the quantity of syrup is large; the bottles are thoroughly cleaned, and kept hot by immersion in boiling water until ready for use; a sufficient number of good corks, which have been thoroughly soaked in hot water, and of the proper size for the bottles, should be at hand. The syrup should be heated to the boiling point (strained, if necessary, and reheated), and poured into the hot bottles until they are filled to the brim. The corks are inserted by forcibly pressing them into the necks of the bottles, thereby displacing a small portion of the syrup, and are tied down with twine in the usual manner. Then, while the necks of the bottles are still hot (and before the syrup can contract in volume through cooling) they are dipped into melted sealing-wax contained in a suitable vessel. By this method the germs which are supposed to produce fermentation are destroyed by the heat, and no air can find its way to the syrup, as the bottles are hermetically sealed. Fruit-juices may be preserved in the same way.

Official Syrups.—There are TWENTY-NINE official syrups. Of this number, ELEVEN are made by the *simple addition of medicating liquid to syrup*, NINE by *agitation of the sugar with the medicating liquid without heat*, and NINE by *solution with heat*. The alternative process of percolation is permitted by the Pharmacopœia in EIGHT syrups.

Official Syrups, arranged in Classes according to the Methods employed in their Preparation

Name and Method of Preparation	Sub-Classes	Ingredients
Simple Addition of Medicating Liquid to Syrup		
Syrupus Acidi Hydriodici	Simple Admixture	(Containing 1 percent. Absolute Hydriodic Acid) 100 Gm. Diluted Hydriodic Acid; 300 Gm. Water; 600 Gm. Syrup
Amygdalæ	“ “	10 Cc. Spirit of Bitter Almond; 100 Cc. Orange Flower Water; Syrup, to 1000 Cc.
Ferri, Quininæ et Strychninæ Phosphatum	“ “	250 Cc. Glycerite of the Phosphates of Iron, Quinine and Strychnine; Syrup, to 1000 Cc.
Acidi Citrici	From tincture and Citric Acid	10 Gm. Citric Acid; 10 Cc. Distilled Water; 10 Cc. Tincture of Fresh Lemon Peel; Syrup, to 1000 Cc.
Lactucarii	From tincture	100 Cc. Tincture of Lactucarium; 1 Gm. Citric Acid; 50 Cc. Orange Flower Water; 200 Cc. Glycerin; Syrup, to 1000 Cc.
Rhei Aromaticus	From aromatic tincture	150 Cc. Aromatic Tincture of Rhubarb; 1 Gm. Potassium Carbonate; 850 Cc. Syrup
Krameriæ	From fluidextract	450 Cc. Fluidextract of Krameria; 550 Cc. Syrup
Rhei	“ “	100 Cc. Fluidextract of Rhubarb; 4 Cc. Spirit of Cinnamon; 10 Gm. Potassium Carbonate; 50 Cc. Water; Syrup, to 1000 Cc.
Rubi	“ “	250 Cc. Fluidextract of Rubus; 750 Cc. Syrup
Senegæ	“ “	200 Cc. Fluidextract of Senega; 800 Cc. Syrup
Sennæ	“ “	250 Cc. Fluidextract of Senna; 5 Cc. Oil of Coriander; Syrup, to 1000 Cc.
Agitation of Sugar with Medicating Liquid without heat		
Syrupus Aurantii Florum	Simple solution	850 Gm. Sugar; Orange Flower Water to make 1000 Cc.
Hypophosphitum	Simple solution or admixture	45 Gm. Calcium Hypophosphite; 15 Gm. Potassium Hypophosphite; 15 Gm. Sodium Hypophosphite; 2 Gm. Diluted Hypophosphorous Acid; 650 Gm. Sugar; 5 Cc. Tincture of Fresh Lemon Peel; Water, to 1000 Cc.
Hypophosphitum Compositus	Simple solution or admixture	35 Gm. Calcium Hypophosphite; 17.5 Gm. Potassium Hypophosphite; 17.5 Gm. Sodium Hypophosphite; 2.25 Gm. Ferric Hypophosphite; 2.25 Gm. Manganese Hypophosphite; 1.10 Gm. Quinine; 0.115 Gm. Strychnine; 3.75 Gm. Sodium Citrate; 15 Cc. Diluted Hypophosphorous Acid; 775 Gm. Sugar; Water, to 1000 Cc.
Pruni Virginianæ	From cold aqueous infusion	150 Gm. Wild Cherry; 700 Gm. Sugar; 150 Cc. Glycerin; Water, to 1000 Cc.
Calcii Lactophosphatis	Solution involving chemical reaction	60 Cc. Lactic Acid; 36 Cc. Phosphoric Acid; 50 Cc. Orange Flower Water; 25 Gm. Precipitated Calcium Carbonate; 725 Gm. Sugar; Water, to 1000 Cc.
Aurantii	From tincture	50 Cc. Tincture of Sweet Orange Peel; 5 Gm. Citric Acid; 10 Gm. Magnesium Carbonate; 820 Gm. Sugar; Water, to 1000 Cc.
Ipecacuanhæ	From fluidextract	70 Cc. Fluidextract of Ipecac; 10 Cc. Acetic Acid; 100 Cc. Glycerin; 700 Gm. Sugar; Water, to 1000 Cc.
Rosæ	“ “	125 Fluidextract of Rose; 10 Cc. Diluted Sulphuric Acid; 750 Gm. Sugar; Water, to 1000 Cc.
Scillæ Compositus	From fluidextracts	80 Cc. Fluidextract of Squill; 80 Cc. Fluidextract of Senega; 2 Gm. Antimony and Potassium Tartrate; 20 Gm. Purified Talc; 750 Gm. Sugar; Water, to 1000 Cc.
Solution with Heat		
Syrupus	Simple solution	850 Gm. Sugar; Distilled Water, to 1000 Cc.
Acaciæ	Simple solution and filtering	100 Gm. Acacia; 800 Gm. Sugar; Distilled Water, to 1000 Cc.

Official Syrups—*Continued*

Name and Method of Preparation	Sub-Classes	Ingredients
Syrupus Calcis	Simple solution and filtering	65 Gm. Lime; 350 Gm. Sugar; Water, to 1000 Cc.
Picis Liquidæ	Maceration and filtering	5 Gm. Tar; 10 Gm. Magnesium Carbonate; 850 Gm. Sugar; Alcohol, Water, to 1000 Cc.
Scillæ	Containing Acetic Acid	450 Cc. Vinegar of Squill; 800 Gm. Sugar; Water, to 1000 Cc.
Ferri Iodidi	Solution involving chemical action, preserved by Sugar	(Containing 5 percent. Ferrous Iodide) 12.5 Gm. Iron Wire; 41.5 Gm. Iodine; 20 Cc. Diluted Hypophosphorous Acid; 600 Gm. Sugar; Distilled Water, to 1000 Gm.
Tolutanus	From tincture	50 Cc. Tincture of Tolu; 10 Gm. Magnesium Carbonate; 820 Gm. of Sugar; Water, to 1000 Cc.
Sarsaparillæ Compositus	From fluidextracts	200 Cc. Fluidextract of Sarsaparilla; 15 Cc. Fluidextract of Glycyrrhiza; 15 Cc. Fluidextract of Senna; 650 Gm. Sugar; 0.2 Cc. Oil of Sassafras; 0.2 Cc. Oil of Anise; 0.2 Cc. Oil of Gaultheria; Water, to 1000 Cc.
Zingiberis	From fluidextract	30 Cc. Fluidextract of Ginger; 10 Gm. Magnesium Carbonate; 820 Gm. Sugar; Alcohol, Water, to 1000 Cc.

Unofficial Syrups

Name	Ingredients	Method of Preparation
Syrupus Allii. U. S. P. 1890	200 Gm. Fresh Garlic, sliced and bruised; 800 Gm. Sugar; Diluted Acetic Acid to make 1000 Cc.	Macerate the Garlic in 300 Cc. Diluted Acetic Acid during four days, express, mix residue with 200 Cc. more of the Acid, again express, and filter mixed liquids. Dissolve the Sugar in the filtrate and add enough Acid to measure 1000 Cc.
Althææ. U. S. P. 1890	50 Gm. Althæa, cut; 30 Cc. Alcohol; 100 Cc. Glycerin; 700 Gm. Sugar; Water to make 1000 Cc.	Macerate the Washed Althæa in 400 Cc. of Water, to which the Alcohol has been added, during one hour, stirring frequently, and then strain without expression. Dissolve the Sugar in the strained liquid, by agitation, add the Glycerin and enough Water to measure 1000 Cc.
Aromaticus. Br.	250 Cc. Tincture of Orange; 250 Cc. Cinnamon Water; 500 Cc. Syrup	Mix the Tincture and Cinnamon Water, add a little powdered talc, filter, and add the Syrup
Cascaræ Aromaticus. Br.	400 Cc. Liquid Extract of Cascara Sagrada; 100 Cc. Tincture of Orange; 50 Cc. Alcohol; 150 Cc. Cinnamon Water; 300 Cc. Syrup	Mix them
Chloral. Br.	91.43 Gm. Chloral Hydrate; 93.75 Cc. Distilled Water; Syrup to make 500 Cc.	Dissolve the Chloral Hydrate in the Distilled Water, and add enough Syrup to make 500 Cc.
Codeinæ. Br.	4.57 Gm. Codeine Phosphate; 12.5 Cc. Distilled Water; 987.5 Cc. Syrup	Dissolve the Codeine Phosphate in the Distilled Water, add the Syrup, and mix
Ferri Phosphatis. Br.	8.6 Gm. Iron Wire; 62.5 Cc. Phosphoric Acid (66.3 percent.); 700 Cc. Syrup; Distilled Water to make 1000 Cc.	Dissolve the Iron Wire in the Phosphoric Acid, previously diluted with an equal volume of Distilled Water, filter the Solution into the Syrup, and add Distilled Water to make 1000 Cc.
Glucosi. Br.	25 Gm. Liquid Glucose; 50 Gm. Syrup	Mix with the aid of gentle heat
Hemidesmi. Br.	100 Gm. Hemidesmus Root, bruised; 700 Gm. Sugar; Distilled Water to make 1050 Gm.	Infuse the drug in 500 Cc. of boiling Water during four hours and strain. Allow the liquid to become clear by settling, and dissolve the Sugar in the clear liquid with the aid of a gentle heat

Unofficial Syrups—*Continued*

Name and Method of Preparation	Sub-Classes	Ingredients
Syrupus Hypophosphitum cum Ferro. U. S. P. 1890	10 Gm. Ferrous Lactate; 10 Gm. Potassium Citrate; Syrup of Hypophosphites to make 1000 Cc.	Rub the Ferrous Lactate and Potassium Citrate with a little of the Syrup until dissolved, and add enough of the Syrup to make 1000 Cc.
Limonis. Br.	20 Gm. fresh, grated Lemon Peel; Alcohol, a sufficient quantity; 500 Cc. Lemon Juice; 760 Gm. Sugar	Macerate the Lemon Peel in enough Alcohol to measure 40 Cc., during seven days, and filter. Dissolve the Sugar in the Lemon Juice with the aid of gentle heat, and when the syrup is cold add to it the Alcoholic solution and mix
Rhœados. Br.	260 Gm. Red-Poppy Petals; 720 Gm. Sugar; 50 Cc. Alcohol; Distilled Water to make 1160 Gm.	Infuse the Red-Poppy Petals in 400 Cc. of heated Water, and afterwards allow it to stand for twelve hours, stirring frequently, strain, dissolve the Sugar in the liquid, add the Alcohol, and enough Distilled Water to make 1160 Gm.
Rubi Idæi. U. S. P. 1890	Fresh, ripe Raspberries; Sugar, a sufficient quantity	Crush the Raspberries and allow them to stand at about 20° C. (68° F.) until the filtered juice will mix clear with half its volume of alcohol. Then separate the juice, filter, and for every 40 parts of filtrate add 60 parts of Sugar, heat the mixture to boiling, strain, and preserve in well-stoppered bottles

SYRUPUS. U.S. Syrup

	Metric	Old form
* **Sugar,** in dry crystalline granules	850 Gm.	7 lbs. 1½ oz. av.
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	8 pints

Dissolve the Sugar, with the aid of heat, in 450 Cc. [old form 58 fl. oz.] of Distilled Water, raise the temperature to the boiling point, strain the liquid, and pass enough Distilled Water through the strainer to make the product, when cold, measure 1000 Cc. [old form 8 pints]. Mix thoroughly.

Syrup may also be prepared in the following manner:

Press down into the neck of a percolator of suitable size a pledget of purified cotton, not too tightly, in such a manner that the cotton shall nearly fill the neck of the percolator, and moisten it with a few drops of Distilled Water; introduce the Sugar into the percolator, make its surface level without shaking or jarring, then carefully pour upon it 450 Cc. [old form 58 fl. oz.] of Distilled Water, and regulate the flow of the liquid, if necessary, so that it will pass out in rapid drops. Return the first portions of the percolate until it runs through clear, and when all the liquid has passed, follow it by Distilled Water, added in portions, so that all the Sugar may be dissolved, and the product measure 1000 Cc. [old form 8 pints]. Mix thoroughly.

Syrup thus prepared has a specific gravity of about 1.313 at 25° C. (77° F.).

SYRUPUS ACACIÆ. U.S. Syrup of Acacia

	Metric	Old form
* **Acacia,** in selected pieces	100 Gm.	3 oz. av. 148 gr.
Sugar	800 Gm.	26 oz. av. 309 gr.
Distilled Water	430 Cc.	13 fl. oz. 365 min.
To make	1000 Cc.	2 pints

Introduce the Acacia into an enamelled or porcelain dish, add the Distilled Water, and stir occasionally until the Acacia is dissolved; then, having added the Sugar, place the dish on a water-bath and apply heat, gradually increasing the temperature, and stirring from time to time until the Sugar is dissolved. Strain the Syrup, if necessary, and add sufficient Distilled Water to make the product measure 1000 Cc. [old form 2 pints].

Syrup of Acacia should be made in small quantities, and stored in small, tightly stoppered bottles, in a cool place.

SYRUPUS ACIDI CITRICI. U.S. Syrup of Citric Acid

	Metric	Old form
* **Citric Acid**	10 Gm.	146 grains
Distilled Water	10 Cc.	2½ fl. dr.
Tincture of Fresh Lemon Peel	10 Cc.	2½ fl. dr.
Syrup, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Citric Acid in the Distilled Water and mix the solution with 500 Cc. [old form 1 pint] of Syrup, then add the Tincture of Fresh Lemon Peel, and lastly enough Syrup to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

SYRUPUS ACIDI HYDRIODICI. U.S. Syrup of Hydriodic Acid

A syrupy liquid containing about 1 percent., by weight, of absolute Hydriodic Acid [$HI = 126.9$], or about 1.19 Gm. in 100 Cc.

	Metric	Old form
* **Diluted Hydriodic Acid**	100 Gm.	3 fl. oz. 3 fl. dr.
Water	300 Gm.	11 fl. oz. 2 fl. dr.
Syrup	600 Gm.	17 fl. oz. 3 fl. dr.
To make	1000 Gm.	2 pints

Mix them.

(For tests and comments, see Part III.)

SYRUPUS AMYGDALÆ. U.S. Syrup of Almond

	Metric	Old form
* **Spirit of Bitter Almond**	10 Cc.	154 minims
Orange Flower Water	100 Cc.	3 fl. oz. 96 min.
Syrup, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix them.

Average dose.— 1 fluidrachm (4 Cc.).

SYRUPUS AURANTII. U.S. Syrup of Orange

	Metric	Old form
* **Tincture of Sweet Orange Peel**	50 Cc.	1 fl. oz. 288 min.
Citric Acid	5 Gm.	73 grains
Magnesium Carbonate	10 Gm.	146 grains
Sugar	820 Gm.	27 oz. av. 163 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Magnesium Carbonate in a mortar with the Tincture, add gradually 400 Cc. [old form 12 fl. oz. 384 min.] of Water, filter, and add sufficient Water through the filter to obtain 450 Cc. [old form 14½ fl. oz.] of filtrate; in this dissolve the Citric Acid and Sugar by agitation without heat, and add sufficient Water to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

SYRUPUS AURANTII FLORUM. U.S. Syrup of Orange Flowers

	Metric	Old form
* **Sugar**	850 Gm.	28 oz. av. 164 gr.
Orange Flower Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Sugar in 450 Cc. [old form 14½ fl. oz.] of Orange Flower Water by agitation, without heat, add enough Orange Flower Water to make the product measure 1000 Cc. [old form 2 pints], and mix thoroughly.

Syrup of Orange Flowers may also be prepared in the following manner:

Prepare a percolator or funnel in the manner described under *Syrupus.* Pour 450 Cc. [old form 14½ fl. oz.] of Orange Flower Water upon the Sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by Orange Flower Water, until the product measures 1000 Cc. [old form 2 pints]. Mix thoroughly.

SYRUPUS CALCII LACTOPHOSPHATIS. U.S. Syrup of Calcium Lactophosphate

	Metric	Old form
* **Precipitated Calcium Carbonate**	25 Gm.	365 grains
Lactic Acid	60 Cc.	1 fl. oz. 442 min.
Phosphoric Acid	36 Cc.	1 fl. oz. 73 min.
Orange Flower Water	50 Cc.	1 fl. oz. 288 min.
Sugar	725 Gm.	24 oz. av. 88 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

To the Lactic Acid mixed with 100 Cc. [old form 3 fl. oz. 96 min.] of Water and contained in a capacious mortar, gradually add the Calcium Carbonate, in portions, stirring until it is dissolved. Then add the Phosphoric Acid, diluted with 50 Cc. [old form 1 fl. oz. 300 min.] of Water, and triturate until the precipitate first formed is dissolved. Add 100 Cc. [old form 3 fl. oz. 96 min.] of Water, and filter, rinsing the mortar with 50 Cc. [old form 1 fl. oz. 300 min.] of Water, and passing the rinsings through the filter. To the mixed filtrates add the Orange Flower Water, and, having added the Sugar, dissolve it by agitation, without heat, and strain. Lastly, pass enough Water through the strainer to make the product measure 1000 Cc. [old form 2 pints], and mix thoroughly.

Average dose.— 2 fluidrachms (8 Cc.).

SYRUPUS CALCIS. U.S. Syrup of Lime. Syrup of Calcium Hydroxide

	Metric	Old form
* **Lime**	65 Gm.	2 oz. av. 74 gr.
Sugar	350 Gm.	11 oz. av. 300 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Slake the Lime by the addition of 35 Cc. [old form 1 fl. oz. 60 min.] of Water with the aid of heat, then mix it and the Sugar thoroughly in a mortar, so as to form a homogeneous powder; add the mixture to 500 Cc. [old form 1 pint] of boiling Water, contained in a bright copper or tinned-iron vessel, and boil for five minutes, constantly stirring. Dilute the liquid with sufficient Water to make it measure 950 Cc. [old form 31 fl. oz.], and filter through white paper, closely covering the funnel during filtration. Then add through the filter enough Water to make the product measure 1000 Cc. [old form 2 pints], and mix thoroughly.

Keep the Syrup in well-stoppered bottles.

(For tests and comments, see Part III.)

SYRUPUS FERRI IODIDI. U.S. Syrup of Ferrous Iodide

A syrupy liquid containing about 5 percent., by weight, of Ferrous Iodide [$FeI_2 = 307.30$], or about 6.74 Gm. in 100 Cc.

	Metric	Old form
* **Iron**, in the form of fine, bright wire, and cut into small pieces	12.5 Gm.	246 gr.
Iodine	41.5 Gm.	1 oz. av. 380 gr.
Diluted Hypophosphorous Acid	20.0 Cc.	414 minims
Sugar	600.0 Gm.	26 oz. av. 428 gr.
Distilled Water, a sufficient quantity,		
To make	1000 Gm.	2 pints

Introduce the Iron into a flask of thin glass, having a capacity of about 500 Cc. [old form 1 pint], add to it 150 Cc. [old form 6½ fl. oz.] of Distilled Water, and afterwards the Iodine. Shake the mixture occasionally, checking the reaction, if necessary, by the affusion of cold water, and, when the solution has acquired a greenish color, and has lost the odor of Iodine, heat it to boiling and add at once 50 Gm. [old form 2 oz. av. 111 gr.] of the Sugar; when this has dissolved, filter the solution into the remainder of the Sugar contained in a porcelain dish. Rinse the flask and Iron Wire with 125 Cc. [old form 5 fl. oz.] of Distilled Water and pass the washings through the filter into the Sugar. Stir the mixture with a porcelain or wooden spatula, heating the liquid on a water-bath until complete solution is effected, and, having passed the syrup through a clean muslin strainer into a tared bottle, add the Diluted Hypophosphorous Acid, and sufficient Distilled Water to make the product weigh 1000 Gm. [old form, or measure, 2 pints].

(For tests and comments, see Part III.)

SYRUPUS FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U.S. Syrup of the Phosphates of Iron, Quinine and Strychnine

[Easton's Syrup]

	Metric	Old form
* **Glycerite of the Phosphates of Iron, Quinine and Strychnine**	250 Cc.	8 fl. oz.
Syrup, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix them. Strain, if necessary.

Average dose.—1 fluidrachm (4 Cc.).

SYRUPUS HYPOPHOSPHITUM. U.S. Syrup of Hypophosphites

	Metric	Old form
* **Calcium Hypophosphite**	45 Gm.	1 oz. av. 220 gr.
Potassium Hypophosphite	15 Gm	219 grains
Sodium Hypophosphite	15 Gm.	219 grains
Diluted Hypophosphorus Acid	2 Gm.	30 minims
Sugar	650 Gm.	21 oz. av. 305 gr.
Tincture of Fresh Lemon Peel	5 Cc.	77 minims
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Hypophosphites with 450 Cc. [old form 14½ fl. oz.] of Water, until they are dissolved, add the Tincture of Fresh Lemon Peel, and the Hypophosphorous Acid, and filter the liquid. In the filtrate dissolve the Sugar by agitation, without heat, and add enough Water, through the filter, to make the product measure 1000 Cc. [old form 2 pints]. Strain, if necessary.

Syrup of Hypophosphites may also be prepared in the following manner :

Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the filtrate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 2 fluidrachms (8 Cc.).

SYRUPUS HYPOPHOSPHITUM COMPOSITUS. U.S. Compound Syrup of Hypophosphites

	Metric	Old form
* **Calcium Hypophosphite**	35.00 Gm.	1 oz. av. 74 gr.
Potassium Hypophosphite	17.50 Gm.	255 grains
Sodium Hypophosphite	17.50 Gm.	255 grains
Ferric Hypophosphite	2.25 Gm.	33 grains
Manganese Hypophosphite	2.25 Gm.	33 grains
Quinine	1.10 Gm.	16 grains
Strychnine	0.115 Gm.	1$\frac{7}{10}$ grains
Sodium Citrate	3.75 Gm.	56 grains
Diluted Hypophosphorous Acid	15.00 Cc.	230 minims
Sugar	775.00 Gm.	25 oz. av. 90 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Rub the Ferric and Manganese Hypophosphites with the Sodium Citrate, add 30 Cc. [old form 460 min.] of Water and warm the mixture for a few minutes, until a clear greenish solution is obtained. Dissolve the Calcium, Potassium, and Sodium Hypophosphites in 400 Cc. [old form 12 fl. oz., 384 min.] of Water to which 5 Cc. [old form 77 min.] of Diluted Hypophosphorous Acid has previously been added; then dissolve the Quinine and Strychnine in 30 Cc. [old form 460 min.] of Water with the aid of 10 Cc. [old form 154 min.] of Diluted Hypophosphorous Acid, and finally dissolve the Sugar, with agitation, in these solutions, previously mixed.

Strain the Syrup, if necessary, and add sufficient Water, through the strainer, to make the product measure 1000 Cc. [old form 2 pints].

Average dose.— 2 fluidrachms (8 Cc.).

SYRUPUS IPECACUANHÆ. U.S. Syrup of Ipecac

	Metric	Old form
* **Fluidextract of Ipecac**	70 Cc.	2 fl. oz. 115 min.
Acetic Acid	10 Cc.	154 minims
Glycerin	100 Cc.	3 fl. oz. 96 min.
Sugar	700 Gm.	23 oz. av. 160 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dilute the Fluidextract of Ipecac with 300 Cc. [old form 9 fl. oz. 288 min.] of Water to which the Acetic Acid has previously been added, and mix them thoroughly by shaking; set the liquid aside in a cool place for twenty-four hours. Then filter, and pass enough Water through the filter to obtain 450 Cc. [old form 14½ fl. oz.] of filtrate. To this liquid add the Glycerin, dissolve the Sugar in the mixture, and add enough Water to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly, and strain, if necessary.

Syrup of Ipecac may also be prepared in the following manner:

Prepare a percolator or funnel in the manner described under *Syrupus.*

Mix the filtrate obtained as directed in the preceding formula with the Glycerin, pour the mixture upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— { Expectorant, 15 minims (1 Cc.).
Emetic, 4 fluidrachms (15 Cc.).

SYRUPUS KRAMERIÆ. U.S. Syrup of Krameria

	Metric	Old form
* **Fluidextract of Krameria**	450 Cc.	14 fl. oz. 3 fl. dr.
Syrup	550 Cc.	17 fl. oz. 5 fl. dr.
To make	1000 Cc.	2 pints

Mix them.

Average dose.— 1 fluidrachm (4 Cc.).

SYRUPUS LACTUCARII. U.S. Syrup of Lactucarium

	Metric	Old form
* **Tincture of Lactucarium**	100 Cc.	3 fl. oz. 96 min.
Glycerin	200 Cc.	6 fl. oz. 192 min.
Citric Acid	1 Gm.	15 grains
Orange Flower Water	50 Cc.	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Tincture of Lactucarium with the Glycerin, add the Orange Flower Water in which the Citric Acid has been previously dissolved, and filter, if necessary. Finally, add a sufficient quantity of Syrup to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 2 fluidrachms (8 Cc.).

SYRUPUS PICIS LIQUIDÆ. U.S. Syrup of Tar

	Metric	Old form
***Tar**	5 Gm.	73 grains
Alcohol	50 Cc.	1 fl. oz. 288 min.
Magnesium Carbonate	10 Gm.	146 grains
Sugar	850 Gm.	28 oz. av. 164 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Tar intimately, in a mortar, with 10 Gm. [old form 146 gr.] of clean white sand, add 100 Cc. [old form 3 fl. oz. 96 min.] of Water, and, after kneading the mass thoroughly with the pestle, pour off the Water and throw it away. Treat the residue with the Alcohol, and, when the Tar is dissolved, add the Magnesium Carbonate and 50 Gm. [old form 1 oz. av. 293 gr.] of Sugar, and after thorough trituration add 400 Cc. [old form 12 fl. oz. 384 min.] of Water; stir the mixture occasionally during two hours, and filter. Dissolve the remainder of the Sugar in the clear filtrate by gentle heat, strain, and add sufficient Water to make the product measure 1000 Cc. [old form 2 pints].

Average dose.— 1 fluidrachm (4 Cc.).

SYRUPUS PRUNI VIRGINIANÆ. U.S. Syrup of Wild Cherry

	Metric	Old form
***Wild Cherry,** in No. 20 powder	150 Gm.	5 oz. av.
Sugar	700 Gm.	23 oz. av. 160 gr.
Glycerin	150 Cc.	4 fl. oz. 384 min.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Wild Cherry with a sufficient quantity of Water, and macerate for twenty-four hours in a covered vessel; introduce the Glycerin into a graduated receiving bottle; pack the Wild Cherry firmly in a cylindrical percolator, and gradually pour Water upon it; continue the percolation (shaking the percolate occasionally with the Glycerin), until the liquid measures 450 Cc. [old form 14½ fl. oz.]. Dissolve the Sugar in the liquid by agitation, without heat, strain, and pass enough Water through the strainer to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Syrup of Wild Cherry may also be prepared in the following manner:

Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the percolate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 1 fluidrachm (4 Cc.).

SYRUPUS RHEI. U.S. Syrup of Rhubarb

	Metric	Old form
***Fluidextract of Rhubarb**	100 Cc.	3 fl. oz. 96 min.
Spirit of Cinnamon	4 Cc.	1 fl. dr.
Potassium Carbonate	10 Gm.	146 grains
Water	50 Cc.	1 fl. oz. 288 min.
Syrup, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Spirit of Cinnamon with the Fluidextract of Rhubarb, and add to it the Potassium Carbonate previously dissolved in the Water, and lastly enough Syrup to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 2 fluidrachms (8 Cc.).

SYRUPUS RHEI AROMATICUS. U.S. Aromatic Syrup of Rhubarb

	Metric	Old form
* **Aromatic Tincture of Rhubarb**	150 Cc.	4 fl. oz. 384 min.
Potassium Carbonate	1 Gm.	15 grains
Syrup	850 Cc.	27 fl. oz. 96 min.
To make	1000 Cc.	2 pints

Dissolve the Potassium Carbonate in the Aromatic Tincture of Rhubarb. Filter, if necessary, and add sufficient Syrup to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 2 fluidrachms (8 Cc.).

SYRUPUS ROSÆ. U.S. Syrup of Rose

	Metric	Old form
* **Fluidextract of Rose**	125 Cc.	4 fl. oz.
Diluted Sulphuric Acid	10 Cc.	154 minims
Sugar	750 Gm.	25 oz. av.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Fluidextract of Rose and Diluted Sulphuric Acid with 300 Cc. [old form 9 fl. oz. 288 min.] of Water ; after allowing the mixture to stand two hours, filter, and dissolve the Sugar in the clear filtrate, by agitation. Finally, add a sufficient quantity of Water to make the product measure 1000 Cc. [old form 2 pints]. Strain, if necessary.

SYRUPUS RUBI. U.S. Syrup of Rubus

	Metric	Old form
* **Fluidextract of Rubus**	250 Cc.	8 fl. oz.
Syrup	750 Cc.	24 fl. oz.
To make	1000 Cc.	2 pints

Mix them.

Average dose.— 1 fluidrachm (4 Cc.).

SYRUPUS SARSAPARILLÆ COMPOSITUS. U.S. Compound Syrup of Sarsaparilla

	Metric	Old form
* **Fluidextract of Sarsaparilla**	200.0 Cc.	6½ fl. oz.
Fluidextract of Glycyrrhiza	15.0 Cc.	½ fl. oz.
Fluidextract of Senna	15.0 Cc.	½ fl. oz.
Sugar	650.0 Gm.	21 oz. av. 305 gr.
Oil of Sassafras	0.2 Cc.	4 drops
Oil of Anise	0.2 Cc.	4 drops
Oil of Gaultheria	0.2 Cc.	4 drops
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Add the Oils (equivalent to about *four drops* each) to the mixed Fluidextracts and shake the liquid thoroughly. Then add enough

Water to make up the volume to 600 Cc. [old form 19 fl. oz.], and mix well. Set the mixture aside for one hour, and then filter it. Dissolve the Sugar in the filtrate with the aid of a gentle heat, allow the liquid to cool, strain, and add enough Water, through the strainer, to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 4 fluidrachms (16 Cc.).

SYRUPUS SCILLÆ. U.S. Syrup of Squill

	Metric	Old form
***Vinegar of Squill**	**450 Cc.**	14½ fl. oz.
Sugar	**800 Gm.**	26 oz. av. 309 gr.
Water, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Dissolve the Sugar in the Vinegar of Squill with the aid of a gentle heat, then strain, and, when the strained liquid is cold, add enough Water, through the strainer, to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 30 minims (2 Cc.).

SYRUPUS SCILLÆ COMPOSITUS. U.S. Compound Syrup of Squill

[HIVE SYRUP]

	Metric	Old form
***Fluidextract of Squill**	**80 Cc.**	2 fl. oz. 4½ fl. dr.
Fluidextract of Senega	**80 Cc.**	2 fl. oz. 4½ fl. dr.
Antimony and Potassium Tartrate	**2 Gm.**	29 grains
Purified Talc	**20 Gm.**	292 grains
Sugar	**750 Gm.**	25 oz. av.
Water, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Mix the Fluidextracts, evaporate them, in a tared dish, on a water-bath, to 100 Gm. [old form 3 oz. av. 148 gr.], and mix the residue with 350 Cc. [old form 11 fl. oz.] of Water. When the mixture is cold, incorporate with it, intimately, the Purified Talc, filter, pass enough Water through the filter to obtain 400 Cc. [old form 12 fl. oz. 6½ fl. dr.] of clear filtrate, and add to this the Antimony and Potassium Tartrate previously dissolved in 25 Cc. [old form 6½ fl. dr.] of hot Water. Dissolve the Sugar in this liquid by agitation, without heat, strain, and add enough Water, through the strainer, to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Compound Syrup of Squill may also be prepared in the following manner:

Prepare a percolator or funnel in the manner described under *Syrupus*. Pour the filtrate obtained as directed in the preceding formula, and mixed with the solution of Antimony and Potassium Tartrate, upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 30 minims (2 Cc.).

SYRUPUS SENEGÆ. U.S. Syrup of Senega

	Metric	Old form
***Fluidextract of Senega**	200 Cc.	6 fl. oz. 192 min.
Syrup	800 Cc.	25 fl. oz. 288 min.
To make	1000 Cc.	2 pints

Mix them.

Average dose.— 1 fluidrachm (4 Cc.).

SYRUPUS SENNÆ. U.S. Syrup of Senna

	Metric	Old form
***Fluidextract of Senna**	250 Cc.	8 fl. oz.
Oil of Coriander	5 Cc.	77 minims
Syrup, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Oil of Coriander with the Fluidextract of Senna and add a sufficient quantity of Syrup to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 1 fluidrachm (4 Cc.).

SYRUPUS TOLUTANUS. U.S. Syrup of Tolu

	Metric	Old form
***Tincture of Tolu**	50 Cc.	1 fl. oz. 288 min.
Magnesium Carbonate	10 Gm.	146 grains
Sugar	820 Gm.	27 oz. av. 163 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Rub the Tincture of Tolu, in a mortar, with the Magnesium Carbonate and 60 Gm. [old form 2 oz. av.] of the Sugar. Then gradually add 450 Cc. [old form 14½ fl. oz.] of Water, with constant trituration, and filter. Dissolve the remainder of the Sugar in the clear filtrate, with the aid of a gentle heat, strain the Syrup while hot, and add a sufficient quantity of Water to make the product measure 1000 Cc. [old form 2 pints].

Syrup of Tolu may also be made in the following manner:

Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the filtrate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 4 fluidrachms (16 Cc.).

SYRUPUS ZINGIBERIS. U.S. Syrup of Ginger

	Metric	Old form
***Fluidextract of Ginger**	30 Cc.	461 minims
Alcohol	20 Cc.	307 minims
Magnesium Carbonate	10 Gm.	146 grains
Sugar	820 Gm.	27 oz. av. 163 gr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Fluidextract of Ginger and the Alcohol, then triturate the liquid in a mortar with the Magnesium Carbonate and 60 Gm. [old form 2 oz. av.] of the Sugar. Then gradually add 450 Cc. [old form 14½ fl. oz.] of Water, with constant trituration, and filter. Dissolve the remainder of the Sugar in the clear filtrate, with the aid of a gentle heat, strain the Syrup while hot, and add a sufficient quantity of Water to make the product measure 1000 Cc. [old form 2 pints].

Syrup of Ginger may also be made in the following manner:

Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the filtrate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and when all the liquid has passed, follow it with Water, until the product measures 1000 Cc. [old form 2 pints]. Mix thoroughly.

Average dose.— 4 fluidrachms (16 Cc.).

Mellita *Honeys*

Official honeys are thick liquid preparations closely allied to the syrups, differing merely in the use of honey as a base, instead of syrup. Their advantages over syrups are not very apparent, particularly since of late years the difficulty of obtaining pure honey has greatly increased. *Three* honeys are official.

Official Honeys

Name	Proportions and definition	Preparation
Mel	Commercial Honey	A saccharine secretion deposited in the honeycomb by *Apis mellifera*
Depuratum	Clarified Honey	Heat Honey, mixed with paper-pulp, over a water-bath, remove the scum and strain; then mix with 5 percent. of its weight of Glycerin
Rosæ	120 Cc. Fluidextract of Rose and enough Clarified Honey to make 1000 Gm.	Mix thoroughly

Unofficial Honey

Name	Proportions and definition	Preparation
Mel Boracis. Br.	50 Gm. Borax, in fine powder; 25 Gm. Glycerin; 400 Gm. Clarified Honey	Mix them

MEL DEPURATUM. U.S. Clarified Honey

[Mel Despumatum, Pharm. 1890]

* **Honey,** a convenient quantity
Distilled Water,
Glycerin, each, a sufficient quantity

Mix the Honey intimately with 2 percent. of its weight of paper pulp, which has been previously reduced to shreds, thoroughly washed and soaked in water, and then strongly expressed and again shredded. Then apply the heat of a water-bath, and as long as any scum rises to the surface, carefully remove this. Finally, add enough Distilled Water to make up the loss incurred by evaporation, strain, and mix the strained liquid with 5 percent. of its weight of glycerin.

Clarified Honey should conform to the tests of purity given under *Mel.*

MEL ROSÆ. U.S. **Honey of Rose**

	Metric	Old form
* **Fluidextract of Rose**	120 Cc.	5 fl. oz.
Clarified Honey, a sufficient quantity,		
To make	1000 Gm.	2 pints

Into a tared vessel introduce the Fluidextract of Rose, then add enough Clarified Honey to make the contents weigh 1000 Gm. [or to measure, old form, 2 pints], and mix thoroughly.

Average dose.— 1 fluidrachm (4 Cc.).

Mucilagines *Mucilages*

The official mucilages are thick, viscid, adhesive liquids, produced by dissolving gum in water, or by extracting with water the mucilaginous principles from vegetable substances. There are *four* official mucilages. *Two* are made without the application of heat, and *two* with heat. The mucilages are all prone to decomposition, and should never be made in larger quantities than can be used immediately.

Official Mucilages

Name	Proportions		Process
Mucilago Acaciæ	340 Gm. Acacia; 330 Gm. Lime Water; Water sufficient to make 1000 Gm.	Without heat	Wash the Acacia with cold water; then add the Lime Water and enough Water to make the mixture weigh 1000 Gm.; agitate until dissolved, and strain
Sassafras Medullæ	2 Gm. Sassafras Pith; Water to make 100 Cc.		Macerate for three hours, and strain without expression
Tragacanthæ	6 Gm. Tragacanth; 18 Gm. Glycerin; Water sufficient to make 100 Gm.	With heat	Mix the Glycerin with 75 Cc. Water, heat to boiling, add the Tragacanth, macerate for twenty-four hours with stirring. Then add enough Water to make the mixture weigh 100 Gm.; strain forcibly through muslin
Ulmi	6 Gm. Elm; Water 100 Cc.		Digest the Elm with the Water, on a water-bath, in a covered vessel, during one hour, then strain

MUCILAGO ACACIÆ. U.S. **Mucilage of Acacia**

	Metric	Old form
* **Acacia,** in small fragments	340 Gm.	12 oz. av. 392 gr.
Lime Water	330 Gm.	11 fl. oz.
Water, a sufficient quantity,		
To make	1000 Gm.	2 pints

Wash the Acacia with cold Water, and allow it to drain. Add the Lime Water to it, and enough Water to make the mixture weigh 1000 Gm. [or measure, old form, 2 pints], agitate or stir it occasionally until the Acacia is dissolved, and strain. Keep the product in well-stoppered, completely filled bottles, in a cool place.

Average dose.— 4 fluidrachms (16 Cc.).

MUCILAGO SASSAFRAS MEDULLÆ. U.S. **Mucilage of Sassafras Pith**

	Metric	Old form
* **Sassafras Pith**	2 Gm.	27 grains
Water	100 Cc.	3 fl. oz.

Macerate the Sassafras Pith in the Water during three hours, and strain without expression. This preparation should be freshly made when wanted.

Average dose.— 4 fluidrachms (16 Cc.).

MUCILAGO TRAGACANTHÆ. U.S. Mucilage of Tragacanth

	Metric	Old form
***Tragacanth**	6 Gm.	90 grains
Glycerin	18 Gm.	½ fl. oz.
Water, a sufficient quantity,		
To make	100 Gm.	about 4 fl. oz.

Mix the Glycerin with 75 Cc. [old form 2½ fl. oz.] of Water in a tared vessel, heat the mixture to boiling, add the Tragacanth, and macerate during twenty-four hours, stirring occasionally. Then add enough Water to make the mixture weigh 100 Gm. [or measure, old form, about 4 fl. oz.], beat it until it has a uniform consistence, and strain it forcibly through muslin.

Average dose.— 4 fluidrachms (16 Cc.).

MUCILAGO ULMI. U.S. Mucilage of Elm

	Metric	Old form
***Elm,** bruised	6 Gm.	82 grains
Water	100 Cc.	3 fl. oz.

Digest the Elm with the Water, on a water-bath, in a covered vessel, during one hour, then strain. This preparation should be freshly made when wanted.

Average dose.— 4 fluidrachms (16 Cc.).

Emulsa *Emulsions*

The U. S. Pharmacopœia of 1890 introduced emulsions as a separate class of preparations; formerly they were included under the general heading of Misturæ. The necessity for differentiation in nomenclature, as preparations of established merit multiply, is apparent. Emulsions are aqueous liquids in which oleaginous substances are suspended by the intervention of gum, yolk of egg, or other viscid matter. Their method of preparation is fully considered under Part V, Extemporaneous liquids. There are *six* official emulsions.

Official Emulsions

Name	Proportions	Description
Emulsum Amygdalæ	60 Gm. Sweet Almond; 10 Gm. Acacia; 30 Gm. Sugar; Water sufficient to make 1000 Cc.	Simple seed emulsion
Asafœtidæ	40 Gm. Asafetida with 1000 Cc. Water	Simple gum-resin emulsion
Chloroformi	40 Cc. Chloroform; 60 Cc. Expressed Oil of Almond; 10 Gm. Tragacanth; Water to make 1000 Cc.	Tragacanth emulsion
Olei Morrhuæ	500 Cc. Cod Liver Oil; 125 Gm. Acacia; 100 Cc. Syrup; 4 Cc. Oil of Gaultheria; Water to make 1000 Cc.	Acacia emulsion
Olei Morrhuæ cum Hypophosphitibus	500 Cc. Cod Liver Oil; 125 Gm. Acacia; 10 Gm. Calcium Hypophosphite; 5 Gm. Potassium Hypophosphite; 5 Gm. Sodium Hypophosphite; 100 Cc. Syrup; 4 Cc. Oil of Gaultheria; Water to make 1000 Cc.	
Olei Terebinthinæ	15 Cc. Rectified Oil of Turpentine; 5 Cc. Expressed Oil of Almond; 25 Cc. Syrup; 15 Gm. Acacia; Water to make 100 Cc.	

Unofficial Emulsion

Name	Proportions	Description
Emulsum Ammoniaci. U. S. P. 1890	40 Gm. Ammoniac, with Water to make 1000 Cc.	Simple gum-resin emulsion
Mistura Ammoniaci. Br.	(See page 304)	

EMULSUM AMYGDALÆ. U. S. Emulsion of Almond

[Milk of Almond]

	Metric	Old form
* **Sweet Almond**	60 Gm.	219 grains
Acacia, in fine powder	10 Gm.	37 grains
Sugar	30 Gm.	109 grains
Water, a sufficient quantity,		
To make	1000 Cc.	8 fl. oz.

Having blanched the Almond, add the Acacia and Sugar, and beat them in a mortar, until they are thoroughly mixed. Then rub the mass with 900 Cc. [old form 7 fl. oz.] of Water, at first very gradually added, until a uniform mixture results. Strain this into a graduated vessel, and wash the mortar and strainer with enough Water to make the product measure 1000 Cc. [old form 8 fl. oz]. Mix the whole thoroughly. This Emulsion should be freshly prepared when required.

Average dose.— 4 fluidounces (120 Cc.).

EMULSUM ASAFŒTIDÆ. U.S. Emulsion of Asafetida

[Milk of Asafetida]

	Metric	Old form
* **Asafetida,** in selected tears	40 Gm.	146 grains
Water, a sufficient quantity,		
To make	1000 Cc.	8 fl. oz.

Rub the Asafetida, in a mortar, with 900 Cc. [old form 7 fl. oz.] of Water, at first very gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and rinse the mortar and strainer with enough Water to make the product measure 1000 Cc. [old form 8 fl. oz.]. Mix the whole thoroughly.

Average dose.— 4 fluidrachms (16 Cc.).

EMULSUM CHLOROFORMI. U.S. Emulsion of Chloroform

	Metric	Old form
* **Chloroform**	40 Cc.	153 minims
Expressed Oil of Almond	60 Cc.	230 minims
Tragacanth, in very fine powder	10 Gm.	37 grains
Water, a sufficient quantity,		
To make	1000 Cc.	8 fl. oz.

Introduce the Tragacanth into a perfectly dry bottle of sufficient capacity, add the Chloroform, and shake the bottle thoroughly, so that every part of the surface may become wetted. Then add about 250 Cc. [old form 2 fl. oz.] of Water, and incorporate it by vigorous shaking. Next add the Expressed Oil of Almond, in several portions, shaking after each addition, and when the Oil has been thoroughly emulsified, add enough Water, in divided portions, shaking after each addition, to make the product measure 1000 Cc. [old form 8 fl. oz.].

Average dose.— 2 fluidrachms (8 Cc.).

EMULSUM OLEI MORRHUÆ. U.S. Emulsion of Cod Liver Oil

	Metric	Old form
* **Cod Liver Oil**	500 Cc.	1 pint
Acacia, in fine powder	125 Gm.	4 oz. av. 76 gr.
Syrup	100 Cc.	3 fl. oz. 96 min.
Oil of Gaultheria	4 Cc.	1 fl. dr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Rub the Acacia with the Cod Liver Oil, in a dry mortar, until uniformly mixed, then add at once 250 Cc. [old form 8 fl. oz.] of Water and triturate lightly and rapidly until a thick homogeneous emulsion is produced; to this add the Oil of Gaultheria and the Syrup, with enough Water to make the product measure 1000 Cc. [old form 2 pints], and mix thoroughly.

NOTE.—The Oil of Gaultheria may be replaced, if desired, by a suitable quantity of Oil of Bitter Almond or other suitable flavoring.

Average dose.— 2 fluidrachms (8 Cc.).

EMULSUM OLEI MORRHUÆ CUM HYPOPHOSPHITIBUS. U.S. Emulsion of Cod Liver Oil with Hypophosphites

	Metric	Old form
* **Cod Liver Oil**	500 Cc.	1 pint
Acacia, in fine powder	125 Gm.	4 oz. av. 76 gr.
Calcium Hypophosphite	10 Gm.	146 grains
Potassium Hypophosphite	5 Gm.	73 grains
Sodium Hypophosphite	5 Gm.	73 grains
Syrup	100 Cc.	3 fl. oz. 96 min.
Oil of Gaultheria	4 Cc.	1 fl. dr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Rub the Acacia with the Cod Liver Oil, in a dry mortar, until uniformly mixed, then add at once 250 Cc. [old form 8 fl. oz.] of Water and triturate lightly and rapidly until a thick, homogeneous emulsion is produced, add the Oil of Gaultheria and incorporate thoroughly; dissolve the Hypophosphites in 100 Cc. [old form 3 fl. oz. 96 min.] of Water, mix the solution with the Syrup, and add the liquid gradually to the emulsion with continued trituration. Lastly, add enough Water to make the product measure 1000 Cc. [old form 2 pints], and mix thoroughly.

NOTE.—The Oil of Gaultheria may be replaced, if desired, by a suitable quantity of Oil of Bitter Almond or other suitable flavoring.

Average dose.— 2 fluidrachms (8 Cc.).

EMULSUM OLEI TEREBINTHINÆ. U.S. Emulsion of Oil of Turpentine

	Metric	Old form
* **Rectified Oil of Turpentine**	15 Cc.	1 fl. oz. 96 min.
Expressed Oil of Almond	5 Cc.	192 min.
Syrup	25 Cc.	2 fl. oz.
Acacia, in fine powder	15 Gm.	1 oz. av. 110 gr.
Water, a sufficient quantity,		
To make	100 Cc.	8 fl. oz.

Introduce the Acacia into a perfectly dry bottle of sufficient capacity, add the Rectified Oil of Turpentine and the Expressed Oil of Almond, and shake the bottle thoroughly. Then add about 30 Cc. [old form $2\frac{3}{4}$ fl. oz.] of Water and incorporate it by vigorous shaking. When the Oil has been completely emulsified, add first the Syrup, in several portions, shaking after each addition, and then enough Water, in divided portions, shaking after each addition, to make the product measure 100 Cc. [old form 8 fl. oz.].

Average dose.— 1 fluidrachm (4 Cc.).

Misturæ *Mixtures*

Mixtures, in a properly restricted sense, are aqueous liquid preparations intended for internal use, which contain suspended insoluble substances. The main object in introducing this class into the Pharmacopœia was to secure uniformity in the formulas of certain well-known and largely used preparations. They are not permanent, as a rule, and it is not wise to keep them on hand for any considerable length of time. They belong properly under the head of Extemporaneous Preparations. (See Mixtures, Part V.) There are *four* official mixtures.

Official Mixtures

Name	Proportions	Description
Mistura Cretæ	20 Gm. Compound Chalk Powder; 40 Cc. Cinnamon Water; Water to make 100 Cc.	Mixtures containing insoluble powders in suspension
Ferri Composita	6 Gm. Ferrous Sulphate; 8 Gm. Potassium Carbonate; 18 Gm. Myrrh; 18 Gm. Sugar; 60 Cc. Spirit of Lavender; Rose Water to make 1000 Cc.	
Glycyrrhizæ Composita	30 Gm. Pure Extract of Glycyrrhiza; 50 Cc. Syrup; 30 Gm. Acacia; 120 Cc. Camphorated Tincture of Opium; 60 Cc. Wine of Antimony; 30 Cc. Spirit of Nitrous Ether; Water to make 1000 Cc.	
Rhei et Sodæ	35 Gm. Sodium Bicarbonate; 15 Cc. Fluidextract of Rhubarb; 3 Cc. Fluidextract of Ipecac; 350 Cc. Glycerin; 35 Cc. Spirit of Peppermint; Water to make 1000 Cc.	Mixture not containing insoluble powders in suspension

Unofficial Mixtures[1]

Name	Ingredients	Method of Preparation
Mistura Ammoniaci. Br.	5 Gm. Ammoniacum, in coarse powder; 10 Cc. Syrup of Tolu; 150 Cc. Distilled Water	Form a smooth mixture, by triturating the Ammoniacum with a little Water, and gradually add the remainder of the Distilled Water and Syrup of Tolu
Creosoti. Br.	1 Cc. Creosote; 1 Cc. Spirit of Juniper; 30 Cc. Syrup; Distilled Water to make 480 Cc.	Shake the Creosote with 420 Cc. of Water; add the other ingredients and enough Distilled Water to make 480 Cc.
Guaiaci. Br.	10 Gm. Guaiacum Resin; 10 Gm. Sugar; 1.6 Gm. Tragacanth; 400 Cc. Cinnamon Water	Triturate the Guaiacum Resin with the Sugar and the Tragacanth, and gradually add the Cinnamon Water
Olei Ricini. Br.	75 Cc. Castor Oil; 37.5 Cc. Mucilage of Gum Acacia; 25 Cc. Stronger Orange Flower Water; 62.5 Cc. Cinnamon Water	Add the Castor Oil and the mixed Waters, alternately, to the Mucilage, contained in a mortar, triturating constantly

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[1] In the British Pharmacopœia (1898) preparations are included in the class Misturæ which should more properly be placed under the head Emulsa.

Unofficial Mixtures—*Continued*

Name	Ingredients	Method of Preparation
Sennæ Composita. Br.	250 Gm. Magnesium Sulphate; 50 Cc. Liquid Extract of Liquorice; 100 Cc. Compound Tincture of Cardamoms; 50 Cc. Aromatic Spirit of Ammonia; Infusion of Senna to make 1000 Cc.	Dissolve the Magnesium Sulphate in 500 Cc. Infusion of Senna, add the other ingredients and enough Infusion of Senna to make 1000 Cc.
Spiritus Vini Gallici. Br.	113 Cc. Brandy; 113 Cc. Cinnamon Water; 14 Gm. Sugar; 2 yolks of eggs	Rub the yolks of eggs and Sugar together; add the Cinnamon Water and Brandy, and mix

MISTURA CRETÆ. U.S. Chalk Mixture

	Metric	Old form
* **Compound Chalk Powder**	20 Gm.	365 grains
Cinnamon Water	40 Cc.	1½ fl. oz.
Water, a sufficient quantity,		
To make	100 Cc.	4 fl. oz.

Rub the Compound Chalk Powder, in a mortar, with the Cinnamon Water and about 20 Cc. [old form 6 fl. dr.] of Water gradually added, to a uniform mixture; transfer this to a graduated vessel, and rinse the mortar with enough Water to make the product measure 100 Cc. [old form 4 fl. oz.]. Mix the whole thoroughly. This preparation should be freshly made when wanted.

Average dose.— 4 fluidrachms (16 Cc.).

MISTURA FERRI COMPOSITA. U.S. Compound Iron Mixture

[Griffith's Mixture]

	Metric	Old form
* **Ferrous Sulphate,** in clear crystals	6 Gm.	11 grains
Myrrh, in small pieces	18 Gm.	33 grains
Sugar	18 Gm.	33 grains
Potassium Carbonate	8 Gm.	15 grains
Spirit of Lavender	60 Cc.	2 fl. dr.
Rose Water, a sufficient quantity,		
To make	1000 Cc.	4 fl. oz.

Rub the Myrrh, Sugar, and Potassium Carbonate, in a mortar, with 700 Cc. [old form 2½ fl. oz.] of Rose Water, at first very gradually added, so that a uniform mixture may result. Transfer this to a graduated vessel, add the Spirit of Lavender, then the Ferrous Sulphate, previously dissolved in about 50 Cc. [old form 1½ fl. dr.] of Rose Water, and, lastly, enough Rose Water to make the product measure 1000 Cc. [old form 4 fl. oz.]. Mix the whole thoroughly. This preparation should be freshly made when wanted.

Average dose.— 4 fluidrachms (16 Cc.).

MISTURA GLYCYRRHIZÆ COMPOSITA. U.S. Compound Mixture of Glycyrrhiza

[Brown Mixture]

	Metric	Old form
* **Pure Extract of Glycyrrhiza**	30 Gm.	1 oz. av.
Syrup	50 Cc.	1½ fl. oz.
Acacia, granulated	30 Gm.	1 oz. av.
Camphorated Tincture of Opium	120 Cc.	3 fl. oz. 7 fl. dr.
Wine of Antimony	60 Cc.	1 fl. oz. 442 min.
Spirit of Nitrous Ether	30 Cc.	460 min.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Rub the Pure Extract of Glycyrrhiza and Acacia, in a mortar, with 500 Cc. [old form 1 pint] of Water, until they are dissolved. Transfer the solution to a graduated vessel containing the other ingredients, and rinse the mortar with enough Water to make the product measure 1000 Cc. [old form 2 pints]. Mix the whole thoroughly.

Average dose.— 2 fluidrachms (8 Cc.).

MISTURA RHEI ET SODÆ. U.S. Mixture of Rhubarb and Soda

	Metric	Old form
* **Sodium Bicarbonate**	35 Gm.	1 oz. av. 74 gr.
Fluidextract of Rhubarb	15 Cc.	230 minims
Fluidextract of Ipecac	3 Cc.	46 minims
Glycerin	350 Cc.	11 fl. oz. 96 min.
Spirit of Peppermint	35 Cc.	1 fl. oz. 1 fl. dr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Sodium Bicarbonate in about 400 Cc. [old form 13 fl. oz.] of Water. Then add the Fluidextracts, the Glycerin, and the Spirit of Peppermint, and, lastly, enough Water to make the product measure 1000 Cc. [old form 2 pints].

Average dose.— 1 fluidrachm (4 Cc.).

Glycerita *Glycerites*

Glycerites are mixtures of medicinal substances with glycerin. Glycerin is a valuable solvent, and one of the principal advantages of the glycerites is that they afford a rapid and simple method of making aqueous solutions of substances which are not otherwise easily soluble. The solutions of phenol, gallic acid, tannic acid, tar, etc., in glycerin are permanent preparations, and they could be made very concentrated if necessary ; the ease with which they can be diluted with water or alcohol, without precipitation, renders such glycerites especially useful at the prescription counter. *Five* glycerites formerly official and *one* new one (Glycerite of the Phosphates of Iron, Quinine and Strychnine) were admitted to the U. S. P. (8th Rev.).

Official Glycerites

Name	Proportion
Glyceritum Acidi Tannici	20 Gm. Tannic Acid ; 80 Gm. Glycerin
Amyli	10 Gm. Starch ; 80 Gm. Glycerin ; 10 Cc. Water. (A translucent jelly)
Boroglycerini	310 Gm. Boric Acid ; 960 Gm. Glycerin
Ferri, Quininæ et Strychninæ Phosphatum	80 Gm. Soluble Ferric Phosphate ; 104 Gm. Quinine ; 0.8 Gm. Strychnine ; 200 Cc. Phosphoric Acid ; 500 Cc. Glycerin ; Water to make 1000 Cc.
Hydrastis	1000 Gm. Hydrastis ; 500 Cc. Glycerin ; Alcohol and Water to make 1000 Cc.
Phenolis	20 Cc. Liquefied Phenol ; 80 Cc. Glycerin

Unofficial Glycerites

Name	Ingredients	Method of Preparation
Glyceritum Aluminis. Br.	20 Gm. Alum; 7.5 Cc. Distilled Water; 120 Cc. Glycerin	Effect solution, warming slightly if necessary, set aside and pour off the clear liquid
Boracis. Br.	20 Gm. Borax; 120 Cc. Glycerin	Triturate together until dissolved
Pepsini. Br.	80 Gm. Pepsin; 10 Cc. Hydrochloric Acid; 525 Cc. Glycerin; Distilled Water to make 875 Cc.	Mix the Acid, Glycerin, and 260 Cc. of the Water, add the Pepsin, and set aside for one week. Then filter and add Distilled Water to filtrate to make 875 Cc.
Plumbi Subacetatis. Br.	100 Gm. Lead Acetate; 70 Gm. Lead Oxide; 400 Cc. Glycerin; 240 Cc. Distilled Water	Mix, boil for fifteen minutes, filter, and evaporate, at a temperature not exceeding 105.5° C. (222° F.), until the product weighs 655 Gm.
Tragacanthæ. Br.	10 Gm. Tragacanth, in powder; 30 Cc. Glycerin; 10 Cc. Distilled Water	Mix the Glycerin and Tragacanth, add the Distilled Water, and triturate until homogeneous
Vitelli. U.S. P. 1890	45 Gm. Fresh Yolk of Egg; 55 Gm. Glycerin	Triturate together, in a mortar, until thoroughly mixed

GLYCERITUM ACIDI TANNICI. U.S. Glycerite of Tannic Acid

	Metric	Old form
***Tannic Acid**	20 Gm.	4 oz. av
Glycerin	80 Gm.	16 oz. av.
To make	100 Gm.	20 oz. av.

Triturate the Tannic Acid with the Glycerin to a smooth paste, transfer this to a porcelain dish, avoiding contact with metallic utensils, and apply the heat of a water-bath, until the Tannic Acid is completely dissolved. Then transfer the solution to a bottle.

Average dose.—15 minims (1 Cc.).

GLYCERITUM AMYLI. U.S. Glycerite of Starch

	Metric	Old form
***Starch**	10 Gm.	290 grains
Water	10 Cc.	5 fl. dr.
Glycerin	80 Gm.	4 fl. oz.

Triturate the Starch with the Water, until a homogeneous mixture is produced. Then gradually add this to the Glycerin, contained in a porcelain dish, and heated to about 140° C. (284° F.). Continue the heat, with constant stirring, keeping it below 144° C. (291.2° F.), until a translucent jelly is formed. Transfer the product to suitable vessels, provided with well-fitting covers.

GLYCERITUM BOROGLYCERINI. U.S. Glycerite of Boroglycerin

	Metric	Old form
***Boric Acid,** in fine powder	310 Gm.	5 oz. av.
Glycerin, a sufficient quantity,		
To make	1000 Gm.	16 oz. av.

Heat 460 Gm. [old form 7 oz. av. 158 gr.] of Glycerin, in a tared porcelain dish, to a temperature not exceeding 150° C. (302° F.), and add the Boric Acid in portions, constantly stirring. When all is added and dissolved, continue the heat at the same temperature, frequently stirring, and breaking up the film which forms on the surface. When the mixture has been reduced to the weight of 500

Gm. [old form 8 oz. av.], add to it 500 Gm. [old form 8 oz. av.] of Glycerin, mix thoroughly, and transfer it to suitable vessels.

GLYCERITUM FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U.S. Glycerite of the Phosphates of Iron, Quinine and Strychnine

	Metric	Old form
* **Soluble Ferric Phosphate**	80.0 Gm.	1 oz. av. 146 gr.
Quinine	104.0 Gm.	1 oz. av. 322 gr.
Strychnine	0.8 Gm.	5$\frac{3}{10}$ grains
Phosphoric Acid	200.0 Cc.	3 fl. oz. 96 min.
Glycerin	500.0 Cc.	8 fl. oz.
Water, a sufficient quantity,		
To make	1000 Cc.	1 pint

Heat the Soluble Ferric Phosphate with 200 Cc. [old form 6 fl. oz. 192 min.] of Water, in a porcelain dish, at a temperature not exceeding 70° C. (158° F.), until it is dissolved. Then add the Phosphoric Acid with the Strychnine and Quinine and sufficient Water to make the product measure 500 Cc. [old form 8 fl. oz.], and stir until solution is effected. Mix the solution with the Glycerin, and filter if necessary.

Average dose.—15 minims (1 Cc.).

GLYCERITUM HYDRASTIS. U.S. Glycerite of Hydrastis

	Metric	Old form
* **Hydrastis,** in No. 60 powder	1000 Gm.	25 oz. av.
Glycerin	500 Cc.	12 fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	24 fl. oz.

Moisten the Hydrastis with 350 Cc. [old form 8½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Hydrastis is practically exhausted. Remove nearly all of the Alcohol by distillation or evaporation, pour the thick concentrated liquid into 500 Cc. [old form 12 fl. oz.] of ice-cold Water, and set it aside, in a cold place, for twenty-four hours. Then filter, pass enough cold Water through the filter to make the filtrate measure 500 Cc. [old form 12 fl. oz.], add the Glycerin, and mix thoroughly.

Average dose.—30 minims (2 Cc.).

GLYCERITUM PHENOLIS. U.S. Glycerite of Phenol

[Glyceritum Acidi Carbolici, Pharm. 1890]

	Metric	Old form
* **Liquefied Phenol**	20 Cc.	2 fl. oz.
Glycerin	80 Cc.	8 fl. oz.
To make	100 Cc.	10 fl. oz.

Add the Liquefied Phenol to the Glycerin, and stir until thoroughly mixed.

Average dose.—5 minims (0.3 Cc.).

CHAPTER XXIII

ALCOHOLIC SOLUTIONS

Spiritus *Spirits*

SPIRITS from a pharmaceutical point of view are simply *alcoholic* solutions of volatile substances. Like the medicated waters, the active ingredient may be solid, liquid, or gaseous. None are made by percolation, but they are officially prepared in five ways: 1. By simple solution. 2. By solution with maceration. 3. By gaseous solution. 4. By chemical reaction. 5. By distillation. The number of official spirits is *twenty.*

1. **By Simple Solution.**—This is the most usual method of making spirits; of the official preparations of this class, *fourteen*, or about three-fourths of the whole number, are prepared in this way, while *eight* of the fourteen are merely solutions of volatile oils in alcohol of different strengths, without any other addition. No skill is required to make these, but a great deal of conscientious care must be used in the selection of the volatile oils, that they be of the best quality, and recently distilled. Filtration is usually unnecessary.

Official Spirits made by Simple Solution

Name	Proportion	Use and Dose
Spiritus Ætheris	325 Cc. Ether; 675 Cc. Alcohol	Stimulant fʒi (4 Cc.)
Ætheris Compositus	325 Cc. Ether; 650 Cc. Alcohol; 25 Cc. Ethereal Oil	Anodyne, stimulant, fʒi (4 Cc.)
Ammoniæ Aromaticus	34 Gm. Ammonium Carbonate; 90 Cc. Ammonia Water; 10 Cc. Oil of Lemon; 1 Cc. Oil of Lavender Flowers; 1 Cc. Oil of Nutmeg; 700 Cc. Alcohol; Distilled Water to make 1000 Cc.	Antacid, 30♏ (2 Cc.)
Amygdalæ Amaræ	10 Cc. Oil of Bitter Almond; 800 Cc. Alcohol; Distilled Water to make 1000 Cc.	Flavor, 8♏ (0.5 Cc.)
Anisi	100 Cc. Oil of Anise; 900 Cc. Alcohol.	Carminative, fʒi (4 Cc.)
Aurantii Compositus	200 Cc. Oil of Orange Peel; 50 Cc. Oil of Lemon; 20 Cc. Oil of Coriander; 5 Cc. Oil of Anise; Alcohol sufficient to make 1000 Cc.	Flavor. Used in making Aromatic Elixir
Camphoræ	100 Gm. Camphor; Alcohol sufficient to make 1000 Cc.	Stimulant, 5 to 60♏ (0.3 to 4 Cc.)
Chloroformi	60 Cc. Chloroform; 940 Cc. Alcohol	Sedative, stimulant, 10 to 60♏ (0.6 to 4 Cc.)
Cinnamomi	100 Cc. Oil of Cinnamon; 900 Cc. Alcohol	Stimulant, 5 to 15♏ (0.3 to 1 Cc.)
Gaultheriæ	50 Cc. Oil of Gaultheria; 950 Cc. Alcohol	Flavor, 5 to 15♏ (0.3 to 1 Cc.)
Glycerylis Nitratis	1 Gm. Glyceryl Trinitrate to 99 Gm. Alcohol	Cardiac stimulant, 1 to 2♏ (0.05 to 0.1 Cc.)
Juniperi	50 Cc. Oil of Juniper; 950 Cc. Alcohol	Stimulant, diuretic, fʒi to fʒii (4 Cc. to 8 Cc.)
Juniperi Compositus	8 Cc. Oil of Juniper; 1 Cc. Oil of Caraway; 1 Cc. Oil of Fennel; 1400 Cc. Alcohol; Water, sufficient to make 2000 Cc.	Stimulant, diuretic, fʒii to fʒiv (8 Cc. to 16 Cc.)
Lavandulæ	50 Cc. Oil of Lavender Flowers; 950 Cc. Alcohol	Flavor, fʒss to fʒi (2 Cc. to 4 Cc.)

2. **Solution with Maceration.**—This method is employed in the Pharmacopœia when it is desirable to solely introduce the coloring matter of the drug into the preparation. This has been done in order to bestow individuality, and in deference to popular feeling in favor of high colors. It is very doubtful whether either object is worthy of consideration.

Official Spirits made by Solution with Maceration

Name	Preparation	Use and Dose
Spiritus Menthæ Piperitæ	100 Cc. Oil of Peppermint; 10 Gm. Peppermint, bruised; Alcohol to make 1000 Cc.	Carminative, 10 to 20♏ (0.6 to 1.2 Cc.)
Menthæ Viridis	100 Cc. Oil of Spearmint; 10 Gm. Spearmint, bruised; Alcohol to make 1000 Cc.	Carminative, 10 to 20♏ (0.6 Cc. to 1.2 Cc.)

3. **By Gaseous Solution.**—The only official representative of this class is the Spirit of Ammonia, and it is the only preparation in the Pharmacopœia that is made by converting a gaseous aqueous solution into a gaseous alcoholic solution by expelling the dissolved gas from water by heat and causing it to be redissolved in alcohol. The spirit is assayed by the use of half-normal volumetric solution of sulphuric acid, and brought to the standard strength of 10 percent. of gaseous ammonia.

Official Spirit made by Gaseous Solution

Name	Preparation	Use and Dose
Spiritus Ammoniæ	Stronger Water of Ammonia; Heat; Alcohol, 10 percent. Gas; assay.	Stimulant, 5 to 30♏ (0.3 to 2 Cc.)

4. **By Chemical Reaction.**—There is but *one* spirit in the Pharmacopœia made by chemical reaction, and that is Spirit of Nitrous Ether. As explained elsewhere (Part IV.), it is the product of the action of nitric acid upon alcohol, and is an alcoholic solution of ethyl nitrite.

Official Spirit made by Chemical Reaction

Name	Preparation	Use and Dose
Spiritus Ætheris Nitrosi	About 4 percent. Ethyl Nitrite	Diaphoretic, diuretic, fʒss to fʒi (2 Cc. to 4 Cc.)

5. **By Distillation.**—This method of making spirits is the oldest and in many respects the best in use. When the desirable volatile principles which are present in the preparation when finished can be vaporized at the temperature of boiling alcohol or diluted alcohol, distillation is preferred. In the case of liquids containing some oils of high boiling points, it is necessary to obtain the oils by distillation with water and afterwards mix the distillate with alcohol. It is certain, however, that spirits made by the admixture of volatile oils with alcohol, as in Class 1, are often deficient in the more delicate

and volatile principles found in the substances from which they are distilled. These principles are often soluble in water and insoluble in the oil, and necessarily in the distillation of the volatile oil with water they must be found in the water, and are absent from the oil. This is well illustrated in the case of oil of neroli and orange flower water; the latter has much the more fragrant odor when compared with the oil obtained in the same distillation from the same flowers and subjected to the same temperature. The only official spirits made by distillation are *two* in number,—Whisky and Brandy.

Official Spirits made by Distillation

Name	Preparation	Use and Dose
Spiritus Frumenti	By distillation from fermented grain; must be at least four years old.	Stimulant, f℥ss to f℥i (15 to 30 Cc.)
Vini Gallici	By distillation from fermented grapes; must be at least four years old.	Stimulant, f℥ss to f℥i (15 to 30 Cc.)

Unofficial Spirits

Name	Ingredients	Method of Preparation
Spiritus Ammoniæ Fetidus. Br.	75 Gm. Asafetida; 100 Cc. Strong Solution of Ammonia (32.5 percent.); Alcohol (90 percent.) to make 1000 Cc.	Macerate the Asafetida in 750 Cc. Alcohol for twenty-four hours, distil off the Alcohol; add the residue to the Strong Solution of Ammonia and enough Alcohol to make 1000 Cc.
Armoraciæ Compositus. Br.	125 Gm. Horseradish Root, scraped; 125 Gm. Dried Bitter Orange Peel; 3.15 Gm. Nutmeg; 625 Cc. Alcohol; 750 Cc. Distilled Water	Mix and distil 1000 Cc.
Aurantii. U. S. P. 1890	50 Cc. Oil of Orange Peel; 950 Cc. Alcohol	Mix them
Cajuputi. Br.	50 Cc. Oil of Cajuput; Alcohol to make 500 Cc.	Mix them
Limonis. U. S. P. 1890	50 Cc. Oil of Lemon; 50 Gm. freshly grated Lemon Peel; Alcohol to make 1000 Cc.	Mix the Oil with 900 Cc. Alcohol, add the Lemon Peel, and macerate during twenty-four hours. Filter and add Alcohol to make 1000 Cc.
Myrciæ. U. S. P. 1890 (Bay Rum)	16 Cc. Oil of Myrcia; 1 Cc. Oil of Orange Peel; 1 Cc. Oil of Pimenta; 1220 Cc. Alcohol; Water to make 2000 Cc.	Mix the Oils with the Alcohol, gradually add the Water, set aside for eight days, and filter
Myristicæ. U. S. P. 1890	50 Cc. Oil of Myristica; 950 Cc. Alcohol	Mix them
Phosphori. U. S. P. 1890	1.2 Gm. Phosphorus; Absolute Alcohol to make 1000 Cc.	Add the carefully weighed Phosphorus to 1000 Cc. Absolute Alcohol contained in a flask; connect with upright condenser and boil the liquid until the Phosphorus is dissolved; then, if necessary, add Absolute Alcohol to make 1000 Cc. and preserve in small, tightly stoppered bottles
Rectificatus. Br.	A liquid containing 90 parts, by volume, of Ethyl Hydroxide, and 10 parts, by volume, of Water	Obtained by distillation of fermented saccharine liquids
Rosmarini. Br.	50 Cc. Oil of Rosemary; Alcohol to make 500 Cc.	Mix them

SPIRITUS ÆTHERIS. U.S. Spirit of Ether

	Metric	Old form
* **Ether**	325 Cc.	4 fl. oz.
Alcohol	675 Cc.	8¼ fl. oz.
To make	1000 Cc.	12¼ fl. oz.

Mix them.

Average dose.—1 fluidrachm (4 Cc.).

SPIRITUS ÆTHERIS COMPOSITUS. U.S. Compound Spirit of Ether

	Metric	Old form
* **Ether**	325 Cc.	8 fl. oz.
Alcohol	650 Cc.	16 fl. oz.
Ethereal Oil	25 Cc.	5 fl. dr.
To make	1000 Cc.	24½ fl. oz.

Mix them. For Hoffmann's Anodyne see page 768.

Average dose.—1 fluidrachm (4 Cc.).

SPIRITUS ÆTHERIS NITROSI. U.S. Spirit of Nitrous Ether

[SWEET SPIRIT OF NITRE]

An Alcoholic solution of Ethyl Nitrite [$NO.OC_2H_5 = 74.51$], yielding, when freshly prepared and tested by the process given below, not less than 4 percent. of ethyl nitrite.

	Metric	Old form
* **Sodium Nitrite**	100.0 Gm.	3 oz. av. 231 gr.
Sulphuric Acid	40.0 Cc.	1 fl. oz. 169 min.
Monohydrated Sodium Carbonate	0.6 Gm.	9 grains
Potassium Carbonate, completely deprived of water by drying	3.0 Gm.	46 grains
Alcohol,		
Water, each, a sufficient quantity		

Mix the Sulphuric Acid with 120 Cc. [old form 4¼ fl. oz.] of Water, cool the liquid, add 85 Cc. [old form 2 fl. oz. 7 fl. dr.] of Alcohol previously diluted with an equal volume of Water, and introduce the solution into a 1000 Cc. [old form 2 pints] flask, surrounded by a mixture of ice and water. Dissolve the Sodium Nitrite in 280 Cc. [old form 9½ fl. oz.] of Water, filter, and, having poured the filtrate into a separatory funnel, allow the liquid to slowly drop into the flask containing the acid mixture. When all has been added and the reaction is complete, allow any crystals which may have formed to settle at the bottom of the flask, and decant the cold mixture of ethyl nitrite and aqueous solution quickly to the previously cleaned separatory funnel, and draw off and discard the aqueous liquid. Wash the separated ethyl nitrite, first, with 20 Cc. [old form 5½ fl. dr.] of ice-cold Water, and then remove any traces of acid by washing it with 15 Cc. [old form 4 fl. dr.] of ice-cold Water, in which the Monohydrated Sodium Carbonate has previously been dissolved. Carefully separate the ethyl nitrite from the aqueous liquid, and agitate it in a well-stoppered vial with the Potassium Carbonate to remove traces of water. Then cool the liquid, decant, and pour the ethyl nitrite immediately into a tared bottle containing 500 Gm. [old form 17 oz. av. 279 gr.] of Alcohol. Ascertain the weight of the ethyl nitrite poured into the Alcohol by noting the increase in weight of the tared bottle and contents, and then add enough Alcohol to make the mixture weigh *22 times* the weight of the ethyl nitrite added. Lastly, transfer the product to small, well-stoppered, dark amber-colored vials, and keep these in a cool place, remote from lights or fire.

(For tests and comments, see Part IV.)

SPIRITUS AMMONIÆ. U.S. **Spirit of Ammonia**

An alcoholic solution of Ammonia [$NH_3 = 16.93$] containing 10 percent., by weight, of the gas. This solution deteriorates on keeping, and should be tested frequently. It must not be dispensed for medicinal purposes if it contains less than 10 percent. of gaseous Ammonia.

	Metric	Old form
* **Stronger Ammonia Water**	**250 Cc.**	8 fl. oz.
Alcohol, recently distilled, and after distillation kept in glass vessels, a sufficient quantity		

Pour the Stronger Ammonia Water into a flask provided with a safety funnel, and connected, by means of a glass condenser, with a well-cooled receiver containing 500 Cc. [old form 1 pint] of Alcohol, the delivery tube of the condenser reaching nearly to the bottom of the receiver. Heat the flask carefully, and very gradually, to a temperature not exceeding 60° C. (140° F.), and maintain it at that temperature until Ammonia ceases to be evolved. Then disconnect the receiver, and, having ascertained the strength of a portion of the contents by the method of assay (see Part III.), add enough Alcohol to make the product contain 10 percent., by weight, of Ammonia gas. Keep the Spirit in glass-stoppered bottles, in a cool place.

(For tests and comments, see Part III.)

SPIRITUS AMMONIÆ AROMATICUS. U.S. **Aromatic Spirit of Ammonia**

	Metric	Old form
* **Ammonium Carbonate,** in translucent pieces	**34 Gm.**	1 oz. av. 59 gr.
Ammonia Water	**90 Cc.**	2 fl. oz. 7 fl. dr.
Oil of Lemon	**10 Cc.**	2½ fl. dr.
Oil of Lavender Flowers	**1 Cc.**	15 minims
Oil of Myristica	**1 Cc.**	15 minims
Alcohol	**700 Cc.**	22 fl. oz. 3 fl. dr.
Distilled Water, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

To the Ammonia Water, contained in a flask, add 140 Cc. [old form 4½ fl. oz.] of Distilled Water, and afterwards the Ammonium Carbonate reduced to a moderately fine powder. Close the flask and agitate the contents until the Ammonium Carbonate is dissolved, and allow to stand for twelve hours. Introduce the Alcohol into a graduated bottle of suitable capacity, add first the Oils, then gradually the solution of Ammonium Carbonate, and afterwards enough Distilled Water to make the product measure 1000 Cc. [old form 2 pints]. Set the liquid aside during twenty-four hours in a cool place, occasionally agitating, then filter it through paper, in a well-covered funnel.

(If the white crystalline precipitate which often falls when the water is added has not disappeared after the liquid has stood twenty-four hours, shake thoroughly and allow it to stand a day longer before filtering.)

Keep the product in glass-stoppered bottles, in a cool place.

(For tests and comments, see Part III.)

Average dose.— 30 minims (2 Cc.).

SPIRITUS AMYGDALÆ AMARÆ. U.S. Spirit of Bitter Almond

	Metric	Old form
* **Oil of Bitter Almond**	10 Cc.	154 minims
Alcohol	800 Cc.	25½ fl. oz.
Distilled Water,		
To make	1000 Cc.	2 pints

Dissolve the Oil in the Alcohol, and add enough Distilled Water to make the product measure 1000 Cc. [old form 2 pints].

Average dose.— 8 minims (0.5 Cc.).

SPIRITUS ANISI. U.S. Spirit of Anise

	Metric	Old form
* **Oil of Anise**	100 Cc.	1 fl. oz.
Alcohol	900 Cc.	9 fl. oz.
To make	1000 Cc.	10 fl. oz.

Mix them.

Average dose.— 1 fluidrachm (4 Cc.).

SPIRITUS AURANTII COMPOSITUS U.S. Compound Spirit of Orange

	Metric	Old form
* **Oil of Orange Peel**	200 Cc.	6 fl. oz. 3 fl. dr.
Oil of Lemon	50 Cc.	1 fl. oz. 5 fl. dr.
Oil of Coriander	20 Cc.	5 fl. dr.
Oil of Anise	5 Cc.	77 minims
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix them. Keep the product in completely filled, well-stoppered bottles, in a cool and dark place.

SPIRITUS CAMPHORÆ. U.S. Spirit of Camphor

	Metric	Old form
* **Camphor**	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Camphor in 800 Cc. [old form 25½ fl. oz.] of Alcohol, filter through paper, and pass enough Alcohol through the filter to make the product measure 1000 Cc. [old form 2 pints].

Average dose.— 15 minims (1 Cc.).

SPIRITUS CHLOROFORMI. U.S. Spirit of Chloroform

	Metric	Old form
* **Chloroform**	60 Cc.	1 fl. oz. 7½ fl. dr.
Alcohol	940 Cc.	30 fl. oz. ½ fl. dr.
To make	1000 Cc.	2 pints

Mix them.

Average dose.— 30 minims (2 Cc.).

SPIRITUS CINNAMOMI. U.S. Spirit of Cinnamon

	Metric	Old form
***Oil of Cinnamon**	100 Cc.	1 fl. oz.
Alcohol	900 Cc.	9 fl. oz.
To make	1000 Cc.	10 fl. oz.

Mix them.

Average dose.— 30 minims (2 Cc.).

SPIRITUS FRUMENTI. U. S. Whisky

An alcoholic liquid obtained by the distillation of the fermented mash of grain—such as Indian corn, rye, wheat, and barley, or their mixtures.

(For tests and comments, see Part IV.)

SPIRITUS GAULTHERIÆ. U. S. Spirit of Gaultheria

[SPIRIT OF WINTERGREEN]

	Metric	Old form
***Oil of Gaultheria**	50 Cc.	1 fl. oz.
Alcohol	950 Cc.	19 fl. oz.
To make	1000 Cc.	20 fl. oz.

Mix them.

Average dose.— 30 minims (2 Cc.).

SPIRITUS GLYCERYLIS NITRATIS. U. S. Spirit of Glyceryl Trinitrate
Spirit of Nitroglycerin

[SPIRITUS GLONOINI, PHARM. 1890]

An alcoholic solution containing 1 percent., by weight, of Glyceryl Trinitrate [$C_3H_5(O.NO_2)_3 = 225.44$]. Spirit of Nitroglycerin should be kept and transported in well-stoppered tin cans, and should be stored in a cool place, remote from lights or fire.

Great care should be exercised in dispensing, handling, packing, transporting, and storing the Spirit, since a dangerous explosion may result if any considerable quantity of it be spilled, and the alcohol be partly or wholly lost by evaporation. If, through accident, it be spilled, a solution of potassium hydroxide should be at once poured over it, to effect decomposition.

A clear, colorless liquid, having the odor and taste of alcohol. *Caution should be exercised in tasting it,* since even a small quantity of it is liable to produce a violent headache. The same effect is produced when it is freely applied to the skin.

It is neutral to litmus paper.

Specific gravity : 0.814 to 0.820 at 25° C. (77° F.).

On diluting 10 Cc. of the Spirit with 15 Cc. of water—both liquids, as well as the mixture, being brought to 15° C. (59° F.)—the liquid will exhibit at most a faint cloudiness, but the addition of a further portion of 5 Cc. of water should produce a white turbidity.

If the specific gravity of the Spirit be higher than 0.830 at 25° C. (77° F.), or if 10 Cc. of it be rendered turbid by less than 10 Cc. of water, the Spirit should be rejected.

Average dose.— 1 minim (0.05 Cc.).

SPIRITUS JUNIPERI. U.S. Spirit of Juniper

	Metric	Old form
***Oil of Juniper**	50 Cc.	1 fl. oz.
Alcohol	950 Cc.	19 fl. oz.
To make	1000 Cc.	20 fl. oz.

Mix them.

Average dose.— 30 minims (2 Cc.).

SPIRITUS JUNIPERI COMPOSITUS. U. S. Compound Spirit of Juniper

	Metric	Old form
***Oil of Juniper**	8 Cc.	30 minims
Oil of Caraway	1 Cc.	4 minims
Oil of Fennel	1 Cc.	4 minims
Alcohol	1400 Cc.	11 fl. oz.
Water, a sufficient quantity,		
To make	2000 Cc.	1 pint

Dissolve the Oils in the Alcohol, and gradually add enough Water to make the product measure 2000 Cc. [old form 1 pint].

Average dose.— 2 fluidrachms (8 Cc.).

SPIRITUS LAVANDULÆ. U.S. Spirit of Lavender

	Metric	Old form
***Oil of Lavender Flowers**	50 Cc.	1 fl. oz.
Alcohol	950 Cc.	19 fl. oz.
To make	1000 Cc.	20 fl. oz.

Mix them.

Average dose.— 30 minims (2 Cc.).

SPIRITUS MENTHÆ PIPERITÆ. U.S. Spirit of Peppermint

	Metric	Old form
***Oil of Peppermint**	100 Cc.	3 fl. oz. 96 min.
Peppermint, bruised	10 Gm.	146 grains
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Oil of Peppermint in 900 Cc. [old form 29 fl. oz.] of Alcohol, add the Peppermint, and allow it to macerate for twenty-four hours. Then filter through paper, and add, through the filter, enough Alcohol to make the Spirit measure 1000 Cc. [old form 2 pints].

Average dose.— 30 minims (2 Cc.).

SPIRITUS MENTHÆ VIRIDIS. U.S. Spirit of Spearmint

	Metric	Old form
***Oil of Spearmint**	100 Cc.	3 fl. oz. 96 min.
Spearmint, bruised	10 Gm.	146 grains
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Oil of Spearmint in 900 Cc. [old form 29 fl. oz.] of Alcohol, add the Spearmint, and allow it to macerate for twenty-four hours. Then filter through paper, and add, through the filter, enough Alcohol to make the Spirit measure 1000 Cc. [old form 2 pints].

Average dose.— 30 minims (2 Cc.).

SPIRITUS VINI GALLICI. U.S. Brandy

An alcoholic liquid obtained by the distillation of the fermented, unmodified juice of fresh grapes.

(For tests and comments, see Part IV.)

Elixiria *Elixirs*

Elixirs are aromatic, sweetened, spirituous preparations, containing small quantities of active medicinal substances. Although they are largely employed throughout the United States, but *three* have been made official,—Adjuvant Elixir, Aromatic Elixir, and Elixir of the Phosphates of Iron, Quinine and Strychnine. Two are intended as vehicles for the administration of active remedies in small doses. There will be found in the Appendix a number of formulas of unofficial elixirs.

Official Elixirs

Name	Proportions
Elixir Adjuvans	120 Cc. Fluidextract of Glycyrrhiza; 880 Cc. Aromatic Elixir
Aromaticum	12 Cc. Compound Spirit of Orange; 375 Cc. Syrup; 30 Gm. Purified Talc; 238 Cc. Alcohol; with sufficient Distilled Water to make 1000 Cc.
Ferri, Quininæ et Strychninæ Phosphatum	17.5 Gm. Soluble Ferric Phosphate; 8.75 Gm. Quinine; 0.275 Gm. Strychnine; 2 Cc. Phosphoric Acid; 9 Gm. Ammonium Carbonate; 60 Cc. Alcohol; 28.65 Gm. Acetic Acid; Ammonia Water to neutralize; with Distilled Water and Aromatic Elixir to make 1000 Cc.

Unofficial Elixir

Name	Ingredients	Method of Preparation
Elixir Phosphori. U.S. P. 1890	210 Cc. Spirit of Phosphorus; 2 Cc. Oil of Anise; 550 Cc. Glycerin; Aromatic Elixir to make 1000 Cc.	Mix the Spirit of Phosphorus, Oil of Anise, and Glycerin by repeatedly inverting the bottle in which they are contained, and, when they have formed a clear liquid, add Aromatic Elixir to make 1000 Cc. Keep in well-stoppered bottles in a dark place

ELIXIR ADJUVANS. U.S. Adjuvant Elixir

	Metric	Old form
* **Fluidextract of Glycyrrhiza**	120 Cc.	3 fl. oz. 7 fl. dr.
Aromatic Elixir	880 Cc.	28 fl. oz. 1 fl. dr.
To make	1000 Cc.	2 pints

Mix, and filter if necessary.

ELIXIR AROMATICUM. U.S. Aromatic Elixir

[SIMPLE ELIXIR]

	Metric	Old form
***Compound Spirit of Orange**	12 Cc.	184 minims
Syrup	375 Cc.	12 fl. oz.
Purified Talc	30 Gm.	1 oz. av.
Alcohol,		
Distilled Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

To the Compound Spirit of Orange, add enough Alcohol to make 250 Cc. [old form 8 fl. oz.]. To this solution, add the Syrup in several portions, agitating after each addition, and afterwards add, in the same manner, 375 Cc. [old form 12 fl. oz.] of Distilled Water. Mix the Purified Talc intimately with the liquid, and then filter through a wetted filter, returning the first portions of the filtrate until a transparent liquid is obtained. Lastly, wash the filter with a mixture of *1 volume* of Alcohol and *3 volumes* of Distilled Water, until the product measures 1000 Cc. [old form 2 pints].

ELIXIR FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U.S. Elixir of the Phosphates of Iron, Quinine and Strychnine

	Metric	Old form
***Soluble Ferric Phosphate**	17.500 Gm.	255 grains
Quinine	8.750 Gm.	127 grains
Strychnine	0.275 Gm.	4 grains
Phosphoric Acid	2.000 Cc.	31 minims
Ammonium Carbonate, in translucent pieces	9.000 Gm.	131 grains
Alcohol	60.000 Cc.	1 fl. oz. 7½ fl. dr.
Acetic Acid	28.650 Gm.	418 grains
Ammonia Water,		
Distilled Water,		
Aromatic Elixir, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Quinine and Strychnine in the Alcohol, then add the Phosphoric Acid and 350 Cc. [old form 11 fl. oz. 1 fl. dr.] of Aromatic Elixir. Add the Acetic Acid to the Ammonium Carbonate, contained in a suitable vessel, and when solution is complete, neutralize with Ammonia Water and add enough Distilled Water to make the product measure 50 Cc. [old form 1 fl. oz. 288 min.]. Mix the solution of Ammonium Acetate with the solution of the alkaloids, and add enough Aromatic Elixir to make the liquid measure 880 Cc. [28 fl. oz. 1 fl. dr.]. Dissolve the Ferric Phosphate in 30 Cc. [old form 7½ fl. dr.] of Distilled Water, by the aid of a gentle heat, and if the solution be acid to litmus paper, neutralize exactly with Ammonia Water, and add enough Aromatic Elixir to make the product measure 120 Cc. [old form 3 fl. oz. 7 fl. dr.]. Finally, mix the two solutions and filter if necessary.

Average dose.— 1 fluidrachm (4 Cc.).

CHAPTER XXIV

ETHEREAL SOLUTIONS

Collodia *Collodions*

Collodions are liquid preparations intended for external use, having for their base a solution of pyroxylin, or gun-cotton, in a mixture of ether and alcohol. (For a description of the properties of pyroxylin and collodions, see Part V.) Collodions are applied to the skin by means of a soft brush, and when the ether and alcohol evaporate, a film is left on the surface, which either acts as a protection or brings a medicating agent in contact with the epidermis. *Four* collodions are official.

Official Collodions

Name	Proportions
Collodium	40 Gm. Pyroxylin; 750 Cc. Ether; 250 Cc. Alcohol. Decant the clear Collodion from the sediment
Cantharidatum	60 Gm. Cantharides, No. 60 powder; 85 Gm. Flexible Collodion; Chloroform sufficient to exhaust the Cantharides; after distillation of the Chloroform, the residue is dissolved in the Flexible Collodion. Decant the clear Cantharidal Collodion from the sediment
Flexile	920 Gm. Collodion; 50 Gm. Canada Turpentine; 30 Gm. Castor Oil
Stypticum	20 Gm. Tannic Acid; 5 Cc. Alcohol; 25 Cc. Ether; Collodion to make 100 Cc.

COLLODIUM. U.S. Collodion

	Metric	Old form
* **Pyroxylin**	40 Gm.	1 oz. av. 147 gr.
Ether	750 Cc.	24 fl. oz.
Alcohol	250 Cc.	8 fl. oz.
To make about	1000 Cc.	2 pints

To the Pyroxylin, contained in a suitable bottle, add the Ether, and allow it to stand for fifteen minutes; then add the Alcohol, and shake the bottle until the Pyroxylin is dissolved. Cork the bottle well, and set it aside until the liquid has become clear. Finally, decant the clear portion from any sediment which may have deposited, and transfer it to bottles, which should be well corked and sealed.

Keep the Collodion in a cool place, remote from lights or fire.

COLLODIUM CANTHARIDATUM. U.S. Cantharidal Collodion

[Blistering Collodion]

	Metric	Old form
* **Cantharides,** in No. 60 powder	60 Gm.	2 oz. av. 50 gr.
Flexible Collodion	85 Gm.	3 oz. av.
Chloroform, a sufficient quantity,		
To make	100 Gm.	3 oz. av. 230 gr.

Pack the Cantharides firmly in a cylindrical percolator and gradually pour Chloroform upon it until the powder is exhausted. Recover the Chloroform by distillation from a water-bath and evaporate the residue in a tared evaporating dish on a water-bath, until it weighs 15 Gm. [old form 230 grains]. Dissolve this in the Flexible Collodion, and set it aside in a securely corked bottle, and in a cool place, to become clear by settling. Finally, pour off the clear portion from any sediment which may have deposited, and transfer it to bottles, which should be well corked and sealed.

Keep the Cantharidal Collodion in a cool place, remote from lights or fire.

COLLODIUM FLEXILE. U. S. Flexible Collodion

	Metric	Old form
***Collodion**	920 Gm.	8 oz. av.
Canada Turpentine	50 Gm.	190 grains
Castor Oil	30 Gm.	115 grains
To make	1000 Gm.	about 9 oz. av.

Weigh the ingredients, successively, into a tared bottle, and mix them thoroughly.

Keep the product in cork-stoppered bottles, in a cool place, remote from lights or fire.

COLLODIUM STYPTICUM. U.S. Styptic Collodion

	Metric	Old form
***Tannic Acid**	20 Gm.	365 grains
Alcohol	5 Cc.	96 minims
Ether	25 Cc.	1 fl. oz.
Collodion, a sufficient quantity,		
To make	100 Cc.	4 fl. oz.

Introduce the Tannic Acid, Alcohol, and Ether into a graduated bottle, agitate the mixture until the Tannic Acid is thoroughly incorporated and partially dissolved, then add enough Collodion to make up the volume to 100 Cc. [old form 4 fl. oz.], and shake occasionally, until the Tannic Acid is completely dissolved.

Keep the product in cork-stoppered bottles, in a cool place, remote from lights or fire.

CHAPTER XXV

OLEAGINOUS SOLUTIONS OR EXTERNAL APPLICATIONS

Linimenta *Liniments*

THESE are solutions or mixtures of various substances in oily or alcoholic liquids, intended for external application, and usually applied with friction and rubbing of the skin. There are *eight* official liniments, of which *three* are made with a fixed oil as the base, *four* with alcohol as the principal liquid, and *one* contains oil of turpentine. They are classified as follows:

Official Liniments

Name	Base	Proportions
Linimentum Ammoniæ	Oil	350 Cc. Ammonia Water; 50 Cc. Alcohol; 570 Cc. Cotton Seed Oil; 30 Cc. Oleic Acid
Calcis	Oil	Equal volumes Lime Water and Linseed Oil
Camphoræ	Oil	200 Gm. Camphor; 800 Gm. Cotton Seed Oil
Belladonnæ	Alcohol	50 Gm. Camphor; Fluidextract of Belladonna to make 1000 Cc.
Chloroformi	Alcohol	300 Cc. Chloroform; 700 Cc. Soap Liniment
Saponis	Alcohol	60 Gm. Granulated Soap; 45 Gm. Camphor; 10 Cc. Oil of Rosemary; 725 Cc. Alcohol; Water to make 1000 Cc.
Saponis Mollis	Alcohol	650 Gm. Soft Soap; 20 Cc. Oil of Lavender Flowers; Alcohol to make 1000 Cc.
Terebinthinæ	Oil of Turpentine	650 Gm. Rosin Cerate; 350 Gm. Oil of Turpentine

Unofficial Liniments

Name	Ingredients	Method of Preparation
Linimentum Aconiti. Br.	500 Gm. Aconite Root, No. 40 powder; 25 Gm. Camphor; Alcohol to make 750 Cc.	Percolate the Aconite Root, after three days maceration, with enough Alcohol to make the liquid, after the Camphor has been dissolved, measure 750 Cc.
Camphoræ Ammoniatum. Br.	50 Gm. Camphor; 2.5 Cc. Oil of Lavender; 100 Cc. Strong Solution of Ammonia (32.5 percent.); Alcohol to make 400 Cc.	Dissolve the Camphor and the Oil of Lavender in 240 Cc. of Alcohol, add the Strong Solution of Ammonia gradually and Alcohol to make 400 Cc., and shake until a clear solution is formed
Crotonis. Br.	20 Cc. Croton Oil; 70 Cc. Oil of Cajuput; 70 Cc. Alcohol	Mix them
Hydrargyri. Br.	30 Gm. Ointment of Mercury; 10 Cc. Strong Solution of Ammonia (32.5 percent); Liniment of Camphor, a sufficient quantity	Add the Strong Solution of Ammonia to enough Liniment of Camphor to make 45 Cc.; triturate the Ointment of Mercury with enough Liniment of Camphor to make 45 Cc. Mix the two liquids
Opii. Br.	50 Cc. Tincture of Opium; 50 Cc. Liniment of Soap	Mix, set aside for a few days, and filter
Potassii Iodidi cum Sapone. Br.	40 Gm. Curd Soap; 30 Gm. Potassium Iodide; 20 Cc. Glycerin; 2.5 Cc. Oil of Lemon; 200 Cc. Distilled Water	Dissolve the Soap, with the aid of a gentle heat, in the Glycerin and Water; add the solution to the powdered Potassium Iodide in a mortar and triturate until cold, set aside for an hour, and then incorporate the Oil of Lemon

Unofficial Liniments—*Continued*

Name	Ingredients	Method of Preparation
Linimentum Sinapis Compositum. U. S. P. 1890	30 Cc. Volatile Oil of Mustard; 200 Cc. Fluidextract of Mezereum; 60 Gm. Camphor; 150 Cc. Castor Oil; Alcohol to make 1000 Cc.	Dissolve the Camphor in 500 Cc. of Alcohol, add successively the Fluidextract, the Oil of Mustard, and the Castor Oil, and finally Alcohol to make 1000 Cc.
Terebinthinæ Aceticum. Br.	100 Cc. Oil of Turpentine; 25 Gm. Glacial Acetic Acid; 100 Cc. Liniment of Camphor	Mix them

LINIMENTUM AMMONIÆ. U.S. Ammonia Liniment

[VOLATILE LINIMENT]

	Metric	Old form
* **Ammonia Water**	350 Cc.	11 fl. oz. 1 fl. dr.
Alcohol	50 Cc.	1 fl. oz. 5 fl. dr.
Cotton Seed Oil	570 Cc.	18 fl. oz. 2 fl. dr.
Oleic Acid	30 Cc.	1 fl. oz.
To make	1000 Cc.	2 pints

Mix them by agitation in a bottle, which should be well stoppered. This Liniment should be freshly prepared when wanted.

LINIMENTUM BELLADONNÆ. U.S. Belladonna Liniment

	Metric	Old form
* **Camphor**	50 Gm.	180 grains
Fluidextract of Belladonna Root, a sufficient quantity,		
To make	1000 Cc.	8 fl. oz.

Dissolve the Camphor in about 800 Cc. [old form 25½ fl. oz.] of the Fluidextract, and then add enough of the latter to make the product measure 1000 Cc. [old form 2 pints]. Mix thoroughly.

LINIMENTUM CALCIS. U.S. Lime Liniment

[CARRON OIL]

	Metric	Old form
* **Lime Water**	500 Cc.	1 pint
Linseed Oil	500 Cc.	1 pint
To make	1000 Cc.	2 pints

Mix them by agitation.

LINIMENTUM CAMPHORÆ. U.S. Camphor Liniment

	Metric	Old form
* **Camphor,** in coarse powder	200 Gm.	2 oz. av.
Cotton Seed Oil	800 Gm.	8 oz. av.
To make	1000 Gm.	10 oz. av.

Introduce the Camphor and the Cotton Seed Oil into a suitable flask, and apply a gentle heat, by means of a water-bath, loosely stoppering the flask during the operation. Agitate the flask occasionally, until the Camphor is dissolved.

LINIMENTUM CHLOROFORMI. U.S. Chloroform Liniment

	Metric	Old form
* **Chloroform**	300 Cc.	9½ fl. oz.
Soap Liniment	700 Cc.	22½ fl. oz.
To make	1000 Cc.	2 pints

Mix them by agitation.

LINIMENTUM SAPONIS. U.S. Soap Liniment

	Metric	Old form
* **Soap,** dried and granulated	60 Gm.	2 oz. av.
Camphor, in small pieces	45 Gm.	1 oz. av. 220 gr.
Oil of Rosemary	10 Cc.	154 minims
Alcohol	725 Cc.	23 fl. oz. 1 fl. dr.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Add the Soap to 200 Cc. [old form 6½ fl. oz.] of boiling Water, heat the mixture on a water-bath until a clear gelatinous mass results. Mix this, while yet warm, with 500 Cc. [old form 1 pint] of Alcohol, and stir it until solution is effected. Dissolve the Camphor and Oil of Rosemary in 225 Cc. [old form 7 fl. oz. 1 fl. dr.] of the Alcohol by agitation in a bottle ; add this solution to the warm Soap mixture ; mix thoroughly, and, if necessary, add enough Water to make the product measure 1000 Cc. [old form 2 pints]. Set it aside in a cool place for twenty-four hours, then filter.

LINIMENTUM SAPONIS MOLLIS. U.S. Liniment of Soft Soap

[TINCTURE OF GREEN SOAP]

	Metric	Old form
* **Soft Soap**	650 Gm.	21½ oz. av.
Oil of Lavender Flowers	20 Cc.	5 fl. dr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Oil of Lavender Flowers with 300 Cc. [old form 9½ fl. oz.] of Alcohol, dissolve in this the Soft Soap by stirring or agitation, and set the solution aside for twenty-four hours. Then filter it through paper, adding sufficient Alcohol to make the product measure 1000 Cc. [old form 2 pints].

LINIMENTUM TEREBINTHINÆ. U.S. Turpentine Liniment

	Metric	Old form
* **Rosin Cerate**	650 Gm.	13 oz. av.
Oil of Turpentine	350 Gm.	7 oz. av.
To make	1000 Gm.	20 oz. av.

Dissolve the Rosin Cerate, previously melted in a dish on a water-bath, in the Oil of Turpentine, and mix them thoroughly.

Oleata *Oleates*

The official oleates are liquid preparations made by dissolving metallic salts or alkaloids in oleic acid. The term oleate is also used commercially to designate solid preparations which are supposed to be chemical compounds of oleic acid with various bases. (See Part

V.) The official oleates are not assumed to be definite chemical compounds. The proportion of oleic acid is excessive, and they must be regarded as solutions of the medicating agent in oleic acid, the latter having special advantages as a basis for administering external remedies, being more readily absorbed than most of the fatty substances used in making ointments. *Five* oleates are official.

Official Oleates

Name	Proportions
Oleatum Atropinæ	2 Gm. Atropine; 2 Cc. Alcohol; 50 Gm. Oleic Acid; Olive Oil to make 100 Gm.
Cocainæ	5 Gm. Cocaine; 5 Cc. Alcohol; 50 Gm. Oleic Acid; Olive Oil to make 100 Gm.
Hydrargyri	25 Gm. Yellow Mercuric Oxide; 25 Cc. Distilled Water; Oleic Acid to make 100 Gm.
Quininæ	25 Gm. Quinine; 75 Gm. Oleic Acid
Veratrinæ	2 Gm. Veratrine; 50 Gm. Oleic Acid; Olive Oil to make 100 Gm.

Unofficial Oleate

Name	Ingredients	Method of Preparation
Oleatum Zinci. U. S. P. 1890	50 Gm. Zinc Oxide; 950 Gm. Oleic Acid	Incorporate the Zinc Oxide with the Oleic Acid contained in a porcelain dish, set aside for three hours, and then heat on a water-bath, frequently stirring, until dissolved

OLEATUM ATROPINÆ. U.S. Oleate of Atropine

	Metric	Old form
* **Atropine**	**2 Gm.**	35 grains
Alcohol	**2 Cc.**	35 minims
Oleic Acid	**50 Gm.**	2 oz. av.
Olive Oil, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Triturate the Atropine in a tared mortar with the Alcohol, then add about an equal volume of the Oleic Acid, and, after warming the mortar, stir until the Alcohol has evaporated, add the remainder of the Oleic Acid, and continue stirring until the Atropine is dissolved; then add sufficient Olive Oil to make the product weigh 100 Gm. [old form 4 oz. av.].

OLEATUM COCAINÆ. U.S. Oleate of Cocaine

	Metric	Old form
* **Cocaine**	**5 Gm.**	87½ grains
Alcohol	**5 Cc.**	90 minims
Oleic Acid	**50 Gm.**	2 oz. av.
Olive Oil, a sufficient quantity,		
To make	**100 Gm.**	4 oz. av.

Triturate the Cocaine, in a tared mortar, with the Alcohol, then add about an equal volume of the Oleic Acid, and, after warming the mortar, stir until the Alcohol has evaporated, add the remainder of the Oleic Acid, and continue stirring until the Cocaine is dissolved; then add sufficient Olive Oil to make the product weigh 100 Gm. [old form 4 oz. av.].

OLEATUM HYDRARGYRI. U.S. Oleate of Mercury

	Metric	Old form
* **Yellow Mercuric Oxide,** in very fine powder	25 Gm.	1 oz. av.
Distilled Water	25 Cc.	1 fl. oz.
Oleic Acid, a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Triturate the Yellow Mercuric Oxide with the Distilled Water in a tared mortar; add 70 Gm. [old form 2½ oz. av.] of Oleic Acid, and mix thoroughly; warm the mortar to a temperature not exceeding 50° C. [122° F.], stir occasionally until the water has evaporated, then add, if necessary, Oleic Acid to make 100 Gm. [old form 4 oz. av.], and mix thoroughly. Avoid contact with metallic utensils; preserve the Oleate in tightly stoppered bottles.

OLEATUM QUININÆ. U.S. Oleate of Quinine

	Metric	Old form
* **Quinine**	25 Gm.	1 oz. av.
Oleic Acid	75 Gm.	3 oz. av.
To make	100 Gm.	4 oz. av.

Triturate the Quinine, in a warm mortar, with a small quantity of the Oleic Acid to a smooth paste. Then add the remainder of the Oleic Acid, previously warmed, and stir frequently, until the Quinine is dissolved.

OLEATUM VERATRINÆ. U.S. Oleate of Veratrine

	Metric	Old form
* **Veratrine**	2 Gm.	35 grains
Oleic Acid	50 Gm.	2 oz. av.
Olive Oil, a sufficient quantity,		
To make	100 Gm.	4 oz. av.

Triturate the Veratrine in a tared mortar with about 5 Cc. [old form 1½ fl. dr.] of Olive Oil, and, after warming the mortar, add the Oleic Acid, and continue stirring until the Veratrine is dissolved; then add sufficient Olive Oil to make the product weigh 100 Gm. [old form 4 oz. av.].

CHAPTER XXVI

AQUEOUS LIQUIDS MADE BY PERCOLATION OR MACERATION

Infusa *Infusions*

INFUSIONS are liquid preparations made by treating vegetable substances with either hot or cold water. *The drug is not subjected to the boiling process,* although it is common to pour boiling water over it; the whole is allowed to stand in a close vessel until cold. While the use of hot water has the advantage of saving time in some cases, it is often objectionable because the *inert* principles in the drug are dissolved by the hot water, and as the infusion cools, they are precipitated out in such a very finely divided condition that they cannot be readily separated by colation or filtration. Cold water should be selected as the menstruum when the drug contains a valuable volatile principle, when the active agent is injured by heat, or when the desirable principles are readily soluble in water of ordinary temperature. The time required to make the infusion must be considered, for in warm weather it is quite possible for an infusion to ferment or decompose before it is finished.

Pure water should be used in making infusions, and large quantities should not be made at one time unless demanded for immediate use, as, without special precautions to preserve them, they soon become decomposed.

Of the inert principles found in plants, starch is extracted by hot water and albumen by cold water, whilst gum, sugar, and extractive are dissolved by both.

In making infusions the drug is usually coarsely comminuted, sliced, or bruised. Fine powders should be avoided whenever possible, because it is difficult to separate the fine particles from the infusion; and if percolation is resorted to, so much time is consumed in the operation, owing to the swelling of the powder, that decomposition may set in before the preparation is finished. The number of official infusions is *three.* Infusions are usually made in four ways: 1. By maceration. 2. By digestion. 3. By percolation. 4. By diluting fluidextracts.

1. **By Maceration.**—This is the process which is most frequently used. The general formula of the U. S. Pharmacopœia, which is here appended, furnishes a model.

General Official Formula for Infusions

An ordinary Infusion, the strength of which is not directed by the physician, nor specified by the Pharmacopœia, shall be prepared by the following formula:

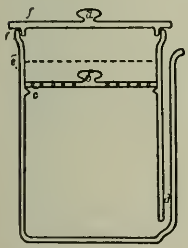
Take of	Metric	Old form
***The Substance,** coarsely comminuted	**50 Gm.**	365 grains
Boiling Water	**1000 Cc.**	1 pint
Water, a sufficient quantity,		
To make	**1000 Cc.**	1 pint

Introduce the Substance into a suitable vessel provided with a cover, pour upon it the Boiling Water, cover the vessel tightly, and let it stand for half an hour in a warm place. Then strain with expression, and pass enough Water through the strainer to make the Infusion measure 1000 Cc. [old form 1 pint].

Caution.—The strength of Infusions of energetic or powerful substances should be specially prescribed by the physician.

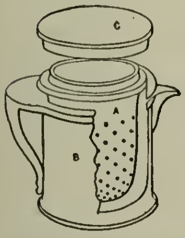
It will be found most convenient to provide special apparatus for making infusions by maceration. One of the oldest forms is known as *Alsop's Infusion Jar.* This presents a very neat and effectual method of making the hot infusions. It consists of an earthen-ware mug, represented in Fig. 430, with a spout, *d*, proceeding from the bottom, and placed closely to the side of the vessel to prevent fracture; a perforated plate or diaphragm, *b*, supported on a ledge, *c*, at about one-quarter or one-third of the height of the vessel from the top; and a lid, *a*, which may be fastened on by a string through holes *f f.* The material to be submitted to infusion is placed on the perforated plate, and the hot water poured in so as to cover it, the vessel having been previously warmed, so as not to chill the liquid. As the water becomes impregnated, it acquires an increased specific gravity, and sinks to the bottom, its place being supplied by the unsaturated portion; and this circulation goes on until the whole of the soluble matter is extracted. In order to maintain a due warmth, the vessel may be placed upon a stove, or upon an iron plate near the fire. The advantage of the process is that the material is subjected to the solvent power of the least impregnated portion of the menstruum. In order that the vessel may be adapted for the preparation of different quantities of infusions, it would be an advantage to have ledges arranged within, at different heights, so that the diaphragm may be supported at any desired point. The surface of the liquid,

Fig. 430



Alsop's infusion jar

Fig. 431



Squire's infusion mug

Fig. 432

Infusion pitcher

Fig. 433

Infusion mug (home-made)

e, should, of course, always be above the medicinal substance. Tinned iron or metallic vessels are unsuited for infusions; they are particularly objectionable when the drug used for making the preparation contains tannin, gallic acid, or an astringent substance. The liability of iron vessels to rust constitutes another objection.

Squire's Infusion Mug differs from the preceding in having a colander of queen's-ware, which is closely covered with a lid, and descends into the jar so as to form a diaphragm for the support of the substance to be infused. It has the advantage that the material, after having been exhausted, may be lifted out without disturbing the infusion. Fig. 431 shows the mug. It is made of queen's-ware, of the capacity of one pint, B; into it a thimble shaped colander, A, descends, supported on the rim of the mug by a projecting ledge, with a carefully fitted cover, C, which closes the whole. The substance to be submitted to infusion is introduced into the colander either before or after it has been fitted to the mug; the water, hot or cold, as the case may be, is then poured in so as to fill the lower vessel and cover the materials in the upper; and, the cover having been applied, the vessel is set aside for the length of time required. The colander is then to be lifted out, and the infusion, without having to strain it, is ready for use.

Fig. 432 represents an earthenware infusion pitcher, which may be used for making a gallon of infusion; it is useful where there is a large demand. Its principle of action is similar to that of Squire's infusion mug. A still better and cheaper apparatus may be made by the pharmacist himself, by selecting a queen's-ware or porcelain tea- or coffee-pot, A, as in Fig. 433, and if a hole is bored with the broken end of a small file through the top, close to the handle, a copper wire may be passed through the hole and around the handle, and made to terminate in a hook. The material to be infused is loosely tied up in a square piece of cheese cloth (coarse, thin muslin) and suspended from the hook; the hot water soon penetrates all parts of the drug and dissolves out the soluble principles by circulatory displacement. This method has the great advantage that no further straining is needed, as the bag retains the solid undissolved portion; the bag may be pressed and the contents then thrown away.

Official Infusions made by Maceration

Name	Ingredients	Use and Dose
Infusum Digitalis	15 Gm. Digitalis; 150 Cc. Cinnamon Water: 100 Cc. Alcohol; 500 Cc. Boiling Water; Cold Water to make 1000 Cc.	Diuretic, cardiac stimulant, fʒii (8 Cc.)
Sennæ Compositum	60 Gm. Senna; 120 Gm. Manna; 120 Gm. Magnesium Sulphate; 20 Gm. Fennel: 800 Cc. Boiling Water; Cold Water to make 1000 Cc.	Purgative, f℥ii to f℥iv (60 Cc. to 120 Cc.)

2. **By Digestion.**—The process of *digestion* consists in subjecting the substance to the continued action of moderate heat below the boiling temperature. In making infusions digestion is often very useful, although it may not be directed in the formula. It generally suffices to place the infusion vessel (see Fig. 433) upon a moderately

hot portion of the stove plate, or upon the floor near the stove or source of heat.

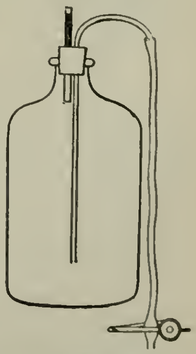
3. **By Percolation.**—This method of making infusions is by far the most satisfactory, and should be used whenever possible. It should be selected when the desirable principles are easily dissolved in water, and when the amount of menstruum is amply sufficient to exhaust the drug thoroughly. Percolation presents the advantages of furnishing a finished preparation, straining being unnecessary. Again, precipitation from the deposition of inert principles after the infusion has been strained, due to the principles being soluble in hot water but insoluble in cold water, is avoided. The chief drawback to the adoption of percolation in making infusions is the length of time it takes to exhaust the drug with water. Infusions are generally extemporaneous preparations, and they are frequently desired quickly; hence the process of maceration is often selected in preference.

Official Infusion made by Percolation

Name	Ingredients	Use and Dose
Infusum Pruni Virginianæ	40 Gm. Wild Cherry; 50 Cc. Glycerin; Water to make 1000 Cc.	Tonic, f℥ii (60 Cc.)

Preservation of Infusions.—The difficulty in preserving infusions arises from the decomposition of the principles which are extracted by water and retained in the preparation. If sufficient alcohol is added to prevent decomposition, the therapeutic action of the infusion is usually interfered with, owing to the comparatively large proportion of spirit contained in the dose. Alcohol is successfully used in preparations like infusion of gentian, orange peel, etc., or simple tonics. If an antiseptic, like boric acid, salicylic acid, sodium benzoate, or phenol, is used, the same objection exists,—the interference due to the therapeutic action of the antiseptic.

Fig. 434



Infusion bottle

It has been proved that infusions may be preserved for a long time if they are protected from the microscopic organisms which float in the air. A simple method is to heat the infusion contained in the bottle gradually to the boiling point, in order to destroy any of the spores that may be present, and then to transfer it at once to small bottles, which are filled to the brim, the corks forced in and tied over, and the cork, lip, and neck of each bottle dipped into hot sealing wax. A useful modification of Almen's method consists in heating to the boiling point the infusion contained in a bottle in a water bath. The rubber cork of the bottle is perforated so as to admit a long bent tube and a short tube; the short tube is loosely filled with cotton, the long limb of the bent tube is passed through the cork, and a rubber tube with a pinchcock attached, as shown in Fig. 434. The cotton permits the admission of air into the bottle, but excludes spores and dust. The infusion may be drawn as wanted from the bottle by the rubber tube and syphon, the flow being controlled by the pinchcock and started by suction.

Infusions from Fluidextracts.—The habit of making infusions from concentrated alcoholic tinctures or fluidextracts is improper and unjustifiable, except in those few cases in which the active and desirable principles of the drug are equally soluble in alcohol and in water, or in the menstrua used for both fluidextract and infusion. This is well illustrated in those preparations in which the activity of the drug is due to resinous bodies. Alcoholic menstrua here are necessary to dissolve the resins, and if such a fluidextract is added to water, precipitation takes place and the filtered infusion is worthless. If the precipitate is inert or does not carry down with it any portion of the active principle, and is readily separated, the only objection to the infusion is the presence of the alcohol, which may or may not seriously interfere with the therapeutic action, according as the quantity present is large or small. The saving in time and labor by making infusions in this way is the cause of the frequent employment of this method, but it should never be used if the therapeutic action of the drug is weakened thereby. The substitution of a fluidextract infusion in a prescription for one directed to be made by the official process is very reprehensible.

The introduction into the British Pharmacopœia (1898) of concentrated infusions made by percolation usually with 20 percent. alcohol (see Table on p. 281) has provoked some criticism on account of their instability through precipitation.

Infusa *Infusions*

General Official Formula.—An ordinary infusion, the strength of which is not directed by the physician, nor specified by the Pharmacopœia, shall be prepared by the following formula :

Take of	Metric	Old form
* **The Substance,** coarsely comminuted	50 Gm.	365 grains
Boiling Water	1000 Cc.	1 pint
Water, a sufficient quantity,		
To make	1000 Cc.	1 pint

Introduce the substance into a suitable vessel provided with a cover, pour upon it the Boiling Water, cover the vessel tightly, and let it stand for half an hour in a warm place. Then strain with expression, and pass enough Water through the strainer to make the Infusion measure 1000 Cc. [old form 1 pint].

Caution.—The strength of Infusions of energetic or powerful substances should be specially prescribed by the physician.

INFUSUM DIGITALIS. U.S. Infusion of Digitalis

	Metric	Old form
* **Digitalis,** bruised	15 Gm.	½ oz. av.
Alcohol	100 Cc.	3¼ fl. oz.
Cinnamon Water	150 Cc.	5 fl. oz.
Boiling Water	500 Cc.	1 pint
Cold Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Upon the Digitalis, contained in a suitable vessel, pour the Boiling Water, and allow it to macerate for one hour. Then strain, add the Alcohol and Cinnamon Water to the strained liquid, and pass enough Cold Water through the residue on the strainer to make the product measure 1000 Cc. [old form 2 pints]. Mix well.

Average dose.— 2 fluidrachms (8 Cc.).

INFUSUM PRUNI VIRGINIANÆ. U.S. Infusion of Wild Cherry

	Metric	Old form
* **Wild Cherry,** in No. 20 powder	40 Gm.	1 oz. av. 147 gr.
Glycerin	50 Cc.	1½ fl. oz.
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the powder with 60 Cc. [old form 2 fl. oz.] of Water, and allow it to macerate for one hour; then pack it firmly in a conical glass percolator, and, having placed the Glycerin in the receiving bottle, gradually pour Water upon the powder and continue percolation until the Infusion measures 1000 Cc. [old form 2 pints]. Mix well.

Average dose.— 2 fluidounces (60 Cc.).

INFUSUM SENNÆ COMPOSITUM. U.S. Compound Infusion of Senna

	Metric	Old form
* **Senna**	60 Gm.	2 oz. av.
Manna	120 Gm.	4 oz. av.
Magnesium Sulphate	120 Gm.	4 oz. av.
Fennel, bruised	20 Gm.	292 grains
Boiling Water	800 Cc.	25½ fl. oz.
Cold Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Upon the Senna, Manna, and Fennel, contained in a suitable vessel, pour the Boiling Water, and allow it to macerate for half an hour. Then strain with expression, dissolve the Magnesium Sulphate in the Infusion, and again strain. Lastly, add enough Cold Water through the strainer to make the Infusion measure 1000 Cc. [old form 2 pints].

Average dose.— 4 fluidounces (120 Cc.).

Unofficial Infusions

Name	Ingredients	Method of Preparation
Infusum Aurantii. Br.	50 Gm. Dried Bitter Orange Peel; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Aurantii Compositum. Br.	25 Gm. Dried Bitter Orange Peel; 12.5 Gm. Fresh Lemon Peel; 6.25 Gm. Cloves, bruised; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Buchu. Br.	50 Gm. Buchu Leaves; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Calumbæ. Br.	50 Gm. Columba Root; 1000 Cc. boiling Distilled Water	Infuse for half an hour; strain
Caryophylli. Br.	25 Gm. Cloves, bruised; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Cascarillæ. Br.	50 Gm. Cascarilla; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Chiratæ. Br.	50 Gm. Chiretta; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Cinchonæ. U.S. P. 1890	60 Gm. Cinchona; 10 Cc. Aromatic Sulphuric Acid; Water to make 1000 Cc.	Percolate the Cinchona with Water, to which the Acid has been added, to make 1000 Cc. of Infusion

Unofficial Infusions—*Continued*

Name	Ingredients	Method of Preparation
Infusum Cuspariæ. Br.	50 Gm. Cusparia Bark; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Ergotæ. Br.	50 Gm. Ergot, freshly crushed; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Gentianæ Compositum. Br.	12.5 Gm. Gentian Root, sliced; 12.5 Gm. Dried Bitter Orange Peel; 25 Gm. Fresh Lemon Peel; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Krameriæ. Br.	50 Gm. Krameria Root, bruised; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Lupuli. Br.	50 Gm. Hops; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Quassiæ. Br.	10 Gm. Quassia Wood, rasped; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Rhei. Br.	50 Gm. Rhubarb Root, sliced; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Rosæ Acidum. Br.	25 Gm. dried Red-Rose Petals; 12.5 Cc. Diluted Sulphuric Acid; 1000 Cc. boiling Distilled Water	Infuse the Red-Rose Petals in the Water, to which the Acid has been added, in a closed vessel during fifteen minutes; strain
Scoparii. Br.	100 Gm. Broom Tops, bruised; 1000 boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Senegæ. Br.	50 Gm. Senega Root, No. 10 powder; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for half an hour; strain
Sennæ. Br.	100 Gm. Senna; 6.25 Gm. Ginger, sliced; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Serpentariæ. Br.	50 Gm. Serpentary Rhizome, No. 10 powder; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain
Uvæ Ursi. Br.	50 Gm. Bearberry Leaves, bruised; 1000 Cc. boiling Distilled Water	Infuse in a covered vessel for fifteen minutes; strain

NOTE.—Processes for some largely used unofficial infusions are appended.

INFUSUM GENTIANÆ COMPOSITUM. U. S. 1870. Compound Infusion of Gentian

	Metric	U. S. 1870
Gentian, in moderately coarse powder	16 Gm.	½ troy oz.
Bitter Orange Peel, in moderately coarse powder	4 Gm.	60 grains
Coriander, in moderately coarse powder	4 Gm.	60 grains
Alcohol	60 Cc.	2 fl. oz.
Water, a sufficient quantity		

Mix the Alcohol with fourteen fluidounces of Water (435 Cc. metric), and, having moistened the mixed powders with three fluidrachms (12 Cc. metric) of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them, first, the remainder of the menstruum, and afterwards Water, until the filtered liquid measures a pint (500 Cc. metric).

Average dose.—4 fluidrachms (16 Cc.).

INFUSUM GENTIANÆ COMPOSITUM FORTIUS. Concentrated Compound Infusion of Gentian (quadruple strength)

	Metric	
Gentian, in moderately coarse powder	64 Gm.	2 troy oz.
Bitter Orange Peel, in moderately coarse powder	16 Gm.	½ troy oz.
Coriander, in moderately coarse powder	16 Gm.	½ troy oz.
Alcohol	60 Cc.	2 fl. oz.
Water	435 Cc.	14 fl. oz.

Mix the Alcohol with the Water, and, having moistened the mixed powders with one fluidounce (30 Cc. metric) of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them, first, the remainder of the menstruum, and afterwards Water, until the filtered liquid measures a pint (500 Cc. metric). This preparation keeps well, is four times the strength of the U. S. P. 1870 infusion, and may be diluted with Water containing Alcohol in the same proportion (1 Alcohol. 7 Water) when Compound Infusion of Gentian is prescribed. If water alone is used to dilute it, a precipitate is apt to occur.

INFUSUM ROSÆ COMPOSITUM. U.S. 1870. Compound Infusion of Rose

	Metric	U. S. 1870
Red Rose, dried petals	16 Gm.	½ troy oz.
Diluted Sulphuric Acid	12 Cc.	3 fl. dr.
Sugar, in coarse powder	48 Gm.	1½ troy oz.
Boiling Water	1250 Cc.	2½ pints

Pour the Water upon the Rose, in a covered glass or porcelain vessel; add the Acid, and macerate for half an hour. Lastly, dissolve the Sugar in the liquid, and strain.

INFUSUM SALVIÆ. U.S. 1870. Infusion of Sage

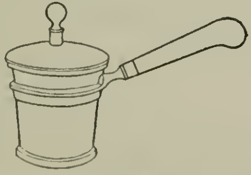
	Metric	U. S. 1870
Sage	16 Gm.	½ troy oz.
Boiling Water	500 Cc.	1 pint

Macerate for half an hour in a covered vessel, and strain.

Decocta *Decoctions*

Decoctions are liquid preparations made by *boiling* vegetable substances with water. The object sought in preparing decoctions is to secure, in aqueous solution, the soluble active principles of drugs which are not injured by heat. It is obvious that very few drugs are suited to this form of administration; and decoctions are rapidly declining in favor. Hot infusion will generally afford a means of obtaining all the benefits that are derived from boiling the drug with water, while the prolonged action of boiling water generally exercises a dissociating effect upon the active principles. The disadvantages of hot infusions are possessed in a more marked degree by decoctions (see page 326). In compound decoctions the ingredients are preferably added at different periods of the opera-

FIG. 435



Block tin decoction vessel

FIG. 436

Brass water bath

tion, the hard, ligneous drugs being added first, and the aromatics, or those containing volatile oils, at the close of the process, so that loss of activity of the latter may not ensue.

The earthenware or porcelain vessels used in preparing infusions are preferred for decoctions (see page 327), as they will bear the heat of boiling water, if heated gradually. Fig. 435 shows a block-tin vessel employed for preparing decoctions, used largely in Germany, and to some extent here. It is preferably used in connection with the brass water bath, R (see Fig. 436). The rim, F, is somewhat flexible, while a small aperture permits the escape of steam. The empyreumatic odor which many decoctions possess when made over a naked fire, and caused by particles adhering to the bottom of the vessel and becoming charred, is avoided by the use of the water bath.

Iron vessels are not used advantageously, because of the discoloration which is caused by the tannin of astringent drugs reacting with the iron.

A general formula for decoctions will be found in the U. S. P. (8th Rev.), but special formulas were not introduced (see below).

DECOCTA. U.S. Decoctions

General Formula U. S. P.—An ordinary Decoction, the strength of which is not directed by the physician, shall be prepared by the following formula:

Take of	Metric	Old form
***The Substance,** coarsely comminuted	50 Gm.	365 grains
Water, a sufficient quantity,		
To make	1000 Cc.	1 pint

Introduce the Substance into a suitable vessel provided with a cover, pour upon it 1000 Cc. [old form 1 pint] of cold Water, cover it well, and boil for fifteen minutes. Then allow it to cool to about 40° C. (104° F.), express, strain the expressed liquid, and pass enough cold Water through the strainer to make the product measure 1000 Cc. [old form 1 pint].

Caution.—The strength of Decoctions of energetic or powerful substances should be specially prescribed by the physician.

NOTE.—Processes for two largely used unofficial decoctions are appended.

DECOCTUM SARSAPARILLÆ COMPOSITUM FORTIUS. P.G. Zittmann's Decoction (Stronger)

	Metric	Old form
Sarsaparilla, cut	20 Gm.	2 oz. av.
Water	520 Cc.	50 fl. oz.

Digest for twenty-four hours, and, having added

	Metric	Old form
Sugar	1 Gm.	44 grains
Alum	1 Gm.	44 grains

expose them in a covered vessel, with occasional stirring, for three hours, to the heat of boiling water; then add to the mixture

	Metric	Old form
Anise, bruised	1 Gm.	44 grains
Fennel, bruised	1 Gm.	44 grains
Senna, cut	5 Gm.	½ oz. av.
Liquorice Root, cut	2 Gm.	88 grains

Digest for a quarter of an hour, and strain the liquid with expression. Allow the Decoction to settle; then pour off the liquid, and, by the addition of water, bring it to 500 Cc. [or 3 pints].

DECOCTUM SARSAPARILLÆ COMPOSITUM MITIUS. P. G. Zittmann's Decoction (Milder)

	Metric	Old form
Sarsaparilla, cut	10 Gm.	1 oz. av.
Water	480 Cc.	46 fl. oz.

Digest for twenty-four hours, and expose in a covered vessel, with occasional stirring, for three hours, to the heat of boiling water on a water bath. Then add to the decoction:

	Metric	Old form
Lemon Peel, cut	1 Gm.	44 grains
Cinnamon, bruised	1 Gm.	44 grains
Cardamom, bruised	1 Gm.	44 grains
Liquorice Root, cut	1 Gm.	44 grains

Digest for a quarter of an hour, and strain the liquid with expression. Allow the Decoction to settle; then pour off the liquid, and, by the addition of water, bring it to 500 Cc. [or 3 pints].

Unofficial Decoctions

Name	Ingredients	Method of Preparation
Decoctum Aloes Compositum. Br.	10 Gm. Extract Barbadoes Aloes; 5 Gm. each of Myrrh, Saffron, and Potassium Carbonate; 40 Gm. Extract Liquorice; 300 Cc. Compound Tincture of Cardamoms; Distilled Water to make 1000 Cc.	Coarsely powder the Extract of Aloes and Myrrh and boil them with the Potassium Carbonate and Extract of Liquorice, in 400 Cc. of Water, for five minutes, then add the Saffron and when cold the Compound Tincture of Cardamoms. Set aside for two hours, strain, and add Distilled Water to make 1000 Cc.
Cetrariæ. U. S. P. 1890	50 Gm. Cetraria; Water to make 1000 Cc.	Infuse the Cetraria, during half an hour, with 400 Cc. Cold Water, express, and throw the liquid away. Boil the residue with 1000 Cc. of Water for thirty minutes, strain, and add Water to make 1000 Cc.
Granati Corticis. Br.	200 Gm. Pomegranate Bark, No. 10 powder; Distilled Water to make 1000 Cc.	Boil the Pomegranate Bark with 1200 Cc. of Water for ten minutes, strain and add Water to make 1000 Cc.
Hæmatoxyli. Br.	50 Gm. Logwood, in chips; 8 Gm. Cinnamon Bark, bruised; Distilled Water to make 1000 Cc.	Boil the Logwood with 1200 Cc. of Water for ten minutes, adding the Cinnamon Bark toward the end of the time, strain, and add Water to make 1000 Cc.
Sarsaparillæ Compositum. U.S.P. 1890	100 Gm. Sarsaparilla, bruised; 20 Gm. Sassafras, No. 20 powder; 20 Gm. rasped Guaiacum Wood; 20 Gm. bruised Glycyrrhiza; 10 Gm. bruised Mezereum; Water to make 1000 Cc.	Boil the Sarsaparilla and Guaiacum Wood for thirty minutes with 1000 Cc. of Water, add the Sassafras, Glycyrrhiza, and Mezereum, cover and macerate for two hours. Finally, strain and add Cold Water to make 1000 Cc.

CHAPTER XXVII

ALCOHOLIC LIQUIDS MADE BY PERCOLATION OR MACERATION

Tincturæ *Tinctures*

TINCTURES are alcoholic solutions of medicinal substances. They differ from spirits in being made from *non-volatile* bodies, there being but one official exception to this rule.[1] They are made by percolation, maceration, solution, or dilution, and the menstrua employed in the official tinctures are alcohol, diluted alcohol of various strengths, aromatic spirit of ammonia, or mixtures of alcohol, water, and glycerin. The official tinctures are *sixty-four* in number. In some unofficial tinctures, ether, spirit of ether, ammoniated alcohol, and spirit of nitrous ether are used. The use of alcohol as a solvent for the active or useful principles in drugs has been practised for many years, but it has required a long time and much experience to determine the proper proportion of water to dilute the alcohol so that the menstrua should thoroughly exhaust the drugs without extracting the inert principles, and yet contain sufficient alcohol to secure permanent preparations that will not deposit in time a portion of their active constituents. The advantages of alcohol as a menstruum have been proved so thoroughly, that the use of aqueous preparations has greatly declined in this country; and yet there are some instances, particularly in the case of the weak tinctures and those requiring a large dose, in which the therapeutic action of the menstruum almost equals that of the drug. In these cases, however, the physician may prefer the fluidextract when he does not desire the stimulating action of the alcohol in the tincture.

In selecting the menstrua the proportion of water in each case was made as great as possible without endangering the permanency of the preparation, one especial advantage being that such tinctures may be added in small proportions to aqueous preparations without serious precipitation. In this respect tinctures have usually a great advantage over fluidextracts, and weaker alcoholic menstrua are often used successfully for tinctures when such would be entirely unsuitable for fluidextracts, because the tincture, on account of its comparative weakness, having a much larger proportion of menstruum than the fluidextract with which to exhaust the drug, may have the excess over the proportion of alcohol used in the fluidextract made up with water. It has been proved that a pint of diluted alcohol will extract by percolation a larger proportion of the soluble principles of a drug than half a pint of alcohol and half a pint of water percolated separately through the drug. The properties of *alcohol* are considered under another head (Part IV.), yet it seems desirable to notice here the solvent properties of this valuable preservative. It mixes freely with

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[1] Tincture of Iodine.

water, ether, acetic acid, a number of volatile oils, and castor oil; it dissolves resins, camphor, tannin, benzoic acid, chlorophyl, the alkaloids, balsams, iodine, ferric chloride, ammonium carbonate, etc. *Diluted alcohol* extracts from drugs, gum, extractive, chlorophyl, albumen, coloring matter, resins, volatile oils, alkaloids, sugar, tannin, etc. *Glycerin* is used in tinctures to prevent precipitation by retaining in solution principles which would otherwise in time be deposited.

Preparation.—Tinctures are officially made in three ways: 1. By percolation. 2. By maceration. 3. By solution or dilution.

1. **By Percolation.**—This is the best method for making tinctures, and it is always directed by the Pharmacopœia when practicable. Tinctures are made in this way from all drugs which are capable of being readily comminuted and displaced. The special advantages of percolation over maceration and expression are seen in the saving of time and labor, and in the greater efficiency of the product if the process has been carefully and skilfully performed. The introduction of metric measures into the U. S. Pharmacopœia of 1890 has greatly simplified the working formulas, there being now no calculations necessary to determine the end product; the employment of metric receiving bottles in percolating operations secures accuracy within reasonable limits, and their convenience will always be a recommendation. The use of parts by weight for tinctures proved unsatisfactory. If the drugs from which the tinctures are directed to be made could be standardized so that they would always contain a definite and uniform weight of the active principles, there might be an advantage in bringing the end product to a weight which would bear a simple relation to the proportion of active principles selected as a standard; but the Pharmacopœia, for obvious reasons, has not fixed a limit for even the amount of moisture in the air dried drugs, and to assay all of them and to fix a maximum and minimum limit of each active principle present in each drug would be impracticable, and in most cases impossible. Now, the variation in the amount of moisture and in the proportion of active principles in commercial drugs is far greater than is generally supposed; and so long as this ever present bar to uniformity is not overcome, it is useless to regard the trifling advantage supposed to exist in favor of accuracy and convenience in weighing liquids; practically, the question of accuracy resolves itself into one of personal error, for a careful operator will make more accurate tinctures by using measures than a careless one will by using weights, and *vice versa.*

2. **By Maceration.**—This method of making tinctures is officially used in the case of resins, balsams, gums, soap, etc., where the practical difficulties likely to be encountered in percolation would offset any advantages that the latter process might possess (see page 242).

3. **By Solution or Dilution.**—A few tinctures are made in this way, such as tincture of iodine by dissolving iodine in alcohol, and tincture of ferric chloride by diluting the solution of ferric chloride with alcohol.

The proportion of the drug to the finished product varies in the class of tinctures, but at the last revision of the U. S. Pharmacopœia an attempt was made to bring about some degree of uniformity by making the majority of them of two strengths,—10 percent. if made from potent drugs, 20 percent. if made from drugs which are not classed as powerful in their action. The selection of 10 percent. as the strength for potent tinctures was made by the International Conference held at Brussels in 1902, and as it is most desirable to promote uniformity in the strength of potent remedies throughout the world, the U. S. Pharmacopœia (8th Rev.) adopted the proposition, and in consequence there has been a reduction of strength of many of the strong tinctures, the most important changes being that of tincture of aconite from 35 percent. to 10 percent. and of tincture of veratrum from 40 percent. to 10 percent. A number of assay processes for tinctures containing alkaloids have been introduced in the U. S. P. (8th Rev.), and these will serve to bring about reliability and uniformity in strength.

The following tables exhibit the official tinctures, classified, so as to show their relative strength both as to weight and volume, the variations in menstrua, and other useful data :

Official Tinctures arranged in the Order of their Relative Strength, and other Data

Number of Grammes of most Active Agent or Drug represented by 100 Cc.	Number of Grains of most Active Ingredients represented by a Fluidrachm	Official Name	Fineness of Powder	Menstruum	Ingredients in 1000 Cc.
1.6	0.91	Tinctura Opii Camphorata	. . . .	Dil. Alcohol, 96 ; Glycerin, 4	4 Gm. Powdered Opium : 4 Gm. Benzoic Acid ; 4 Gm. Camphor ; 4 Cc. Oil of Anise
Ext. 2	1.14	Nucis Vomicæ	. . . .	Alc. 75 ; Wat. 25	20 Gm. Dried Extract
4.5	2.56	Lavandulæ Composita	. . . .	Alc. 75 ; Wat. 25	8 Cc. Oil of Lavender Flowers ; 2 Cc. Oil of Rosemary ; 20 Gm. Saigon Cinnamon ; 5 Gm. Cloves ; 10 Gm. Myristica ; 10 Gm. Red Saunders
5	2.85	Gambir Composita	50	Dil. Alcohol	50 Gm. Gambir ; 25 Gm. Saigon Cinnamon
5	2.85	Kino	. . . .	Alc. 65 ; Wat. 20 ; Glycerin, 15	50 Gm. Kino
5	2.85	Moschi	. . . .	Alc. 50 ; Wat. 50	50 Gm. Musk
6.2	3.53	Cardamomi Composita	. . . .	Dil. Alcohol, 95 ; Glycerin, 5	25 Gm. Cardamom ; 25 Gm. Saigon Cinnamon, 12 Gm. Caraway ; 5 Gm. Cochineal
7	3.99	Iodi	. . . .	Alcohol	70 Gm. Iodine ; 50 Gm. Potassium Iodide
10	5.70	Aconiti	60	Alc. 70 ; Wat. 30	100 Gm. Aconite. Assayed
10	5.70	Aloes	40	Dil. Alcohol	100 Gm. Purified Aloes ; 200 Gm. Glycyrrhiza
10	5.70	Belladonnæ Foliorum	60	Dil. Alcohol	100 Gm. Belladonna Leaves. Assayed
10	5.70	Cannabis Indicæ	40	Alcohol	100 Gm. Indian Cannabis
10	5.70	Cantharidis	60	Alcohol	100 Gm. Cantharides
10	5.70	Capsici	50	Alc. 95 ; Wat. 5	100 Gm. Capsicum
10	5.70	Colchici Seminis	50	Alc. 60 ; Wat. 40	100 Gm. Colchicum Seed. Assayed
10	5.70	Digitalis	60	Dil. Alcohol	100 Gm. Digitalis
10	5.70	Gelsemii	60	Alc. 65 ; Wat. 35	100 Gm. Gelsemium
10	5.70	Gentianæ Composita	. . . .	Alc. 60 ; Wat. 40	100 Gm. Gentian ; 40 Gm. Bitter Orange Peel ; 10 Gm. Cardamom

Tinctures, U. S. P.—*Continued*

Number of Grammes of most Active Agent or Drug represented by 100 Cc.	Number of Grains of most Active Ingredients represented by a Fluidrachm.	Official Name	Fineness of Powder	Menstruum	Ingredients in 1000 Cc.
10	5.70	Tinctura Hyoscyami	60	Dil. Alcohol	100 Gm. Hyoscyamus. Assay
10	5.70	Lobeliæ	50	Dil. Alcohol	100 Gm. Lobelia
10	5.70	Opii	. . . .	Alc. 50; Wat. 50	100 Gm. Granulated Opium. Assayed
10	5.70	Opii Deodorati	. . . .	Alc. 20; Wat. 80	100 Gm. Granulated Opium. Assayed
10	5.70	Physostigmatis	50	Alcohol	100 Gm. Physostigma. Assay
10	5.70	Sanguinariæ	60	Alc. 60; Wat. 40; Acetic Acid, 2	100 Gm. Sanguinaria
10	5.70	Scillæ	20	Alc. 75; Wat. 25	100 Gm. Squill
10	5.70	Stramonii	60	Dil. Alcohol	100 Gm. Stramonium. Assayed
10	5.70	Strophanthi	60	Alc. 65; Wat. 35	100 Gm. Strophanthus
10	5.70	Vanillæ	Cut and bruised	Alc. 65; Wat. 35	100 Gm. Vanilla; 200 Gm. Sugar
10	5.70	Veratri	60	Alcohol	100 Gm. Veratrum
13.3	7.57	Ferri Chloridi	. . . .	Alc. 75; Wat. 25	350 Cc. Solution of Ferric Chloride
20	11.40	Aloes et Myrrhæ	40	Alc. 75; Wat. 25	100 Gm. Aloes; 100 Gm. Myrrh; 100 Gm. Glycyrrhiza
20	11.40	Arnicæ	20	Dil. Alcohol	200 Gm. Arnica
20	11.40	Asafœtidæ	Bruised	Alcohol	200 Gm. Asafetida
20	11.40	Aurantii Amari	40	Alc. 60; Wat. 40	200 Gm. Bitter Orange Peel
20	11.40	Benzoini	40	Alcohol	200 Gm. Benzoin
20	11.40	Calendulæ	20	Alcohol	200 Gm. Calendula
20	11.40	Calumbæ	20	Alc. 60; Wat. 40	200 Gm. Calumba
20	11.40	Cardamomi	30	Dil. Alcohol	200 Gm. Cardamom
20	11.40	Cimicifugæ	40	Alcohol	200 Gm. Cimicifuga
20	11.40	Cinchonæ	60	Alc. 67.5; Wat. 25; Glycerin, 7.5	200 Gm. Cinchona. Assayed
20	11.40	Cinchonæ Composita	. . . .	Alc. 67.5; Wat. 25; Glycerin, 7.5	100 Gm. Red Cinchona; 80 Gm. Bitter Orange Peel; 20 Gm. Serpentaria
20	11.40	Cinnamomi	50	Alc. 67.5; Wat. 25; Glycerin, 7.5	200 Gm. Saigon Cinnamon
20	11.40	Gallæ	40	Alcohol, 90; Glycerin, 10	200 Gm. Nutgall
20	11.40	Guaiaci	40	Alcohol	200 Gm. Guaiac
20	11.40	Guaiaci Ammoniata	40	Aromatic Spirit of Ammonia	200 Gm. Guaiac
20	11.40	Hydrastis	60	Alc. 65; Wat. 35	200 Gm. Hydrastis. Assayed
20	11.40	Ipecacuanhæ et Opii	. . . .	. . . .	1000 Cc. Deodorized Tincture of Opium; evaporate off 100 Cc. and add 100 Cc. Fluidextract of Ipecac
20	11.40	Krameriæ	40	Dil. Alcohol	200 Gm. Krameria
20	11.40	Myrrhæ	Course powder	Alcohol	200 Gm. Myrrh
20	11.40	Pyrethri	50	Alcohol	200 Gm. Pyrethrum
20	11.40	Quassiæ	50	Alc. 35; Wat. 65	200 Gm. Quassia
20	11.40	Quillajæ	20	Alc. 35; Wat. 65	200 Gm. Quillaja
20	11.40	Rhei	. . . .	Alc. 50; Wat. 40; Glycerin, 10	200 Gm. Rhubarb; 40 Gm. Cardamom
20	11.40	Rhei Aromatica	. . . .	Alc. 50; Wat. 40; Glycerin, 10	200 Gm. Rhubarb; 40 Gm. Saigon Cinnamon; 40 Gm. Cloves; 20 Gm. Myristica
20	11.40	Serpentariæ	50	Alc. 65; Wat. 35	200 Gm. Serpentaria

Tinctures, U. S. P.—*Continued*

Number of Grammes of most Active Agent or Drug represented by 100 Cc.	Number of Grains of most Active Ingredients represented by a Fluidrachm	Official Name	Fineness of Powder	Menstruum	Ingredients in 1000 Cc.
20	11.40	Tinctura Tolutana	. . . .	Alcohol	200 Gm. Balsam of Tolu
20	11.40	Valerianæ	60	Alc. 75; Wat. 25	200 Gm. Valerian
20	11.40	Valerianæ Ammoniata	60	Aromatic Spirit of Ammonia	200 Gm. Valerian
20	11.40	Zingiberis	50	Alcohol	200 Gm. Ginger
24	13.68	Benzoini Composita	40	Alcohol	100 Gm. Benzoin; 20 Gm. Purified Aloes; 80 Gm. Storax; 40 Gm. Balsam of Tolu
50	28.50	Aurantii Dulcis	. . . .	Alcohol	500 Gm. Sweet Orange Peel (fresh)
50	28.50	Lactucarii	. . . .	Alcohol, Water, and Glycerin	500 Gm. Lactucarium
50	28.50	Limonis Corticis	. . . .	Alcohol	500 Gm. Lemon Peel (fresh)
50	28.50	Tincturæ Herbarum Recentium	Cut, bruised, or crushed	Alcohol	500 Gm. of the Fresh Herb

Table of Compound Official Tinctures (arranged Alphabetically) with Data showing Total Amount of Ingredients represented by the Tincture

Total number of Grammes of Ingredients represented by 100 Cc.	Total number of Grains of Ingredients represented by one fluidrachm	Official Name	Ingredients in 1000 Cc.
30	17.10	Aloes	100 Gm. Purified Aloes; 200 Gm. Glycyrrhiza
30	17.10	Aloes et Myrrhæ	100 Gm. Purified Aloes; 100 Gm. Myrrh; 100 Gm. Glycyrrhiza
24	13.68	Benzoini Composita	100 Gm. Benzoin; 20 Gm. Purified Aloes; 80 Gm. Storax; 40 Gm. Balsam of Tolu
6.7	3.82	Cardamomi Composita	25 Gm. Cardamom; 25 Gm. Saigon Cinnamon; 12 Gm. Caraway; 5 Gm. Cochineal
20	11.40	Cinchonæ Composita	100 Gm. Red Cinchona; 80 Gm. Bitter Orange Peel; 20 Gm. Serpentaria
7.5	4.27	Gambir Composita	50 Gm. Gambir; 25 Gm. Saigon Cinnamon
15	8.55	Gentianæ Composita	100 Gm. Gentian; 40 Gm. Bitter Orange Peel; 10 Gm. Cardamom
20	11.40	Ipecacuanhæ et Opii	1000 Cc. Tincture of Deodorized Opium, evaporate off 100 Cc. and add 100 Cc. Fluid Extract of Ipecac
5.5	3.13	Lavandulæ Composita	8 Cc. Oil of Lavender Flowers; 2 Cc. Oil of Rosemary; 20 Gm. Saigon Cinnamon; 5 Gm. Cloves; 10 Gm. Myristica; 10 Gm. Red Saunders
1.6	0.91	Opii Camphorata	4 Gm. Powdered Opium; 4 Gm. Benzoic Acid; 4 Gm. Camphor; 4 Cc. Oil of Anise
24	13.68	Rhei	200 Gm. Rhubarb; 40 Gm. Cardamom
30	17.10	Rhei Aromatica	200 Gm. Rhubarb; 40 Gm. Saigon Cinnamon; 40 Gm Cloves; 20 Gm. Myristica
30	17.10	Vanillæ	100 Gm. Vanilla; 200 Gm. Sugar

Unofficial Tinctures

Name	Ingredients	Method of Preparation
Tinctura Arnicæ Radicis. U. S. P. 1890	100 Gm. Arnica Root, No. 40 powder; Alcohol (65 percent.) to make 1000 Cc.	Percolate the drug with the menstruum to make 1000 Cc.
Bryoniæ. U. S. P. 1890.	100 Gm. Bryonia, No. 40 powder; Alcohol to make 1000 Cc.	Percolate the drug with Alcohol, after macerating twenty-four hours, to make 1000 Cc.
Buchu. Br.	200 Gm. Buchu Leaves, No. 20 powder; Alcohol (60 percent.) to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Cascarillæ. Br.	200 Gm. Cascarilla, No. 40 powder; Alcohol (70 percent.) to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Chiratæ. Br. U. S. P. 1890	100 Gm. Chirata, No. 40 powder; Alcohol (about 60 percent.) to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Chloroformi et Morphinæ Composita. Br.	75 Cc. Chloroform; 10 Gm. Morphine Hydrochloride; 50 Cc. Diluted Hydrocyanic Acid; 25 Cc. Tincture of Capsicum; 100 Cc. Tincture of Indian Hemp; 1.5 Cc. Oil of Peppermint; 250 Cc. Glycerin; Alcohol (90 percent.) to make 1000 Cc.	Mix the Chloroform, Tinctures of Capsicum, and Indian Hemp, Oil of Peppermint, and Glycerin with 450 Cc. of Alcohol, dissolve the Morphine Hydrochloride in the mixture, add the Diluted Hydrocyanic Acid and Alcohol to make 1000 Cc.
Cocci. Br.	100 Gm. Cochineal, in powder; Alcohol (45 percent.) 1000 Cc.	Macerate during seven days, frequently agitating, strain, express, and filter liquid if necessary
Conii. Br.	200 Gm. Conium Fruit, No. 40 powder; Alcohol (70 percent.) to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Croci. U. S. P. 1890	100 Gm. Saffron; Diluted Alcohol to make 1000 Cc.	Percolate the drug with Diluted Alcohol to make 1000 Cc.
Cubebæ. U.S.P. 1890	200 Gm. Cubeb, No. 30 powder; Alcohol to make 1000 Cc.	Percolate the drug with Alcohol, after twenty-four hours maceration, to make 1000 Cc.
Ergotæ Ammoniata. Br.	250 Gm. Ergot, No. 20 powder; 100 Cc. Solution of Ammonia (10 percent.); Alcohol (60 percent.) to make 1000 Cc.	Percolate the drug with 900 Cc. of the 60 percent. Alcohol, to which the Solution of Ammonia has been added, and continue with the Alcohol to make 1000 Cc. Set aside for twenty-four hours, filter if necessary
Hamamelidis. Br.	100 Gm. Hamamelis Bark, No. 20 powder; Alcohol (45 percent.) to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Humuli. U.S.P. 1890	200 Gm. Hops, No. 20 powder; Diluted Alcohol to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Jaborandi. Br.	200 Gm. Jaborandi Leaves, No. 40 powder; Alcohol (45 percent.) to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Jalapæ. Br.	200 Gm. Jalap, No. 40 powder; Alcohol (70 percent.), a sufficient quantity	Percolate the drug with the menstruum, to make 600 Cc. of percolate, express the marc, mix the two liquids, then set it aside for twenty-four hours, and filter. Assay for Resin, and add menstruum to make each 100 Cc. contain 1.5 Gm. of Resin
Limonis. Br.	250 Gm. Fresh Lemon Peel, shredded; Alcohol (90 percent.) 1000 Cc.	Macerate during seven days, frequently agitating, strain, express, and filter liquid if necessary
Lobeliæ Ætherea. Br.	200 Gm. Lobelia, No. 40 powder; Spirit of Ether to make 1000 Cc.	Percolate the drug with Spirit of Ether, after macerating for twenty-four hours, to make 1000 Cc.
Matico. U.S.P. 1890	100 Gm. Matico, No. 40 powder; Diluted Alcohol to make 1000 Cc.	Percolate the drug with Diluted Alcohol, after maceration for twenty-four hours, to make 1000 Cc.
Opii Ammoniata. Br.	150 Cc. Tincture of Opium; 20.6 Gm. Benzoic Acid; 6.25 Cc. Oil of Anise; 200 Cc. Solution of Ammonia (10 percent.); Alcohol (90 percent.) to make 1000 Cc.	Dissolve the Oil of Anise and Benzoic Acid in 600 Cc. of Alcohol; add the Tincture of Opium and Solution of Ammonia, mix, filter, and add enough of the Alcohol to make 1000 Cc.

Unofficial Tinctures—*Continued*

Name	Ingredients	Method of Preparation
Tinctura Podophylli. Br.	36.5 Gm. Podophyllum Resin; Alcohol (90 percent.) to make 1000 Cc.	Add the Resin to 900 Cc. of the Alcohol; set aside for twenty-four hours, occasionally agitating; filter, and add enough Alcohol to make 1000 Cc.
Pruni Virginianæ. Br.	200 Gm. Wild Cherry Bark, No. 20 powder; 625 Cc. Alcohol; 375 Cc. Water	Mix the drug with the Water; set aside for twenty-four hours, then add the Alcohol and macerate during seven days, frequently agitating; strain, express, and filter liquid if necessary
Quininæ. Br.	20 Gm. Quinine Hydrochloride; 1000 Cc. Tincture of Orange	Dissolve the Quinine Hydrochloride in the Tincture of Orange
Quininæ Ammoniata. Br.	20 Gm. Quinine Sulphate; 100 Cc. Solution of Ammonia (10 percent.); 900 Cc. Alcohol (60 percent.)	Mix the Solution of Ammonia with the Alcohol, add the Quinine Sulphate, and shake until a clear solution results; set it aside for three days, and filter
Rhei Dulcis. U. S. P. 1890	100 Gm. Rhubarb; 40 Gm. Glycyrrhiza; 40 Gm. Anise; 10 Gm. Cardamom; 100 Cc. Glycerin; Alcohol and Water to make 1000 Cc.	Reduce the Rhubarb, Glycyrrhiza, Anise, and Cardamom to a No. 40 powder; mix the Glycerin with 500 Cc. Alcohol and 400 Cc. Water, and percolate the mixed powders, after twenty-four hours maceration, with this menstruum, finishing with Diluted Alcohol to make 1000 Cc.
Senegæ. Br.	200 Gm. Senega Root, No. 40 powder; Alcohol (60 percent.) to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.
Sennæ Composita. Br.	200 Gm. Senna, broken; 100 Gm. Raisins (seeded); 25 Gm. Caraway Fruit, bruised; 25 Gm. Coriander Fruit, bruised; 1000 Cc. Alcohol (45 percent.)	Macerate the drugs with the 45 percent. Alcohol during seven days, express, and filter liquid if necessary
Stramonii Seminis. U. S. P. 1890	150 Gm. Stramonium Seed, No. 40 powder; Diluted Alcohol to make 1000 Cc.	Percolate the drug with Diluted Alcohol, after macerating twenty-four hours, to make 1000 Cc.
Sumbul. U. S. P. 1890	100 Gm. Sumbul, No. 30 powder; Alcohol, 65, and Water, 35, to make 1000 Cc.	Percolate the drug with the menstruum, after twenty-four hours maceration, to make 1000 Cc.

TINCTURA ACONITI. U. S. Tincture of Aconite

Note.—The strength of this Tincture has been reduced from 35 Gm. of Aconite in 100 Cc. (Pharm. 1890) to 10 Gm. of Aconite in 100 Cc.

	Metric	Old form
* **Aconite,** in No. 60 powder (containing not less than 0.5 percent. of aconitine)	100 Gm.	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix Alcohol and Water in the proportion of 700 Cc. [old form 22½ fl. oz.] of Alcohol to 300 Cc. [old form 9½ fl. oz.] of Water. Moisten the Aconite with 40 Cc. [old form 1½ fl. oz.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it very firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum until 1000 Cc. [old form 2 pints] are obtained.

Tincture of Aconite, when assayed by the process given below, should contain in 100 Cc., 0.045 Gm. of aconitine.

Assay of Tincture of Aconite

Transfer 100 Cc. of Tincture of Aconite to an evaporating dish and evaporate it carefully to dryness at a temperature not exceeding 60° C. (140° F.), and assay the resulting extract by the method given under *Fluidextractum Aconiti*, page 382, using the same details as there directed for 10 Cc. of Fluidextract of Aconite, with the exception that the multiplication of the product by 10 must be omitted; the result will represent the weight in grammes of aconitine contained in 100 Cc. of Tincture of Aconite.

Average dose.— 10 minims (0.6 Cc.).

TINCTURA ALOES. U.S. Tincture of Aloes

	Metric	Old form
* **Purified Aloes,** in No. 40 powder	100 Gm	3 oz. av. 148 gr.
Glycyrrhiza, in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Purified Aloes and Glycyrrhiza in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of Diluted Alcohol, for seven days, with occasional agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pass enough Diluted Alcohol through the residue to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA ALOES ET MYRRHÆ. U.S. Tincture of Aloes and Myrrh

	Metric	Old form
* **Purified Aloes,** in No. 40 powder	100 Gm.	3 oz. av. 148 gr.
Myrrh, in No. 40 powder	100 Gm.	3 oz. av. 148 gr.
Glycyrrhiza, in No. 40 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 750 Cc. [old form 24 fl. oz.] of Alcohol with 250 Cc. [old form 8 fl. oz.] of Water. Macerate the Purified Aloes, Myrrh, and Glycyrrhiza in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of the menstruum, for seven days, with occasional agitation; then filter through purified cotton, or a plain filter, and, when the liquid has drained off completely, pass enough menstruum through the residue to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA ARNICÆ. U.S. Tincture of Arnica

[TINCTURA ARNICÆ FLORUM, PHARM. 1890]

	Metric	Old form
* **Arnica,** in No. 20 powder	200 Gm.	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Arnica with 500 Cc. [old form 1 pint] of Diluted Alcohol in a closed vessel, in a moderately warm place, for three days, with occasional stirring, and express strongly. Repeat this operation twice successively with 250 Cc. [old form 8 fl. oz.] of Diluted Alcohol, macerating for twenty-four hours each time; then, having ascertained the volume of the united expressed liquids, macerate the residual marc for six hours with sufficient menstruum to make approximately 1000 Cc. [old form 2 pints], and express as before. Mix the expressed liquids, filter through paper, and pass sufficient Diluted Alcohol through the filter to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA ASAFŒTIDÆ. U.S. Tincture of Asafetida

	Metric	Old form
* **Asafetida**, well bruised	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Asafetida in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of Alcohol, during three days, with frequent agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pass enough Alcohol through the residue to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA AURANTII AMARI. U.S. Tincture of Bitter Orange Peel

	Metric	Old form
* **Bitter Orange Peel**, in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 600 Cc. [old form 19 fl. oz.] of Alcohol with 400 Cc. [old form 13 fl. oz] of Water. Moisten the Bitter Orange Peel with 80 Cc. [old form 2½ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA AURANTII DULCIS. U.S. Tincture of Sweet Orange Peel

	Metric	Old form
* **Sweet Orange Peel**, from the fresh fruit, in thin shavings and cut into narrow shreds	500 Gm.	16 oz. av. 302 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Sweet Orange Peel in a stoppered wide-mouthed container and in a moderately warm place, with 1000 Cc. [old form 2 pints] of Alcohol, during forty-eight hours, with frequent agitation; then filter through purified cotton, and, when the liquid has drained off completely, gradually pass enough menstruum through the residue to make 1000 Cc. [old form 2 pints] of Tincture; finally, filter it through paper.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA BELLADONNÆ FOLIORUM. U.S. Tincture of Belladonna Leaves

	Metric	Old form
* **Belladonna Leaves,** in No. 60 powder (containing not less than 0.3 percent. of alkaloids)	100 Gm.	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the powder with 40 Cc. [old form 1½ fl. oz.] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for three hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually pouring on Diluted Alcohol until 1000 Cc. [old form 2 pints] of percolate are obtained.

Tincture of Belladonna Leaves, when assayed by the process given below, should contain in 100 Cc., 0.03 Gm. of the alkaloids from Belladonna Leaves.

Assay of Tincture of Belladonna Leaves

Transfer 100 Cc. of Tincture of Belladonna Leaves to an evaporating dish and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Belladonnæ Radicis* (page 384), using the same details as there directed for 10 Cc. of Fluidextract of Belladonna Root, with the exception that the multiplication of the product by 10 be omitted; the result will represent the weight in grammes of alkaloids contained in 100 Cc. of Tincture of Belladonna Leaves.

Average dose.— 8 minims (0.5 Cc.).

TINCTURA BENZOINI. U.S. Tincture of Benzoin

	Metric	Old form
* **Benzoin,** in No. 40 powder.	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Benzoin with 250 Cc. [old form 8 fl. oz.] of Alcohol until a uniform magma is obtained. Transfer this to a stoppered container with the aid of 500 Cc. [old form 1 pint] of Alcohol, and set it aside in a moderately warm place, shaking frequently during three days. Then transfer the mixture to a paper filter, and when the liquid has drained off completely, pour on enough Alcohol to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA BENZOINI COMPOSITA. U. S. Compound Tincture of Benzoin.

	Metric	Old form
* **Benzoin,** in No. 40 powder	100 Gm.	3 oz. av. 148 gr.
Purified Aloes, in No. 40 powder	20 Gm.	292 grains
Storax	80 Gm.	2 oz. av. 293 gr.
Balsam of Tolu	40 Gm.	1 oz. av. 147 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Benzoin and Purified Aloes with 250 Cc. [old form 8 fl. oz.] of Alcohol until a uniform magma is obtained. Transfer this to a stoppered container with the aid of 500 Cc. [old form 1 pint] of Alcohol, add the Storax and Balsam of Tolu, and set the mixture aside in a moderately warm place, shaking it frequently during three days; then transfer it to a paper filter, and, when the liquid has drained off completely, pour on enough Alcohol to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA CALENDULÆ. U. S. Tincture of Calendula

	Metric	Old form
* **Calendula,** in No. 20 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Calendula with 80 Cc. [old form 2½ fl. oz.] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it very firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

TINCTURA CALUMBÆ. U. S. Tincture of Calumba

	Metric	Old form
* **Calumba,** in No. 20 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 600 Cc. [old form 19 fl. oz.] of Alcohol with 400 Cc. [old form 13 fl. oz.] of Water. Moisten the Calumba with 100 Cc. [old form 3¼ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for twenty-four hours; then pack it with moderate pressure, pour on enough menstruum to saturate the powder and leave a stratum above it, and allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA CANNABIS INDICÆ. U.S. Tincture of Indian Cannabis

	Metric	Old form
* **Indian Cannabis,** in No. 40 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Indian Cannabis with 50 Cc. [old form $1\frac{3}{4}$ fl. oz.] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered for six hours; then pack it very firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 10 minims (0.6 Cc.).

TINCTURA CANTHARIDIS. U.S. Tincture of Cantharides

NOTE.—The strength of this tincture has been increased in the U. S. P., 8th Rev., from 5 Gm. in 100 Cc. to 10 Gm. in 100 Cc.

	Metric	Old form
* **Cantharides,** in No. 60 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Cantharides with 35 Cc. [old form $1\frac{1}{4}$ fl. oz.] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it very firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 5 minims (0.3 Cc.).

TINCTURA CAPSICI. U.S. Tincture of Capsicum

NOTE.—The strength of this tincture has been increased in the U. S. P., 8th Rev., from 5 Gm. in 100 Cc. to 10 Gm. in 100 Cc.

	Metric	Old form
* **Capsicum,** in No. 50 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 950 Cc. [old form 30 fl. oz.] of Alcohol with 50 Cc. [old form 2 fl. oz.] of Water. Moisten the Capsicum with 35 Cc. [old form $1\frac{1}{4}$ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow

the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 8 minims (0.5 Cc.).

TINCTURA CARDAMOMI. U.S. Tincture of Cardamom

	Metric	Old form
* **Cardamom,** in No. 30 powder	200 Gm.	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Cardamom with 80 Cc. [old form 2½ fl. oz.] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Diluted Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA CARDAMOMI COMPOSITA. U.S. Compound Tincture of Cardamom

	Metric	Old form
* **Cardamom**	25 Gm.	365 grains
Saigon Cinnamon	25 Gm.	365 grains
Caraway	12 Gm.	175 grains
Cochineal	5 Gm.	73 grains
Glycerin	50 Cc.	1½ fl. oz.
Diluted Alchol, a sufficient quanity,		
To make	1000 Cc.	2 pints

Mix the Glycerin with 950 Cc. [old form 30 fl. oz.] of Diluted Alcohol. Reduce the Cardamom, Saigon Cinnamon, Caraway, and Cochineal to a No. 40 powder, and macerate this powder in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of the menstruum during seven days, with occasional agitation; then filter through purified cotton, or a plain filter, and, when the liquid has drained off completely, pour on the residue, first the remainder of the menstruum, and then sufficient Diluted Alcohol to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA CIMICIFUGÆ. U.S. Tincture of Cimicifuga

	Metric	Old form
* **Cimicifuga,** in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Cimicifuga with 60 Cc. [old form 2 fl. oz.] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA CINCHONÆ. U.S. Tincture of Cinchona

	Metric	Old form
* **Cinchona**, in No. 60 powder (yielding not less than 4 percent. of anhydrous ether-soluble alkaloids) . .	200 Gm.	6 oz. av. 296 gr.
Glycerin	75 Cc.	2½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Glycerin with 675 Cc. [old form 21½ fl. oz.] of Alcohol and 250 Cc. [old form 8 fl. oz.] of Water. Moisten the Cinchona with 80 Cc. [old form 2½ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, until 1000 Cc. [old form 2 pints] of percolate are obtained.

Tincture of Cinchona, when assayed by the process given below, should contain in 100 Cc., 0.75 Gm. of anhydrous ether-soluble alkaloids of Cinchona.

Assay of Tincture of Cinchona

Transfer 50 Cc. of Tincture of Cinchona to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc., transfer the liquid to a bottle having the capacity of about 180 Cc., rinsing the dish with 10 Cc. of diluted alcohol, then assay the resulting liquid by the method given under *Fluidextractum Cinchonæ* (page 389), with the exception that the multiplication of the product should be by 4 instead of 20; the result will represent the weight in grammes of anhydrous ether-soluble alkaloids contained in 100 Cc. of Tincture of Cinchona.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA CINCHONÆ COMPOSITA. U.S. Compound Tincture of Cinchona

	Metric	Old form
* **Red Cinchona** (yielding not less than 5 percent. of anhydrous cinchona alkaloids)	100 Gm.	3 oz. av. 148 gr.
Bitter Orange Peel	80 Gm.	2 oz. av. 293 gr.
Serpentaria	20 Gm.	292 grains
Glycerin	75 Cc.	2½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Glycerin with 675 Cc. [old form 21½ fl. oz.] of Alcohol and 250 Cc. [old form 8 fl. oz.] of Water. Reduce the Red Cinchona, Bitter Orange Peel, and Serpentaria to a No. 60 powder, moisten this powder with 80 Cc. [old form 2½ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA CINNAMOMI. U.S. Tincture of Cinnamon

	Metric	Old form
* **Saigon Cinnamon,** in No. 50 powder	**200 Gm.**	6 oz. av. 296 gr.
Glycerin	**75 Cc.**	2½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Mix the Glycerin with 675 Cc. [old form 21½ fl. oz.] of Alcohol and 250 Cc. [old form 8 fl. oz.] of Water. Moisten the Saigon Cinnamon with 80 Cc. [old form 2½ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA COLCHICI SEMINIS. U.S. Tincture of Colchicum Seed

	Metric	Old form
* **Colchicum Seed,** in No. 50 powder (containing not less than 0.45 percent. of colchicine)	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Mix 600 Cc. [old form 19 fl. oz.] of Alcohol with 400 Cc. [old form 13 fl. oz.] of Water. Moisten the Colchicum Seed with 40 Cc. [old form 1½ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of percolate.

Tincture of Colchicum Seed, when assayed by the process given below, should contain in 100 Cc., 0.04 Gm. of colchicine.

Assay of Tincture of Colchicum Seed

Transfer 100 Cc. of Tincture of Colchicum Seed to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Colchici Seminis* (page 391), with the exception that the multiplication of the product by 10 be omitted ; the result will represent the weight in grammes of colchicine contained in 100 Cc. of Tincture of Colchicum Seed.

Average dose.— 30 minims (2 Cc.).

TINCTURA DIGITALIS. U.S. Tincture of Digitalis

	Metric	Old form
* **Digitalis,** in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Moisten the Digitalis with 40 Cc. [old form 1½ fl. oz.] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours ; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA FERRI CHLORIDI. U.S. Tincture of Ferric Chloride

A hydro-alcoholic solution of Ferric Chloride [$FeCl_3 = 161.04$] containing not less than 13.28 percent. of the anhydrous salt, corresponding to 4.6 (4.58) percent. of metallic iron.

	Metric	Old form
* **Solution of Ferric Chloride**	**350 Cc.**	22 fl. oz. 3 fl. dr.
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	4 pints

Mix the Solution with enough Alcohol to make 1000 Cc. [old form 4 pints]. Let the Tincture stand, in a closely covered vessel, protected from light, at least three months ; then transfer it to glass-stoppered bottles, and keep it protected from light.

(For tests and comments, see Part III.)

Average dose.— 8 minims (0.5 Cc.).

TINCTURA GALLÆ. U.S. Tincture of Nutgall

	Metric	Old form
* **Nutgall,** in No. 40 powder	**200 Gm.**	6 oz. av. 296 gr.
Glycerin	**100 Cc.**	3¼ fl. oz.
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Mix the Glycerin with 900 Cc. [old form 28¾ fl. oz.] of Alcohol. Introduce the Nutgall, without moistening it, into a glass percolator, shaking down the powder evenly and compactly, and pour on sufficient of the menstruum to saturate it and leave a stratum above it. Allow the percolation to proceed slowly, pouring on the remainder of the menstruum, and then sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA GAMBIR COMPOSITA. U.S. Compound Tincture of Gambir

[To replace Tinctura Catechu Composita, Pharm. 1890]

	Metric	Old form
***Gambir**, in No. 50 powder	50 Gm.	1 oz. av. 293 gr.
Saigon Cinnamon, in No. 50 powder	25 Gm.	365 grains
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Gambir and Saigon Cinnamon in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of Diluted Alcohol during forty-eight hours, with frequent agitation; then filter through purified cotton, or a plain filter, and, when the liquid has drained off completely, pass enough menstruum through the residue to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.—1 fluidrachm (4 Cc.).

TINCTURA GELSEMII. U.S. Tincture of Gelsemium

	Metric	Old form
***Gelsemium**, in No. 60 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 650 Cc. [old form 21 fl. oz.] of Alcohol with 350 Cc. [old form 11 fl. oz.] of Water. Moisten the Gelsemium with 35 Cc. [old form 1¼ fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.—8 minims (0.5 Cc.).

TINCTURA GENTIANÆ COMPOSITA. U.S. Compound Tincture of Gentian

	Metric	Old form
***Gentian**	100 Gm.	3 oz. av. 148 gr.
Bitter Orange Peel	40 Gm.	1 oz. av. 147 gr.
Cardamom	10 Gm.	146 grains
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 600 Cc. [old form 19 fl. oz.] of Alcohol with 400 Cc. [old form 13 fl. oz.] of Water. Reduce the Gentian, Bitter Orange Peel, and Cardamom to a No. 40 powder, moisten this powder with 60 Cc. [old form 2 fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for twelve hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twelve hours; then

allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA GUAIACI. U.S. Tincture of Guaiac

	Metric	Old form
* **Guaiac,** in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Guaiac in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of Alcohol during three days, with frequent agitation; then filter, and when the liquid has drained off, pour on enough Alcohol to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA GUAIACI AMMONIATA. U.S. Ammoniated Tincture of Guaiac

	Metric	Old form
* **Guaiac,** in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Aromatic Spirit of Ammonia, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Guaiac in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of Aromatic Spirit of Ammonia during three days, with frequent agitation; then filter, and, when the liquid has drained off, pour on enough Aromatic Spirit of Ammonia to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA HYDRASTIS. U.S. Tincture of Hydrastis

	Metric	Old form
* **Hydrastis,** in No. 60 powder (containing not less than 2.5 percent. of hydrastine)	200 Gm.	6 oz. av. 296 gr.
Alcohol, **Water,** each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix Alcohol and Water in the proportion of 650 Cc. [old form 21 fl. oz.] of Alcohol and 350 Cc. [old form 11 fl. oz.] of Water. Moisten the Hydrastis with 60 Cc. [old form 2 fl. oz.] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until 1000 Cc. [old form 2 pints] of percolate are obtained.

Tincture of Hydrastis, when assayed by the process given below, should contain in 100 Cc., 0.4 Gm. of hydrastine.

Assay of Tincture of Hydrastis

Transfer 100 Cc. of Tincture of Hydrastis to an evaporating dish, and evaporate it on a water-bath until the liquid measures about 10 Cc. If any insoluble matter has separated, add sufficient alcohol to dissolve it, and then assay the resulting liquid by the method given under *Fluidextractum Hydrastis* (page 401), using the same details as there directed for 10 Cc. of Fluidextract of Hydrastis, with the exception that the weight of the residual alkaloids must be multiplied by 2 instead of by 20 as there directed, to give the weight in grammes of hydrastine contained in 100 Cc. of Tincture of Hydrastis.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA HYOSCYAMI. U.S. Tincture of Hyoscyamus

	Metric	Old form
* **Hyoscyamus,** in No. 60 powder (containing not less than 0.8 percent. of mydriatic alkaloids)	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Moisten the Hyoscyamus with 40 Cc. [old form 1½ fl. oz.] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol until 1000 Cc. [old form 2 pints] are obtained.

Tincture of Hyoscyamus, when assayed by the process given below, should contain in 100 Cc., 0.007 Gm. of mydriatic alkaloids.

Assay of Tincture of Hyoscyamus

Transfer 100 Cc. of Tincture of Hyoscyamus to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Belladonnæ Radicis* (page 384), using the same details as there directed for 10 Cc. of Fluidextract of Belladonna Root, with the exception that the multiplication by 10 be omitted; the result will represent the weight in grammes of alkaloids contained in 100 Cc. of Tincture of Hyoscyamus.

Average dose.— 15 minims (1 Cc.).

TINCTURA IODI. U.S. Tincture of Iodine

	Metric	Old form
* **Iodine**	**70 Gm.**	255 grains
Potassium Iodide	**50 Gm.**	182 grains
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	8 fl. oz.

Triturate the Iodine and Potassium Iodide rapidly, in a mortar, to a coarse powder, and transfer it at once to a graduated bottle. Rinse the mortar with several successive portions of Alcohol, and pour the rinsings into the bottle. Then add Alcohol, shaking occasionally, until the Iodine and Potassium Iodide are dissolved, and the finished Tincture measures 1000 C. [old form 8 fl. oz.]. (If there is no necessity for rapid solution, the unpowdered Iodine and Potassium Iodide may be placed in the bottle containing the Alcohol and allowed to dissolve slowly.)

If 5 Cc. of the Tincture be mixed with about 25 Cc. of water and titrated with tenth-normal sodium thiosulphate V.S., about 27.25 Cc. of tenth-normal sodium thiosulphate V. S. should be required for complete decolorization (corresponding to about 6.86 Gm. of Iodine in 100 Cc.).

Average dose.— 1½ minims (0.1 Cc.).

TINCTURA IPECACUANHÆ ET OPII. U.S. Tincture of Ipecac and Opium

[Fluid Dover's Powder]

	Metric	Old form
* **Tincture of Deodorized Opium**	1000 Cc.	10 fl. oz.
Fluidextract of Ipecac	100 Cc.	1 fl. oz.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	10 fl. oz.

Evaporate the Tincture of Deodorized Opium, in a tared dish, on a water-bath, until it weighs 800 Gm. [old form 8 oz. av.]. When it has become cold, add to it the Fluidextract of Ipecac, filter the mixture, and pass enough Diluted Alcohol through the filter to obtain 1000 Cc. [old form 10 fl. oz.] of Tincture.

Average dose.— 8 minims (0.5 Cc.).

TINCTURA KINO. U. S. Tincture of Kino

Note.—The strength of this tincture has been reduced from 10 Gm. in 100 Cc., U. S. P. 1890, to 5 Gm. in 100 Cc., U. S. P. 8th Rev.

	Metric	Old form
* **Kino**	50 Gm.	182 grains
Purified Talc	10 Gm.	36 grains
Glycerin	150 Cc.	1 fl. oz. 1 fl. dr.
Alcohol	650 Cc.	5 fl. oz. 1 fl. dr.
Water, a sufficient quantity,		
To make	1000 Cc.	8 fl. oz.

Mix the Glycerin with 200 Cc. [old form 1 fl. oz. 6 fl. dr.] of Water, and triturate the Kino and Purified Talc with sufficient of the mixture to produce a thin, smooth magma. Transfer this magma to a flask by the aid of the remainder of the mixture, and, having ascertained the weight of the flask and contents, heat it on a water-bath for about one hour; allow the flask and contents to cool, and restore the original weight by the addition of sufficient Water. Then add the Alcohol, mix, and pass the Tincture through a filter of purified cotton, keeping the funnel well covered. Finally, add sufficient Alcohol through the filter to obtain 1000 Cc. [old form 8 fl. oz.] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA KRAMERIÆ. U. S. Tincture of Krameria

	Metric	Old form
* **Krameria,** in No. 40 powder	200 Gm.	6 oz. av. 296 gr.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Krameria with 80 Cc. [old form 2½ fl. oz.] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Diluted Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA LACTUCARII. U. S. Tincture of Lactucarium

	Metric	Old form
* **Lactucarium**	**500 Gm.**	16 oz. av. 302 gr.
Glycerin	**250 Cc.**	8 fl. oz.
Alcohol,		
Purified Petroleum Benzin,		
Diluted Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Beat the Lactucarium in an iron mortar, with clean sand, to a coarse powder, and introduce it into a bottle; add 2000 Cc. [old form 4 pints] of Purified Petroleum Benzin, cork the bottle tightly, and set it aside for forty-eight hours, frequently agitating the mixture. Pour the mixture on a double filter, and allow it to drain. Wash the residue by gradually adding 1500 Cc. [old form 3 pints] of Purified Petroleum Benzin, and allow the Lactucarium to dry by exposing it to a current of air. When it is dry and free from the odor of Benzin, reduce it to powder, using more sand, if necessary, and pack it moderately in a conical percolator. Mix the Glycerin with 200 Cc. [old form 6½ fl. oz.] of Water, and 500 Cc. [old form 1 pint] of Alcohol, and moisten the powder with 500 Cc. [old form 1 pint] of the mixture. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed very slowly, gradually adding, first the remainder of the menstruum, and then diluted Alcohol, until the Lactucarium is exhausted. Reserve the first 750 Cc. [old form 24 fl. oz.] of the percolate, evaporate the remainder on a water-bath, at a temperature not exceeding 70° C. (158° F.), to 250 Cc. [old form 8 fl. oz.] and mix this with the reserved portion. Filter, and add enough Diluted Alcohol through the filter to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA LAVANDULÆ COMPOSITA. U. S. Compound Tincture of Lavender

	Metric	Old form
* **Oil of Lavender Flowers**	**8 Cc.**	123 minims
Oil of Rosemary	**2 Cc.**	31 minims
Saigon Cinnamon	**20 Gm.**	292 grains
Cloves	**5 Gm.**	73 grains
Myristica	**10 Gm.**	146 grains
Red Saunders	**10 Gm.**	146 grains
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Reduce the Saigon Cinnamon, Cloves, Myristica, and Red Saunders to a No. 50 powder, and macerate this powder for three days in a mixture of 750 Cc. [old form 24 fl. oz.] of Alcohol and 250 Cc. [old form 8 fl. oz.] of Water, in which liquid the Oils have been dissolved. Then filter, and, when the liquid has drained off completely, pass enough of a mixture of Alcohol and Water, made in the same proportions as before, through the residue on the filter to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA LIMONIS CORTICIS. U. S. Tincture of Lemon Peel

	Metric	Old form
* **Lemon Peel,** from the fresh fruit, in thin shavings and cut into narrow shreds	**500 Gm.**	16 oz. av. 302 gr.
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Macerate the Lemon Peel in a stoppered, wide-mouthed container, in a moderately warm place, with 1000 Cc. [old form 2 pints] of Alcohol during forty-eight hours, with frequent agitation; then filter through purified cotton, and, when the liquid has drained off completely, gradually pour on enough Alcohol to make 1000 Cc. [old form 2 pints] of Tincture, and filter.

TINCTURA LOBELIÆ. U. S. Tincture of Lobelia

NOTE.—The strength of this tincture has been reduced from 20 Gm. of Lobelia in 100 Cc. to 10 Gm. of Lobelia in 100 Cc.

	Metric	Old form
* **Lobelia,** in No. 50 powder,	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Moisten the Lobelia with 40 Cc. [old form 1½ fl. oz.] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Diluted Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— { Expectorant, 15 minims (1 Cc.).
Emetic, 1 fluidrachm (4 Cc.).

TINCTURA MOSCHI. U. S. Tincture of Musk

	Metric	Old form
* **Musk**	**5 Gm.**	91 grains
Alcohol	**45 Cc.**	1 fl. oz. 6 fl. dr.
Water	**45 Cc.**	1 fl. oz. 6 fl. dr.
Diluted Alcohol, a sufficient quantity,		
To make	**100 Cc.**	4 fl. oz.

Triturate the Musk with the Water, a little at a time, until a smooth mixture is obtained; transfer this mixture to a bottle and allow it to stand twenty-four hours; add the Alcohol and macerate the mixture for six days, occasionally shaking it. Then filter through a plain paper filter, and, when the liquid has drained off completely, pass enough Diluted Alcohol through the filter to make 100 Cc. [old form 4 fl. oz.] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA MYRRHÆ. U.S. Tincture of Myrrh

	Metric	Old form
* **Myrrh,** in moderately coarse powder	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Macerate the Myrrh in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of Alcohol during three days, with frequent agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pour on enough menstruum to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA NUCIS VOMICÆ. U.S. Tincture of Nux Vomica

	Metric	Old form
* **Extract of Nux Vomica** (containing 5 percent. of strychnine)	20 Gm.	292 grains
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Extract of Nux Vomica in a sufficient quantity of a mixture of Alcohol and Water, made in the proportion of 750 Cc. [old form 24 fl. oz.] of Alcohol and 250 Cc. [old form 8 fl. oz.] of water, to make the solution measure 1000 Cc. [old form 2 pints], and filter through a well-covered filter.

Tincture of Nux Vomica, when assayed by the process given below, should contain in 100 Cc., 0.1 Gm. of strychnine.

Assay of Tincture of Nux Vomica

Transfer 100 Cc. of Tincture of Nux Vomica to a porcelain dish, evaporate it to dryness on a water-bath, and assay the resulting extract by the method given under *Extractum Nucis Vomicæ* (page 449), using the same details as there directed for 2 Gm. of Extract of Nux Vomica, with the exception that the multiplication by 50 be omitted; the result will represent the weight in grammes of strychnine contained in 100 Cc. of Tincture of Nux Vomica.

Average dose.— 10 minims (0.6 Cc.).

TINCTURA OPII. U.S. Tincture of Opium. Laudanum

	Metric	Old form
* **Granulated Opium** (containing 12 to 12.5 percent. of crystallizable morphine)	100 Gm.	3 oz. 148 gr.
Alcohol,		
Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Heat 400 Cc. [old form 13 fl. oz.] of water to boiling, and pour it on the Granulated Opium contained in a tared vessel, weigh, and stir occasionally during twelve hours; then restore the original weight by the addition of cold Water, add 400 Cc. [old form 13 fl. oz.] of Alcohol, pour the mixture into a bottle, and continue the maceration for forty-eight hours, occasionally shaking. Transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the liquid ceases to drop, continue the percolation slowly, pouring on sufficient Diluted Alcohol until 1000 Cc. [old form 2 pints] are obtained.

Tincture of Opium when assayed by the process given below, should contain in 100 Cc. not less than 1.2 nor more than 1.25 Gm. of crystallizable morphine.

Assay of Tincture of Opium

Tincture of Opium	**100.0 Cc.**
Ammonia Water	**3.5 Cc.**
Alcohol,	
Ether,	
Water,	
Lime Water, each, a sufficient quantity	

Transfer 100 Cc. of Tincture of Opium to an evaporating dish and evaporate it on a water-bath to about 20 Cc., add 40 Cc. of Water, mix thoroughly, and set the liquid aside for one hour, occasionally stirring to disintegrate the resinous flakes adhering to the dish. Then filter the liquid and wash the filter and residue with water, until all soluble matter is extracted (indicated by an almost colorless filtrate), and collect the washings separately. First evaporate the washings, in a tared dish, to a small volume, then add the first filtrate and evaporate the whole to a weight of 14 Gm.

Determine the morphine in this extract by the method given under Opium (twenty-first line of the Assay, beginning with the word "Rotate"), using the same details as there directed for 10 Gm. of Opium, with the exception that the final multiplication by 10 be omitted. The result will represent the weight in grammes of crystallized morphine yielded by 100 Cc. of Tincture of Opium.

Average dose.— 8 minims (0.5 Cc.).

TINCTURA OPII CAMPHORATA. U.S. Camphorated Tincture of Opium. Paregoric

	Metric	Old form
* **Powdered Opium**	4 Gm.	58½ grains
Benzoic Acid	4 Gm.	58½ grains
Camphor	4 Gm.	58½ grains
Oil of Anise	4 Cc.	1 fl. dr.
Glycerin	40 Cc.	1¼ fl. oz.
Diluted Alcohol	950 Cc.	30 fl. oz.
To make	1000 Cc.	2 pints

Place all the ingredients in a stoppered container and macerate for three days with frequent agitation; then filter the mixture through a well-covered paper filter, adding sufficient Diluted Alcohol through the filter to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 2 fluidrachms (8 Cc.).

TINCTURA OPII DEODORATI. U.S. Tincture of Deodorized Opium

	Metric	Old form
* **Granulated Opium** (containing 12 to 12.5 per cent. of crystallizable morphine)	100 Gm.	3 oz. av. 148 gr.
Purified Petroleum Benzin	75 Cc.	2½ fl. oz.
Alcohol	200 Cc.	6 fl. oz. 3 fl. dr.
Water,		
To make	1000 Cc.	2 pints

Heat 500 Cc. [old form 1 pint] of Water to boiling, and pour it on the Granulated Opium contained in a suitable vessel, stirring the mixture frequently during twenty-four hours. Then transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the liquid ceases to drop, continue the percolation with Water until the Opium is exhausted. Concentrate the percolate by evaporation on a water-bath until it measures 150 Cc. [old form 4¾ fl. oz.], and, when cooled, shake it frequently and vigorously for ten minutes with 65 Cc. [old form 2 fl. oz.] of the Purified Petroleum Benzin. Separate the Benzin, repeat the shaking out for a few minutes with the remainder of the Benzin, and, having carefully and completely separated this second portion of Benzin, evaporate the remaining liquid in a warm place spontaneously, until the odor of Benzin has disappeared, removing the last traces by the heat of a water-bath. Mix the deodorized liquid so obtained with 500 Cc. [old form 19 fl. oz.] of Water, filter the mixture through a paper filter, and, having mixed the Alcohol with the filtrate, wash the filter with sufficient Water to make 1000 Cc. [old form 2 pints] of Tincture.

Assay of Tincture of Deodorized Opium

If 100 Cc. of Tincture of Deodorized Opium be assayed by the process given under *Tinctura Opii* (page 359) it should yield not less than 1.2 nor more than 1.25 Gm. of crystallized morphine.

Average dose.— 8 minims (0.5 Cc.).

TINCTURA PHYSOSTIGMATIS. U.S. Tincture of Physostigma

	Metric	Old form
* **Physostigma,** in No. 50 powder (containing 0.15 percent. of ether-soluble alkaloids)	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Physostigma with 40 Cc. [old form 1½ fl. oz.] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Tincture of Physostigma, when assayed by the process given below, should contain in 100 Cc., 0.014 Gm. of the ether-soluble alkaloids from Physostigma.

Assay of Tincture of Physostigma

Transfer 100 Cc. of Tincture of Physostigma to a porcelain dish, evaporate it to dryness on a water-bath, and assay the resulting extract by the method given under *Extractum Physostigmatis* (page 451), using the same details as there directed for 1 Gm. of Extract of Physostigma, with the exception that the product must be multiplied by 2 instead of 200; the result will represent the weight in grammes of ether-soluble alkaloids from Physostigma contained in 100 Cc. of Tincture of Physostigma.

Average dose.— 15 minims (1 Cc.).

TINCTURA PYRETHRI. U.S. Tincture of Pyrethrum

	Metric	Old form
* **Pyrethrum,** in No. 50 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Moisten the Pyrethrum with 80 Cc. [old form 2½ fl. oz.] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

TINCTURA QUASSIÆ. U.S. Tincture of Quassia

	Metric	Old form
* **Quassia,** in No. 50 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity		
To make	**1000 Cc.**	2 pints

Mix 350 Cc. [old form 11 fl. oz.] of Alcohol with 650 Cc. [old form 21 fl. oz.] of Water. Moisten the Quassia with 60 Cc. [old form 2 fl. oz.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA QUILLAJÆ. U.S. Tincture of Quillaja

	Metric	Old form
* **Quillaja,** in No. 20 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol	**350 Cc.**	11 fl. oz.
Water, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Boil the Quillaja in a covered vessel with 800 Cc. [old form 25½ fl. oz.] of Water for fifteen minutes, strain while hot, and wash the residue on the strainer with 200 Cc. [old form 6½ fl. oz.] of Water, previously heated to boiling. Then evaporate the strained liquid to 600 Cc. [old form 19 fl. oz.], allow it to cool, add the Alcohol, and set it aside for twelve hours. Decant the clear liquid, filter it through paper, then pour the residue on the filter, and, when the liquid ceases to drop, wash the filter with sufficient water to make 1000 Cc. [old form 2 pints] of Tincture.

TINCTURA RHEI. U. S. Tincture of Rhubarb

	Metric	Old form
* **Rhubarb**	200 Gm.	6 oz. av. 296 gr.
Cardamom	40 Gm.	1 oz. av. 147 gr.
Glycerin	100 Cc.	3¼ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Glycerin with 500 Cc. [old form 1 pint] of Alcohol, and 400 Cc. [old form 12¾ fl. oz.) of Water. Reduce the Rhubarb and Cardamom to a No. 40 powder, and moisten this powder with 90 Cc. [old form 3 fl. oz.] of this menstruum ; transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for twelve hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on, first, the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA RHEI AROMATICA. U. S. Aromatic Tincture of Rhubarb

	Metric	Old form
* **Rhubarb**	200 Gm.	6 oz. av. 296 gr.
Saigon Cinnamon	40 Gm.	1 oz. av. 147 gr.
Cloves	40 Gm.	1 oz. av. 147 gr.
Myristica	20 Gm.	292 grains
Glycerin	100 Cc.	3¼ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix the Glycerin with 500 Cc. [old form 1 pint] of Alcohol and 400 Cc. [old form 12¾ fl. oz.] of Water. Reduce the Rhubarb, Saigon Cinnamon, Cloves, and Myristica to a No. 40 powder, and moisten this powder with 90 Cc. [old form 3 fl. oz.] of this menstruum ; transfer it to a percolator, and, without pressing the powder, allow it to stand for twelve hours ; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on, first, the remainder of the menstruum, and then sufficient of a mixture of

Alcohol and Water, made in the same proportions as before, to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA SANGUINARIÆ. U. S. Tincture of Sanguinaria

	Metric	Old form
* **Sanguinaria,** in No. 60 powder	100 Gm.	3 oz. av. 148 gr.
Acetic Acid	20 Cc.	5 fl. dr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 600 Cc. [old form 19 fl. oz.] of Alcohol with 400 Cc. [old form 13 fl. oz.] of water. Moisten the Sanguinaria with the Acetic Acid and 30 Cc. [old form 1 fl. oz.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA SCILLÆ. U.S. Tincture of Squill

	Metric	Old form
* **Squill,** in No. 20 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 750 Cc. [old form 24 fl. oz.] of Alcohol with 250 Cc. [old form 8 fl. oz.] of Water. Macerate the Squill with 600 Cc. [old form 19 fl. oz.] of the menstruum, in a closed vessel, in a moderately warm place for three days, occasionally stirring, and express strongly. Repeat this operation with 300 Cc. [old form 9½ fl. oz.] of menstruum, macerating one day before expression; and, finally, macerate the residue for six hours in sufficient menstruum to make the united expressed liquids measure about 1000 Cc. [old form 2 pints]. Express as before, mix the expressed liquids, filter through paper, and pass sufficient menstruum through the filter to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA SERPENTARIÆ. U.S. Tincture of Serpentaria

	Metric	Old form
* **Serpentaria,** in No. 50 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 650 Cc. [old form 21 fl. oz.] of Alcohol with 350 Cc. [old form 11 fl. oz.] of Water. Moisten the Serpentaria with 60 Cc. [old form

2 fl. oz.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA STRAMONII. U.S. Tincture of Stramonium

	Metric	Old form
* **Stramonium,** in 60 powder (containing not less than 0.25 percent. of mydriatic alkaloids)	**100 Gm.**	3 oz. av. 148 gr.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Moisten the Stramonium with 40 Cc. [old form 1½ fl. oz.] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for three hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually pouring on Diluted Alcohol until 1000 Cc. [old form 2 pints] are obtained.

Tincture of Stramonium, when assayed by the process given below, should contain in 100 Cc., 0.025 Gm. of mydriatic alkaloids from Stramonium.

Assay of Tincture of Stramonium

Transfer 100 Cc. of Tincture of Stramonium to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Belladonnæ Radicis* (page 384), using the same details as there directed for 10 Cc. of Fluidextract of Belladonna Root, with the exception that the multiplication by 10, as there directed, be omitted; the result will represent the weight in grammes of alkaloids contained in 100 Cc. of Tincture of Stramonium.

Average dose.— 8 minims (0.5 Cc.).

TINCTURA STROPHANTHI. U.S. Tincture of Strophanthus

NOTE.—The strength of this tincture has been increased from 5 Gm. of Strophanthus in 100 Cc. to 10 Gm. of Strophanthus in 100 Cc.

	Metric	Old form
* **Strophanthus,** in No. 60 powder	**100 Gm.**	3 oz. av. 148 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Mix 650 Cc. [old form 21 fl. oz.] of Alcohol with 350 Cc. [old form 11 fl. oz.] of Water. Moisten the Strophanthus with 50 Cc. [old form 1¾ fl. oz.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to satu-

rate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 8 minims (0.5 Cc.).

TINCTURA TOLUTANA. U.S. Tincture of Tolu.

	Metric	Old form
* **Balsam of Tolu,**	**200 Gm.**	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Macerate the Balsam of Tolu in 800 Cc. [old form 25 fl. oz., 288 min.] of Alcohol, shaking frequently until dissolved; then filter through paper, and wash the filter with sufficient Alcohol to make 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA VALERIANÆ. U.S. Tincture of Valerian

	Metric	Old form
* **Valerian,** in No. 60 powder	**200 Gm.**	6 oz. av. 296 gr.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Mix 750 Cc. [old form 24 fl. oz.] of Alcohol with 250 Cc. [old form 8 fl. oz.] of Water. Moisten the Valerian with 60 Cc. [old form 2 fl. oz.] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 1 fluidrachm (4 Cc.).

TINCTURA VALERIANÆ AMMONIATA. U.S. Ammoniated Tincture of Valerian

	Metric	Old form
* **Valerian,** in No. 60 powder	**200 Gm.**	6 oz. av. 296 gr.
Aromatic Spirit of Ammonia, a sufficient quanity,		
To make	**1000 Cc.**	2 pints

Moisten the Valerian with 60 Cc. [old form 2 fl. oz.] of Aromatic Spirit of Ammonia, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Aromatic Spirit of Ammonia to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Aromatic Spirit of Ammonia to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURA VANILLÆ. U.S. Tincture of Vanilla

	Metric	Old form
* **Vanilla,** cut into small pieces and bruised	100 Gm.	3 oz. av. 148 gr
Sugar, in coarse powder	200 Gm.	6 oz. av. 296 gr.
Alcohol,		
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 650 Cc. [old form 21 fl. oz.] of Alcohol with 350 Cc. [old form 11 fl. oz.] of Water. Macerate the Vanilla in 500 Cc. [old form 1 pint] of the mixture for twelve hours; then drain off the liquid and set it aside. Transfer the Vanilla to a mortar, beat it with the Sugar into a uniform powder, then pack it in a percolator and pour upon it the reserve liquid. When this has disappeared from the surface, continue the percolation by gradually pouring on sufficient menstruum to make 1000 Cc. [old form 2 pints] of Tincture.

TINCTURA VERATRI. U.S. Tincture of Veratrum

[Tinctura Veratri Viridis, Pharm. 1890]

Note.—The strength of this tincture has been reduced from 40 Gm. of Veratrum Viride in 100 Cc. to 10 Gm. of Veratrum in 100 Cc.

	Metric	Old form
* **Veratrum,** in No. 60 powder	100 Gm.	3 oz. av. 148 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Veratrum with 40 Cc. [old form 1½ fl. oz.] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 15 minims (1 Cc.).

TINCTURA ZINGIBERIS. U.S. Tincture of Ginger

	Metric	Old form
* **Ginger,** in No. 50 powder	200 Gm.	6 oz. av. 296 gr.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	2 pints

Moisten the Ginger with 60 Cc. [old form 2 fl. oz] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain 1000 Cc. [old form 2 pints] of Tincture.

Average dose.— 30 minims (2 Cc.).

TINCTURÆ HERBARUM RECENTIUM. U.S. **Tinctures of Fresh Herbs**

Tinctures of Fresh Herbs, when not otherwise directed, are to be prepared according to the following formula:

	Metric	Old form
* **The Fresh Herb,** cut, bruised, or crushed	500 Gm.	16½ oz. av.
Alcohol	1000 Cc.	2 pints

Macerate the Herb with the Alcohol in a closed vessel in a moderately warm place during fourteen days, with occasional stirring; then strongly express the liquid and filter it through paper.

Vina Medicata *Medicated Wines*

These are liquid preparations containing the soluble principles of medicinal substances dissolved in wine. Pharmaceutically they most resemble tinctures, differing from them merely in the character of the menstruum. The fermented juice of the grape, known officially as "Vinum Album," or "White Wine," when brought to a definite alcoholic strength, is the menstruum used as the basis for medicated wines; and wines have the advantage over infusions and decoctions of being much more permanent preparations, on account of the presence of alcohol.

The stability of medicated wines was greatly improved by the requirement of the U. S. P. 1880 that they should be made from stronger white wine, a menstruum containing from 20 to 25 per-cent. of absolute alcohol by weight. The Eighth Decennial Revision of the U. S. P. requires the addition of alcohol or of an alcoholic tincture to every medicated wine. It is apparent that more useful and permanent preparations could be made by substituting a menstruum composed of alcohol and water, and hence tinctures are preferable. Of the *ten* official wines, *two* are not medicated, *seven* are made by solution or admixture, and *one* by maceration.

Official Wines

Name	Definition and Ingredients
Not Medicated	
Vinum Album	An alcoholic liquid, made by fermenting the juice of fresh grapes freed from seeds, stems, and skins
Rubrum	An alcoholic liquid, made by fermenting the juice of fresh, red-colored grapes, in presence of their skins
Made by Solution or Admixture	
Vinum Antimonii	4 Gm. Antimony and Potassium Tartrate; 65 Cc. Boiling Distilled Water; 175 Cc. Alcohol; White Wine to make 1000 Cc.
Cocæ	65 Cc. Fluidextract of Coca; 75 Cc. Alcohol; 65 Gm. Sugar; Red Wine to make 1000 Cc.
Colchici Seminis	100 Cc. Fluidextract of Colchicum Seed; 150 Cc. Alcohol; 750 Cc. White Wine
Ergotæ	200 Cc. Fluidextract of Ergot; 50 Cc. Alcohol; 750 Cc. White Wine
Ferri	40 Gm. Iron and Ammonium Citrate; 60 Cc. Tincture of Sweet Orange Peel; 100 Cc. Syrup; White Wine to make 1000 Cc.
Ferri Amarum	50 Gm. Soluble Iron and Quinine Citrate; 60 Cc. Tincture of Sweet Orange Peel; 300 Cc. Syrup; White Wine to make 1000 Cc.
Ipecacuanhæ	100 Cc. Fluidextract of Ipecac; 100 Cc. Alcohol; 800 Cc. White Wine
Made by Maceration	
Opii	100 Gm. Granulated Opium; 10 Gm. Saigon Cinnamon; 10 Gm. Cloves; Alcohol, White Wine, to make 1000 Cc.

Unofficial Wines

Name	Ingredients	Method of Preparation
Vinum Aurantii. Br.	Wine, containing 10 to 12 per-cent. of ethyl hydroxide and flavored by Bitter-Orange Peel.	Obtained from the fermentation of a saccharine solution to which Fresh Bitter Orange Peel has been added
Colchici Radicis. U. S. P. 1890.	400 Gm. Colchicum Root, No. 30 powder; 150 Cc. Alcohol; White Wine to make 1000 Cc.	Percolate the drug with 850 Cc. of White Wine, to which the Alcohol has been added, finishing with White Wine to make 1000 Cc.
Ferri. Br.	50 Gm. Iron Wire; 1000 Cc. Sherry	Set aside for thirty days in a closed vessel, frequently shaking; filter
Quininæ. Br.	2 Gm. Quinine Hydrochloride; 875 Cc. Orange Wine	Dissolve the Quinine Hydrochloride in the Orange Wine and filter if necessary

VINUM ALBUM. U.S. White Wine

An alcoholic liquid, made by fermenting the juice of fresh grapes, the fruit of *Vitis vinifera* Linné (Fam. *Vitaceæ*), freed from seeds, stems, and skins, and subjected to the usual cellar-treatment for fining and aging.

When White Wine is prescribed without further specification, it is recommended that a dry White Wine of domestic production be employed.

White Wine should be preserved in well-closed casks filled as full as possible, or in well-stoppered bottles, in a cool place.

(For tests and comments, see Part IV.)

VINUM ANTIMONII. U.S. Wine of Antimony

	Metric	Old form
***Antimony and Potassium Tartrate**	4 Gm.	58½ grains
Boiling Distilled Water	65 Cc.	2 fl. oz.
Alcohol	175 Cc.	5½ fl. oz.
White Wine, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Antimony and Potassium Tartrate in the Boiling Distilled Water. Add this solution to a mixture of the Alcohol with 725 Cc. [old form 23 fl. oz.] of White Wine; mix well, and allow the mixture to stand until it has cooled. Then filter and add sufficient White Wine through the filter to make the liquid measure 1000 Cc. [old form 2 pints].

Average dose.— 15 minims (1 Cc.).

VINUM COCÆ. U.S. Wine of Coca

	Metric	Old form
***Fluidextract of Coca**	65 Cc.	2 fl. oz. 38 min.
Alcohol	75 Cc.	2½ fl. oz.
Sugar	65 Gm.	2⅓ oz. av.
Red Wine, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the sugar in 500 Cc. [old form 1 pint] of Red Wine, add the Alcohol and Fluidextract of Coca, and enough Red Wine to make the liquid measure 1000 Cc. [old form 2 pints]. Set the mixture aside for two days; then filter through paper, in a well-covered funnel.

Average dose.— 4 fluidrachms (16 Cc.).

VINUM COLCHICI SEMINIS. U. S. Wine of Colchicum Seed

	Metric	Old form
***Fluidextract of Colchicum Seed**	100 Cc.	3 fl. oz. 1 fl. dr.
Alcohol	150 Cc.	4 fl. oz. 7 fl. dr.
White Wine	750 Cc.	24 fl. oz.
To make	1000 Cc.	2 pints

Mix them. Set the mixture aside for two days; then filter through paper, in a well-covered funnel.

Average dose.— 30 minims (2 Cc.).

VINUM ERGOTÆ. U. S. Wine of Ergot

	Metric	Old form
***Fluidextract of Ergot**	200 Cc.	6¼ fl. oz.
Alcohol	50 Cc.	1¾ fl. oz.
White Wine	750 Cc.	24 fl. oz.
To make	1000 Cc.	2 pints

Mix them. Set the mixture aside for two days; then filter through paper, in a well-covered funnel.

Average dose.— 2 fluidrachms (8 Cc.).

VINUM FERRI. U.S. Wine of Iron

[VINUM FERRI CITRATIS PHARM. 1890]

	Metric	Old form
***Iron and Ammonium Citrate**	40 Gm.	1 oz. av. 147 gr.
Tincture of Sweet Orange Peel	60 Cc.	2 fl. oz.
Syrup	100 Cc.	3¼ fl. oz.
White Wine, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Iron and Ammonium Citrate in 700 Cc. [old form 22½ fl. oz.] of White Wine. Add to this the Tincture of Sweet Orange Peel and the Syrup, and, lastly, enough White Wine to make the product measure 1000 Cc. [old form 2 pints]. Set the mixture aside for two days; then filter through paper, in a well-covered funnel.

Average dose.— 2 fluidrachms (8 Cc.).

VINUM FERRI AMARUM. U.S. Bitter Wine of Iron

	Metric	Old form
***Soluble Iron and Quinine Citrate**	50 Gm.	1 oz. av. 293 gr.
Tincture of Sweet Orange Peel	60 Cc.	2 fl. oz.
Syrup	300 Cc.	9½ fl. oz.
White Wine, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Soluble Iron and Quinine Citrate in 500 Cc. [old form 1 pint] of White Wine. Add to this the Tincture of Sweet

Orange Peel and the Syrup, and, lastly, enough White Wine to make the product measure 1000 Cc. [old form 2 pints]. Set the mixture aside for two days; then filter through paper, in a well-covered funnel.

Average dose.— 2 fluidrachms (8 Cc.).

VINUM IPECACUANHÆ. U.S. Wine of Ipecac

	Metric	Old form
* **Fluidextract of Ipecac**	100 Cc.	3 fl. oz. 1 fl. dr.
Alcohol	100 Cc.	3 fl. oz. 1 fl. dr.
White Wine	800 Cc.	25 fl. oz. 6 fl. dr.
To make	1000 Cc.	2 pints

Mix them. Set the mixture aside for two days; then filter through paper, in a well-covered funnel.

Average dose.— 15 minims (1 Cc.).

VINUM OPII. U.S. Wine of Opium

	Metric	Old form
* **Granulated Opium**	100 Gm.	3 oz. av. 148 gr.
Saigon Cinnamon, in No. 60 powder	10 Gm.	146 grains
Cloves, in No. 30 powder	10 Gm.	146 grains
Alcohol, **White Wine,** each, a sufficient quantity,		
To make	1000 Cc.	2 pints

Mix 150 Cc. [old form 5 fl. oz.] of Alcohol and 850 Cc. [old form 27 fl. oz.] of White Wine. Macerate the Opium, Saigon Cinnamon, and Cloves in a stoppered container, in a moderately warm place, with 750 Cc. [old form 24 fl. oz.] of this menstruum, during seven days, with occasional agitation; then filter through purified cotton, in a well-covered funnel, returning the first portions until the filtrate passes perfectly clear, and finally pass enough menstruum through the residue to make the liquid measure 1000 Cc. [old form 2 pints].

For this preparation of Opium the U. S. Pharmacopœia (8th Rev.) does not provide an assay process owing to the presence of extractive matter from the powders; this interferes with the estimation of the morphine.

Average dose.— 8 minims (0.5 Cc.).

VINUM RUBRUM. U.S. Red Wine

An alcoholic liquid, made by fermenting the juice of fresh red-colored grapes, the fruit of *Vitis vinifera* Linné (Fam. *Vitaceæ*), in presence of their skins, and subjected to the usual cellar-treatment for fining and aging.

When Red Wine is prescribed without further specification, it is recommended that a dry Red Wine of domestic production be employed.

Red Wine should be preserved in well-closed casks filled as full as possible, or in well-stoppered bottles, in a cool place.

(For tests and comments, see Part IV.)

Fluidextracta *Fluidextracts*

Fluidextracts are liquid alcoholic preparations of uniform and definite strength, made by percolating drugs with menstrua, and concentrating a portion of the percolate so that in each case a cubic centimeter represents the medicinal virtues of one gramme of the drug; they are mostly concentrated tinctures. Fluidextracts were official for the first time in 1850, and the list was then made up of *seven* concentrated preparations, although but *one* of these could be called a fluidextract within the present meaning of the term; of the seven, two were oleoresins, four were concentrated syrups, and but one was a concentrated tincture. Since 1850 the use of fluidextracts has increased to an enormous extent; the Pharmacopœia contains formulas for *eighty-five*, the number being greater than that of any other class of preparations in the work. Fluidextracts may be justly called "American preparations," and the advance made in pharmacy in this country within the last quarter of a century is largely due to the stimulus given by the studies in percolation and the demand for these useful liquids. The striking advantages possessed by fluidextracts are: 1. Permanence. 2. Concentration. 3. The uniform relation existing between the fluidextract and the drug.

In the U. S. P., 8th Revision, one word, "Fluidextractum," was adopted in place of two words, "Extractum Fluidum," formerly used. The object of this change was to avoid the confusion heretofore existing due to the alphabetical arrangement, which compelled Fluidextracts to be printed with the Extracts; thus, "Extractum Rhei" had to be followed by "Extractum Rhei Fluidum." By making the Latin name for fluidextracts "Fluidextractum," these preparations are now under the letter F instead of E. The English name is, of course, "Fluidextract" instead of "Fluid Extract."

Permanence is secured by the use of alcoholic menstrua; formerly, sugar and glycerin were relied upon as preservatives, but continued experience has developed the value of alcohol, so that at present it is most largely used as the solvent.

Concentration enables the physician to decrease the bulk of the dose, diminishing the volume of the preparation so that portability is secured. It also aids greatly in securing permanence.

The uniform relation existing between the fluidextract and the drug is of great assistance to the physician in fixing the dose, because, as one cubic centimeter is represented by one gramme, the dose of the fluidextract must be practically the same as that of the drug. It has also obvious advantages in the arrangement of the formulas and in working from them. The present strength of fluidextracts renders them five percent. weaker than the fluidextracts of U. S. P. 1870; this is practically of no significance, so long as the drugs themselves are not brought to a standard limiting the amount of moisture or active principles present, for there would be more variation than five percent. between different lots of the same drug, in these particulars; indeed, the proposition to make fluidextracts just half their present strength has met with favor from many able pharmacists, the principal arguments being that more thorough exhaustion can be secured by the ordinary operator upon the small scale, and that the fluidextracts can be made to represent the drug more accurately and honestly when *one hundred* parts by measure are made from *fifty* parts by weight of the drug than when one hundred parts by measure are made from one hundred parts by weight of the drug. The standard of strength of the official fluidextracts is based upon the theory that from a given weight of drug an amount of fluidextract shall be made equal in measure to the bulk of the same weight of distilled water; in other words, the relation is that of gramme to cubic centimeter.

Fluidextracts may be standardized whenever made from a drug capable of being assayed. *Fourteen* official fluidextracts are standardized, they are as follows: Aconite, belladonna root, cinchona, coca, colchicum seed, conium, guarana, hydrastis, hyoscyamus, ipecac, nux vomica, pilocarpus, scopola, stramonium.

Preparation.—Fluidextracts are made in several ways. The manufacturer generally adopts a different process from that directed by the Pharmacopœia, because upon the large scale some practical modifications are necessary; the finished preparation is, however, generally brought to the official standard. The processes at present in use may be classified as follows: 1. Percolation with partial evaporation (official). 2. Percolation with incomplete exhaustion. 3. Repercolation. 4. Continuous percolation. 5. Vacuum maceration with percolation.

1. **Percolation with Partial Evaporation.**—This process can be best described by selecting from the official formulas a type which will serve as an example.

Typical Formula for an Official Fluidextract

1000 Gm. of the powdered drug is moistened with a certain quantity of menstruum, packed in a suitable percolator, and enough menstruum added to saturate the powder and leave a stratum above it; the lower orifice of the percolator is closed when the liquid begins to drop, and the percolator is closely covered to prevent evaporation and permit maceration for a specified time; additional menstruum is poured on and percolation continued slowly until the drug is exhausted. Usually about 800 Cc. of the first portion of the percolate is reserved, and the remainder evaporated at a temperature not exceeding 50° C. (122° F.) to a soft extract; this is to be dissolved in the reserved portion, and enough menstruum added to make the fluidextract measure 1000 Cc. In the case of standardized fluidextracts, 10 Cc. of the reserved percolate is assayed and the finished fluidextract brought to the standard strength by the addition of the proper quantity of menstruum. The precipitation experienced heretofore when the evaporated weak percolate was added to the reserved portion is considerably diminished by causing the former to be evaporated to a soft extract. This precipitation, formerly noticed more particularly in alcoholic fluidextracts, was due to the volatility of the alcohol in the weak percolates, which, when evaporated, left the residue to a great extent aqueous; when this residue was added to the strongly alcoholic reserved portion, a precipitation of resinous and frequently of active matter took place, which necessitated the storing of the fluidextract until precipitation ceased, and subsequent filtration. This is almost altogether avoided by evaporating to a soft extract, and the loss of activity through precipitation thus greatly diminished.

The argument is frequently advanced that the application of heat is detrimental to solutions of organic principles, that it dissociates some, and always proves injurious to the desirable constituents, *and that no heat whatever should be used in making fluidextracts;* these views are undoubtedly correct, when considered in connection with a few special cases, but do not apply with any practical force to the moderate use of heat recommended by the official processes upon that portion of the percolate which represents the least active and least desirable constituents of the drug, for from seven-tenths to nine-tenths of the whole amount of percolate (frequently representing ninety-five percent. of the activity of the drug) is reserved and is not subjected to heat at all.

2. **Percolation with Incomplete Exhaustion.**—This process consists in percolating a given weight of a drug with the proper menstruum in the usual manner, and stopping the percolation when an amount of percolate has been received which is equal to about three-fourths of the weight of the drug. To illustrate: 1000 grammes, or 16 ounces, of drug is percolated with the menstruum until 750 Cc. or 12 fluidounces of percolate has been received; this is the complete process, and the residue containing absorbed menstruum is sacrificed. This method has the merit of saving time and labor, and avoiding evaporation with the necessary contact of heat. It is based on the assumption that when percolation is properly conducted, the first seventy-five percent. of percolate received contains at least seventy-five percent. of the soluble and desirable principles of the drug, and that the wastage of alcohol comes chiefly from the effort to obtain the last twenty-five percent. or less of soluble principles. In addition, this smaller amount of extractive matter in the weak percolate is said to be lessened in activity by the effects of the heat during the evaporation to recover the alcohol from it; hence the argument that in carefully conducted operations the active matter left after receiving the percolate representing seventy-five percent. of the drug, does not represent twenty-five percent. of activity, but oftentimes less than ten percent. The principal disadvantage of this method is that the *strength* of the finished fluidextract depends *entirely* upon the *skill* and *care* of the operator. If careful, in one operation he may obtain seventy-five percent. of the active principles in the first seventy-five percent. of percolate; in another case, circumstances may prevent his obtaining more than fifty percent. of the active principles in the first seventy-five percent. of percolate. By this method of making fluidextracts he cannot invariably secure uniformity, while in making fluidextracts by the official process a valuable check always exists,—*i.e., that percolation proceeds until exhaustion is reached, the weak percolate is evaporated at a limited temperature, and the soft extract is incorporated with the reserved portion*, so that imperfect percolation happening in the first part of the process is compensated for in the latter part, the only difference being that the weak percolate in this case contains a larger proportion of activity than if the operation had been thoroughly conducted from the first.

3. **Repercolation.**—This process, already considered under the head of percolation (see page 269), is an improvement upon the method just noticed, because the drug is percolated to exhaustion,

and evaporation obviated by storing away the weak percolate until the next operation upon the same drug, when it is used in the place of fresh menstruum. This process may be best explained by selecting a typical fluidextract and noting the details.

Fluidextract of Cinchona by Repercolation (Squibb).—Take of Yellow Cinchona, in powder No. 50, 32 parts; Alcohol, 2 parts; Glycerin, 1 part; Water, 2 parts, or a sufficient quantity.

Weigh the Alcohol, Glycerin, and Water in succession, in any convenient quantity at a time, into a tared bottle, and mix them thoroughly for a menstruum.

Moisten 8 parts of the Cinchona with 8 parts of the menstruum, by thoroughly mixing them, and allow the mixture to stand eight hours in a closely covered vessel. Then pass the moist powder through a No. 8 sieve, and pack it firmly in a percolator. Pour menstruum on top until the mass is filled with liquid and a stratum remains on top unabsorbed; cover the percolator closely, and macerate for forty-eight hours. Then arrange the percolator for an automatic supply of menstruum, and start the percolation at such a rate as to give 1 part of percolate in about four hours. Reserve the first 6 parts of percolate, and continue the percolation until the Cinchona is exhausted, separating the percolate received after the reserved portion into fractions of about 8 parts each.

Moisten a second portion of 8 parts of the Cinchona with 8 parts of the weak percolate,—the first portion that was obtained next after the reserved percolate,—and allow the moist powder to stand for eight hours in a vessel closely covered. Then pack it moderately in a percolator, and supply the percolator automatically with the remaining fractions of the weak percolate in the order in which they were received, and finally with fresh menstruum, until the Cinchona is exhausted. Percolate in the same manner and at the same rate as with the first portion of Cinchona, and, reserving 8 parts of the first percolate, separate the weaker percolate into fractions of about 8 parts each.

Percolate the third and fourth portions of 8 parts each of the Cinchona in the same way as the second portion.

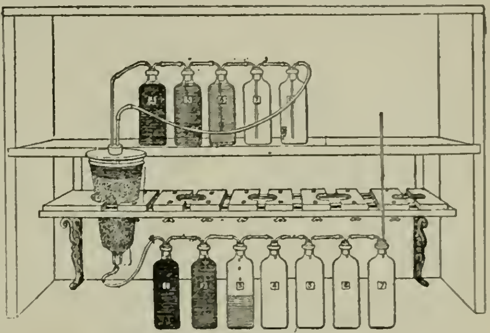
Finally, mix the four reserved percolates together to make 30 parts of finished fluidextract; and, having corked, labelled, and numbered the bottles containing the fractions of weak percolate, set them away until the process for Cinchona is to be resumed.

When this fluidextract is to be again made, repeat the process as with the second portion, and reserve 8 parts of the first percolate as finished fluidextract from each 8 parts of Cinchona from that time forward so long as the fractions of weak percolate are carried forward with which to commence each operation.

4. **Continuous Percolation.**—Robert W. Beck has devised a modification of Dr. Squibb's method of repercolation with a view of rendering the process more suitable for the smaller operations carried on by retail pharmacists. The storing away of the last weak percolates, and particularly the necessity for collecting the fractions of percolates, have operated to prevent repercolation from being used in small operations to the extent that it would be otherwise. Mr. Beck has sought to remove some of these disadvantages, and the illustration shown in Fig. 437 serves to render the explanations which follow

more easily understood. His process and apparatus effect a saving in time and attention, and the difficulty of keeping the percolators containing the drugs supplied with the proper menstruum at the time when the portion previously added has just disappeared has been overcome ; the watchfulness necessary to see that each receiving vessel does not overflow, or get more than its due proportion of the weaker percolate or menstruum, is reduced to a minimum, and the constant changing of receiving bottles is no longer required. The continuous method is based on the principle of *connecting* the receiving bottles containing the weaker percolates or menstruum, and after this to join the series to the percolator containing the drug by a syphon tube so that the menstruum will flow slowly and regularly, and that each portion will be delivered on the upper surface of the drug in its proper order.

FIG. 437



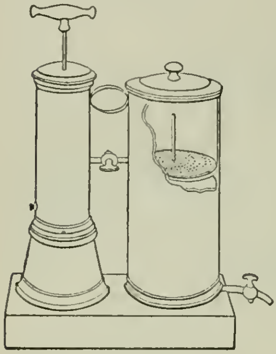
Beck's continuous percolation method

The percolate is carried from one receiving bottle, when full, to the next one by tubes inserted in the corks from the neck of one bottle to the neck of the other. Very little diffusion occurs, owing to the fact that the heavier liquids are drawn off first, and in each case a lighter liquid is deposited slowly (by drops) upon a denser one ; as the same principle is employed in receiving the percolates, the bottle nearest the percolator is filled with very dense percolate, and when the bottle is as full as desired, the tube connecting with the next bottle draws off the light liquid as it is deposited on top, and practically no intermixture occurs. Of course, the same action takes place in the remaining bottles of the series. If desired, the reserve or strongest percolate or finished fluidextract contained in the first bottles of the series can be removed, their place being supplied by empty bottles, so that even the slight risk of diffusion would apply only to weak percolates. In Fig. 437 the percolator is connected with No. 1 bottle by a rubber tube having a pinchcock to regulate the flow ; the remaining bottles are all connected in proper order by means of glass tubes and rubber tubing, as shown, the ends of the glass tubes being adjusted so as to be on the same level. When No. 1 bottle is full of dense percolate No. 2 bottle begins to fill with weaker percolate, then No. 3 with still weaker percolate, and so on. From the top of the last bottle on the upper shelf (No. 8) a piece of rubber tubing is connected with a glass tube having an inside diameter of $\frac{1}{4}$ inch, which passes through the cover of the percolator, the lower end about $\frac{1}{8}$ inch above the surface of the drug. This device makes an automatic supply of menstruum, the latter ceasing to flow when the liquid rises in the percolator above the end of the supply tube.

5. **Vacuum Maceration followed by Percolation.**—This method

of making fluidextracts was proposed in 1869 by S. P. Duffield. His original process was to introduce the drug, ground to the requisite fineness, into a strong cylinder connected with an airpump. The air was exhausted by the pump, and through a syphon tube the requisite amount of menstruum was sucked into the vacuum chamber. The air enclosed in the interstices and pores of the drug was thus expelled, and, the menstruum being brought immediately in contact with the soluble constituents, maceration was facilitated. The same process was suggested by Needles many years ago. Fig. 438 is an illustration of his original apparatus, the vessel upon the right hand being the percolator and receiver, the pump for exhausting the receiver being connected by a short tube carrying a stopcock. The most effective apparatus known to the author for using this principle upon the large scale is that devised by Wm. M. Thomson, of Philadelphia, and illustrated in the *American Journal of Pharmacy*, page 237, 1882. The percolators are egg shaped, and made of tinned copper; they are capable of being tightly covered, and communicate with a very efficient double-acting airpump by means of stopcocks above and below, and iron and stout rubber tubing. The moistened powder is packed tightly in the percolator, and the cover securely bolted on. The stopcock in the cover, communicating with the airpump, is opened, and a partial vacuum created in the space above the moistened drug; it is then closed, and another stopcock in the cover opened, which communicates by a tube with the reservoir containing the menstruum. The menstruum quickly penetrates the powder, taking the place of the interstitial air, and when the powder is saturated it is permitted to macerate *in vacuo* a sufficient length of time. To start percolation, a receiver is connected with the beak of the percolator, and the air exhausted from it. When the flow slackens, air may be forced by the pump into the space above the powder, and the receiver again exhausted below. In this way entire control of these powerful physical forces may be secured. The advantages are apparent in preventing the loss of alcohol and protecting from chemical change caused by exposure to the air. It is quite possible to make an official fluidextract without recourse to the subsequent evaporation of weak percolate.

Fig. 438



Needles's vacuum percolator

Preservation of Fluidextracts.—Very little trouble is experienced in keeping fluidextracts which have been properly made. They should be placed in glass vessels and stored in rooms of uniform temperature; precipitation to a greater or less extent will certainly take place. This is often especially noticeable in fluidextracts made during warm weather, and is due to the greater solvent action of the menstruum at higher temperatures. Precipitation is also caused by the variation in the strength of different portions of the menstruum in an alcoholic fluidextract; the first part of the percolate which is received contains the displaced water which was present as moisture in the powder, and the mixture of this with the strong alcoholic percolate which follows causes precipitation in time. The character of the precipitates should be ascertained; if active, they should be incorporated by shaking with the fluidextract; if inert, they should be filtered out.

Acetic Fluidextracts, or Fluidacetracts.—These were proposed by C. F. Squibb, and consist of preparations made like fluidextracts of definite strength (gramme for cubic centimeter), but made with acetic acid or diluted acetic acid of various strengths. The advantages claimed for them are cheapness, permanence, and miscibility with aqueous liquids. The disadvantages which have been urged against their use are the presence of acetic acid, which is not always desirable, and the loading of the finished preparation with inert constituents for which acetic acid is a good solvent. It is obvious that this class of preparations is of value, but it is also clear that acetic acid is suited, on account of its great solvent and penetrating power, for extracting the soluble principles from certain drugs, but for others alcohol is to be preferred. The ideal menstruum for any drug is one which will extract the desirable principles and leave in the marc those which are not needed. In the Pharmacopœia of 1870 glycerin entered as a menstruum into nearly every fluidextract; experience showed, however, that it was unsuited for this purpose, because the fluidextract was loaded heavily with inert and useless principles which were dissolved in the glycerin. For oleoresinous drugs and those containing resinous active principles the acetic acid used as a menstruum should range in strength from 36 percent. to 90 percent., while for drugs which do not contain these principles the acetic acid need not be stronger than from 6 to 10 percent.

The antiseptic powers of acetic acid are well known, and where it is desirable to avoid the use of alcohol, fluidacetracts would supply an excellent substitute.

The fears which have been frequently expressed about the action of acetic acid when taken into the stomach have not been borne out by considerable experience with their use, because it must be remembered that the quantity of acetic acid entering the stomach in the small dose in which these concentrated preparations are administered would not be more than the quantity frequently used by patients with their food. At the present time sufficient experience has not been had with them to justify the admission of more than three to the United States Pharmacopœia, 8th Revision.

Fluidextracts from Green Drugs.—This class of preparations has been used to some extent, and they may be made by crushing the drug, obtaining the liquid by pressure, and adding alcohol or diluted alcohol, according to the nature of the drug, repressing, and making the final product represent one gramme in a cubic centimeter. Owing to the varying proportion of water found in green drugs, it is evident that each preparation must be made from a special formula, and the quantity of alcohol to be added must depend upon the amount of water present in the drug; for drugs containing principles which are volatile or easily dissociated, this method produces good preparations, but unusual care must be exercised to secure uniformity.

Official Fluidextracts arranged in Classes according to the Alcoholic Strength of their Menstrua, with Manipulative Notes

Name	Number of Cc. used to moisten	Menstruum	Number of Cc. of Reserve	Process and Remarks
Class 1		**Alcohol**		
Fluidextractum Aromaticum	350	“	850	From Aromatic Powder
Cannabis Indicæ	300	“	900	
Capsici	500	“	900	Having moistened the powder, exhaust with the menstruum, reserve the number of Cc. directed, and distil or evaporate the remainder to a soft extract; add this to the reserved portion and sufficient menstruum to make the whole measure 1000 Cc.
Cimicifugæ	250	“	900	
Cubebæ	200	“	900	
Gelsemii	300	“	900	
Lupulini	. .	“	900	
Sabinæ	250	“	900	
Veratri	300	“	900	
Zingiberis	250	“	900	
Class 2		**Alcohol, 4** **Water, 1**		
Fluidextractum Belladonnæ Radicis	350	“ “	800	Assayed, special process
Eriodictyi	400	“ “	900	
Euonymi	350	“ “	800	
Mezerei	400	“ “	900	
Podophylli	300	“ “	850	
Rhei	400	“ “	750	
Scopolæ	350	“ “	800	Assayed, special process
Serpentariæ	300	“ “	900	
Staphisagriæ	300	“ “	800	
Class 3		**Alcohol, 3** **Water, 1**		
Fluidextractum Aconiti	400	“ “	800	Assayed, special process
Buchu	400	“ “	850	
Calami	350	“ “	900	
Eucalypti	400	“ “	900	
Grindeliæ	300	“ “	850	
Ipecacuanhæ	350	“ “	850	Assayed, special process
Leptandræ	400	“ “	850	
Matico	300	“ “	850	
Nucis Vomicæ	1000	“ “	900	With 5 percent. of Acetic Acid added to the menstruum to fix alkaloids. Assayed, special process
Sumbul	400	“ “	850	
Valerianæ	300	“ “	850	
Xanthoxyli	250	“ “	900	
Class 4		**Alcohol, 7** **Water, 3**		
Fluidextractum Calumbæ	300	“ “	700	
Class 5		**Alcohol, 2** **Water, 1**		
Fluidextractum Aurantii Amari	350	“ “	800	
Colchici Seminis	300	“ “	750	Assayed, special process
Hyoscyami	400	“ “	800	Assayed, special process
Senegæ	450	“ “	850	With 3 percent. of Solution of Potassium Hydroxide to menstruum, to dissolve pectinous bodies
Stramonii	400	“ “	800	Assayed, special process
Viburni Opuli	300	“ “	850	
Viburni Prunifolii	300	“ “	850	
Class 6		**Alcohol, 65** **Water, 35**		
Fluidextractum Convallariæ	400	“ “	800	

Official Fluidextracts—*Continued*

Name	Number of Cc. used to moisten	Menstruum	Number of Cc. of Reserve	Process and Remarks
Class 7		**Diluted Alcohol**		
Fluidextractum Berberidis	400	" "	700	
Chimaphilæ	400	" "	800	
Chiratæ	350	" "	850	
Cocæ	450	" "	700	Assayed, special process
Conii	300	" "	800	With 2 percent. of Acetic Acid added to the menstruum to fix alkaloids. Assayed, special process
Cypripedii	350	" "	850	
Digitalis	400	" "	850	
Ergotæ	300	" "	850	With 2 percent. of Acetic Acid added to the menstruum to fix alkaloids
Eupatorii	400	" "	800	
Gentianæ	350	" "	800	
Guaranæ	200	" "	700	Assayed, special process.
Krameriæ	400	" "	800	
Lappæ	400	" "	800	
Phytolaccæ	400	" "	800	
Pilocarpi	350	" "	750	Assayed, special process
Quillajæ	400	" "	800	
Rubi	350	" "	800	
Scutellariæ	350	" "	800	
Sennæ	400	" "	800	The Senna first exhausted with Alcohol, to remove resins, dried, and the process continued as usual
Spigeliæ	300	" "	850	
Stillingiæ	300	" "	850	
Taraxaci	300	" "	800	With 5 percent. of Solution of Potassium Hydroxide to menstruum to neutralize Acids
Class 8		**Alcohol, 2** **Water, 3**		
Fluidextractum Rhamni Purshianæ	400	" "	800	Having moistened the powder, exhaust with the menstruum, reserve the number of Cc. directed, and distil or evaporate the remainder to a soft extract; add this to the reserved portion and sufficient menstruum to make the whole measure 1000 Cc.
Class 9		**Alcohol, 5** **Water, 8**		
Fluidextractum Frangulæ	350	" "	800	
Class 10		**Alcohol, 1** **Water, 2**		
Fluidextractum Quassiæ	400	" "	900	
Sarsaparillæ	400	" "	800	
Class 11		**Containing Glycerin**		
Fluidextractum Cinchonæ	350	Glycerin, 10 Alcohol, 80 Water, 10	700	Finish percolation with Alcohol, 4; Water, 1. Assayed, special process
Apocyni	400	Glycerin, 10 Alcohol, 60 Water, 30	900	Finish percolation with Alcohol, 3; Water, 2
Geranii	350	Glycerin, 10 Alcohol, 60 Water, 30	800	
Hydrastis	300	Glycerin, 10 Alcohol, 60 Water, 30	750	Finish percolation with Alcohol, 2; Water, 1. Assayed, special process
Pareiræ	400	Glycerin, 10 Alcohol, 60 Water, 30	850	

Official Fluidextracts—*Continued*

Name	Number of Cc. used to moisten	Menstruum	Number of Cc. of Reserve	Process and Remarks
Fluidextractum Rhamni Purshianæ Aromaticum	400	Glycerin, 25 Alcohol, 50 Water, 25	800	Special process
Granati	400	Glycerin, 10 Dil. Alcohol, 90	800	Finish percolation with Diluted Alcohol
Quercus	400	Glycerin, 10 Dil. Alcohol, 90	700	
Rhois Glabræ	350	Glycerin, 10 Dil. Alcohol, 90	800	
Rosæ	400	Glycerin, 10 Dil. Alcohol, 90	750	
Sarsaparillæ Compositum	400	Glycerin, 10 Dil. Alcohol, 90	800	Finish percolation with Diluted Alcohol
Hamamelidis Foliorum	350	Glycerin, 10 Alcohol, 30 Water, 60	850	Finish percolation with Alcohol, 1; Water, 2
Pruni Virginianæ	300	Glycerin, 20 Alcohol, 20 Water, 60	. .	Finish percolation with Alcohol, 1; Water, 4
Uvæ Ursi	400	Glycerin, 30 Alcohol, 20 Water, 50	800	Finish percolation with Alcohol, 2; Water, 5
Class 12		**Acetic Acid 10 Percent.**		
Fluidextractum Lobeliæ	350	" "	900	Having moistened the powder, exhaust with the menstruum, reserve the number of Cc. directed, and distil or evaporate the remainder to a soft extract; add this to the reserved portion and sufficient menstruum to make the whole measure 1000 Cc.
Sanguinariæ	300	" "	850	
Scillæ	800	" "		
Class 13		**Boiling Water**		
Fluidextractum Glycyrrhizæ		" "		Macerate the Glycyrrhiza with 400 Cc. of Boiling Water; pack in percolator and pour Boiling Water upon it until exhausted; evaporate the percolate to 450 Cc., add 450 Cc. Alcohol, allow it to stand three days, distil off the Alcohol, add 250 Cc. Glycerin, 50 Cc. Ammonia Water, 200 Cc. Alcohol, and sufficient Water to make the whole measure 1000 Cc.
Tritici		" "		Percolate the Triticum with Boiling Water until exhausted, evaporate to 750 Cc., add 250 Cc. of Alcohol, filter, and add enough of a mixture of 1 volume of Alcohol with 3 volumes of Water to make the whole measure 1000 Cc.

Table of Unofficial Fluidextracts and Liquid Extracts

(To make 1000 Cc.)

Name	Number of Cc. used to moisten	Menstruum	Number of Cc. Reserved	Fineness of Powder	Process and Remarks
Extractum Arnicæ Radicis Fluidum. U. S. P. 1890	400	Alc. 75; Wat. 25	900	60	General process (see below)
Asclepiadis. U. S. P. 1890	400	Diluted Alcohol	900	60	“ “ “ “
Aspidospermatis. U. S. P. 1890	400	Alc. 60; Wat. 30; glycerin, 10	800	60	Finish with Alcohol, 2; Water, 1; but use general process (see below)
Castaneæ. U. S. P. 1890	. .	Boiling Water	. .	30	Macerate the Castanea with 5000 Cc. of Boiling Water for two hours, express, percolate residue with water to exhaustion, mix the two liquids, and evaporate to 2000 Cc., adding 600 Cc. Alcohol. Finally, filter out the insoluble matter, evaporate the liquid to 700 Cc., add 100 Cc. Glycerin and enough Alcohol to make 1000 Cc.
Colchici Radicis. U. S. P. 1890	350	Alc. 60; Wat. 30	850	60	General process (see below)
Cusso. U. S. P. 1890	400	Alcohol	900	40	“ “ “ “
Dulcamaræ. U. S. P. 1890	400	Diluted Alcohol	800	60	Finish with Alcohol, but use general process (see below)
Gossypii Radicis. U. S. P. 1890	500	Alcohol, 75; glycerin, 25	700	30	General process (see below)
Iridis. U. S. P. 1890	400	Alcohol	900	60	“ “ “ “
Lobeliæ. U. S. P. 1890	350	Diluted Alcohol	850	60	“ “ “ “
Menispermi. U. S. P. 1890	400	Alc. 60; Wat. 30	900	60	“ “ “ “
Opii Liquidum. Br.	. .	. . . .	. .	. .	18.75 Gm. Extract of Opium; 400 Cc. Distilled Water; 100 Cc. 90 percent. Alcohol. Rub the extract with the water, stir frequently during an hour, add the Alcohol, set aside for twenty-four hours, and then filter
Rumicis Fluidum. U. S. P. 1890	350	Diluted Alcohol	800	40	General process (see below)
Sanguinariæ. U. S. P. 1890	300	Alc. 75; Wat. 25	850	60	50 Cc. Acetic Acid included in the 300 Cc. used to moisten drug
Scillæ. U. S. P. 1890	200	Alc. 75; Wat. 25	750	20	General process (see below)
Scoparii. U. S. P. 1890	350	Diluted Alcohol	850	60	“ “ “ “
Stramonii Seminis. U. S. P. 1890	200	Alc. 75; Wat. 25	900	60	“ “ “ “

General Process for Fluidextracts.—Having moistened the powder, macerate for forty-eight hours, then exhaust with the menstruum, reserving the number of Cc. directed and distilling or evaporating the remainder to a soft extract: add this to the reserved portion and sufficient menstruum to make the whole measure 1000 Cc.

FLUIDEXTRACTUM ACONITI. U.S. Fluidextract of Aconite

[EXTRACTUM ACONITI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Aconite,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 Cc.**	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Aconite is exhausted. Reserve the first 800 Cc. [old form $38\frac{1}{2}$ fl. oz.] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserve portion, mixing thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of aconitine in the remainder of the liquid, add to this enough menstruum to make each 100 Cc. of the finished fluidextract contain 0.4 Gm. of aconitine.

Assay of Fluidextract of Aconite

Fluidextract of Aconite	**10 Cc.**
Ether,	
Distilled Water,	
Ammonia Water,	
Tenth-normal Sulphuric Acid V.S.,	
Fiftieth-normal Potassium Hydroxide V.S.,	
Cochineal T.S., each, a sufficient quantity	

Transfer 10 Cc. of Fluidextract of Aconite by means of a graduated pipette to a porcelain dish, and evaporate it carefully to dryness on a water-bath at a temperature not exceeding 60° C. (140° F.). Add 5 Cc. of tenth-normal sulphuric acid V.S. and 25 Cc. of distilled water. When the extract is dissolved, filter the liquid into a separator, washing the dish and filter, with about 25 Cc. of distilled water; when this has passed through, add 25 Cc. of ether and 2 Cc. of ammonia water to the separator, and agitate for one minute. Draw off the lower layer into a flask and filter the ether-solution into a beaker. Return the contents of the flask to the separator, add 15 Cc. of ether, and agitate for one minute. Draw off the lower layer into the flask and filter the ether-solution into the beaker. Repeat, with two other portions of 10 Cc. each of ether. Evaporate the ether-solution to dryness, and dissolve the residue in 3 Cc. of tenth-normal sulphuric acid V.S. diluted with 20 Cc. of distilled water. Add to the solution 5 drops of cochineal T.S., and then carefully run in fiftieth-normal potassium hydroxide V.S. until a pink color is produced. Divide the number of Cc. of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 3 (the 3 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.064, and this product by 10, which will give the weight in grammes of aconitine contained in 100 Cc. of the Fluidextract of Aconite.

Average dose.—1 minim (0.05 Cc.).

FLUIDEXTRACTUM APOCYNI. U.S. **Fluidextract of Apocynum**

[Extractum Apocyni Fluidum, Pharm. 1890]

	Metric	Old form
* **Apocynum,** in No. 60 powder	1000 Gm.	50 oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Alcohol, **Water,** each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Glycerin with 600 Cc. [old form 29 fl. oz.] of Alcohol and 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of 600 Cc. [old form 29 fl. oz.] of Alcohol to 400 Cc. [old form 19 fl. oz.] of Water, until the Apocynum is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. [122° F.], to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM AROMATICUM. U.S. **Aromatic Fluidextract**

[Extractum Aromaticum Fluidum, Pharm. 1890]

	Metric	Old form
* **Aromatic Powder**	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Aromatic Powder is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM AURANTII AMARI. U.S. **Fluidextract of Bitter Orange Peel**

[Extractum Aurantii Amari Fluidum, Pharm. 1890]

	Metric	Old form
* **Bitter Orange Peel,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol, **Water,** each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 600 Cc. [old form 29 fl. oz.] of Alcohol with 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it moderately in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Bitter Orange Peel is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM BELLADONNÆ RADICIS. U.S. Fluidextract of Belladonna Root

[Extractum Belladonnæ Radicis Fluidum, Pharm. 1890]

	Metric	Old form
* **Belladonna Root,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 Cc.**	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Belladonna Root is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract, dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid; add to this enough menstruum to make each 100 Cc. of the finished Fluidextract contain 0.4 Gm. of mydriatic alkaloids from Belladonna Root.

Assay of Fluidextract of Belladonna Root

Fluidextract of Belladonna Root	**10 Cc.**
Distilled Water,	
Ammonia Water,	
Chloroform,	
Normal Sulphuric Acid V.S.,	
Tenth-normal Sulphuric Acid V.S.,	
Fiftieth-normal Potassium Hydroxide V.S.,	
Cochineal T.S. or Iodeosin T.S., each, a sufficient quantity	

Transfer 10 Cc. of Fluidextract of Belladonna Root by means of a graduated pipette to a separator, add 10 Cc. of distilled water, 20 Cc. of chloroform, and 2 Cc. of ammonia water. Shake the separator well for one minute, and draw off the lower chloroformic layer into a second separator. Repeat the extraction with two portions of 10 Cc. each of chloroform, and draw the chloroformic solution into the second separator. To the latter add 8 Cc. of normal sulphuric acid V.S. and 20 Cc. of distilled water, shaking well for one minute. When perfectly separated draw off and reject the lower chloroformic layer, and filter the acid aqueous layer into a clean separator. Wash the separator and filter with 10 Cc. of distilled water, adding this to the clean separator. To the latter add 20 Cc. of chloroform and 4 Cc. of ammonia water, and shake well for several minutes. Draw off the lower chloroformic layer into a beaker, and repeat the extraction with two portions of 10 Cc. each of chloroform, adding the chloroformic solution to the beaker. Allow the chloroform in the beaker to evaporate on a water-bath, containing warm water, until the residue is perfectly dry. To the alkaloidal residue add 5 Cc. of tenth-normal sulphuric acid V.S., and when the residual alkaloids have all dissolved, titrate the solution with fiftieth-normal potassium hydroxide V.S., using 5 drops of cochineal or iodeosin T.S. as an indicator. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0287, and this product by 10, to obtain the weight in grammes of mydriatic alkaloids contained in 100 Cc. of the Fluidextract of Belladonna Root.

Average dose.— 1 minim (0.05 Cc.).

FLUIDEXTRACTUM BERBERIDIS. U.S. Fluidextract of Berberis

	Metric	Old form
* **Berberis,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol until the Berberis is exhausted. Reserve the first 700 Cc. [old form 33½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM BUCHU. U.S. Fluidextract of Buchu

[Extractum Buchu Fluidum, Pharm. 1890]

	Metric	Old form
* **Buchu,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the

percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Buchu is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—30 minims (2 Cc.).

FLUIDEXTRACTUM CALAMI. U.S. Fluidextract of Calamus

[Extractum Calami Fluidum, Pharm. 1890]

	Metric	Old form
* **Calamus,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Calamus is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—15 minims (1 Cc.).

FLUIDEXTRACTUM CALUMBÆ. U.S. Fluidextract of Calumba

[Extractum Calumbæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Calumba,** in 20 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 700 Cc. [old form 33½ fl. oz.] of Alcohol with 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Calumba is exhausted. Reserve the first 700 Cc. [old form 33½

fl. oz.] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure, 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM CANNABIS INDICÆ. U.S. Fluidextract of Indian Cannabis

[Extractum Cannabis Indicæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Indian Cannabis,** in No. 30 powder	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 300 Cc. [old form 14½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Indian Cannabis is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 1 minim (0.5 Cc.).

FLUIDEXTRACTUM CAPSICI. U.S. Fluidextract of Capsicum

[Extractum Capsici Fluidum, Pharm. 1890]

	Metric	Old form
* **Capsicum,** in No. 50 powder	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 500 Cc. [old form 24 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Capsicum is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 1 minim (0.05 Cc.).

FLUIDEXTRACTUM CHIMAPHILÆ. U.S. Fluidextract of Chimaphila

[Extractum Chimaphilæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Chimaphila,** in No. 30 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Chimaphila is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM CHIRATÆ. U.S. Fluidextract of Chirata

[Extractum Chiratæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Chirata,** in No. 30 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Diluted Alcohol, pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Chirata is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM CIMICIFUGÆ. U.S. Fluidextract of Cimicifuga

[Extractum Cimicifugæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Cimicifuga,** in No. 60 powder	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 250 Cc. [old form 12 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Cimicifuga is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM CINCHONÆ. U.S. Fluidextract of Cinchona

[EXTRACTUM CINCHONÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
***Cinchona**, in No. 60 powder	1000 Gm.	50 oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Mix the Glycerin with 800 Cc. [old form 38½ fl. oz.] of Alcohol and 100 Cc. [old form 4 fl. oz. 384 min.] of Water. Moisten the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, and, when the liquid in the percolator has disappeared from the surface, gradually pour on a mixture of Alcohol and Water, made in the proportion of 800 Cc. [old form 38½ fl. oz.] of Alcohol to 200 Cc. [old form 9½ fl. oz.] of Water, and continue the percolation slowly until the Cinchona is exhausted. Reserve the first 700 Cc. [old form 33½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of anhydrous ether-soluble alkaloids in the remainder of the liquid, and add to this enough of a mixture of Alcohol and Water, using the same proportions as before, to make each 100 Cc. of the Fluidextract contain 4 Gm. of anhydrous ether-soluble alkaloids from Cinchona.

Assay of Fluidextract of Cinchona

Fluidextract of Cinchona	10 Cc.
Ether, sp. gr. not above 0.720 at 25° C. (77° F.),	
Normal Sulphuric Acid V.S.,	
Ammonia Water,	
Chloroform, each, a sufficient quantity	

Transfer 10 Cc. of Fluidextract of Cinchona by means of a graduated pipette to an Erlenmeyer flask of 200 Cc. capacity, and add a mixture of 100 Cc. of ether, 25 Cc. of chloroform, and 10 Cc. of ammonia water. Insert the stopper securely, and shake the flask vigorously, at intervals, during ten minutes. Allow the liquids to separate, decant into a measuring cylinder exactly 66 Cc. of the supernatant liquid (representing 5 Cc. of the Fluidextract), and transfer this to a separator, rinsing the cylinder with 5 Cc. of ether and adding this to the separator. Add to the latter about 10 Cc. of normal sulphuric acid V.S., or enough to make the solution distinctly acid, and shake the separator vigorously for several minutes, and when the liquids have completely separated, draw off the lower layer into a second separator. To the first separator add 5 Cc. more of normal sulphuric acid V.S., and 5 Cc. of distilled water, shake it for several minutes, and when the liquids have separated, draw off the lower layer into the second separator. Now add 5 Cc. of distilled water to the first separator, shake it, separate as before, and then draw off the lower aqueous layer into the second separator. To the second separator add 25 Cc. of ether, a small piece of red litmus paper, and then, gradually, ammonia water, keeping the temperature of the liquids below 25° C. (77° F.), until the reaction is alkaline. Then shake the separator vigorously for two minutes, and allow the liquids to stand for ten minutes at a temperature below 15° C. (59° F.). Draw off and reject the lower aqueous layer,

and then transfer the ether-layer into a tared beaker. Add 5 Cc. more of ether to the separator, rinse carefully, and add the rinsings to the tared beaker, and entirely evaporate the ether at a moderate heat on a water-bath. Then dry the beaker in an air-bath at 110° C. (230° F.) for half an hour, cool, and weigh. Replace the beaker in the air-bath, and heat again at the same temperature for half an hour, cool, and weigh, repeating until the weight is constant. Multiply the weight of the residue by 20, to obtain the weight in grammes of anhydrous ether-soluble alkaloids contained in 100 Cc. of the Fluidextract of Cinchona.

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM COCÆ. U.S. Fluidextract of Coca

[EXTRACTUM COCÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Coca,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make about	**1000 Cc.**	3 pints

Moisten the powder with 450 Cc. [old form 21½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Coca is exhausted. Reserve the first 700 Cc. [old form 33½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of ether-soluble alkaloids in the remainder of the liquid, and add to this enough Diluted Alcohol to make each 100 Cc. of the Fluidextract contain 0.5 Gm. of ether-soluble alkaloids from Coca.

Assay of Fluidextract of Coca

Fluidextract of Coca	**10 Cc.**
Ammonia Water,	
Ether,	
Distilled Water,	
Normal Sulphuric Acid V.S.,	
Tenth-normal Sulphuric Acid V.S.,	
Fiftieth-normal Potassium Hydroxide V. S.,	
Cochineal T. S. or Iodeosin T. S., each, a sufficient quantity.	

Transfer 10 Cc. of Fluidextract of Coca by means of a graduated pipette to a separator, add 25 Cc. of ether, and then 2 Cc. of ammonia water, shaking together for one minute. When the liquids have completely separated, draw off the lower aqueous layer into a second separator, and to this add 20 Cc. more of ether, and repeat the shaking for one minute. Draw off and reject the lower aqueous layer from the second separator, and add the ether-layer to the first separator. To this separator now add 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, and shake it well for one or two minutes. After the liquids have separated, draw off the lower aqueous layer into the other separator, and repeat the extraction in the first separator with 9 Cc. of distilled water and 1 Cc. of normal sulphuric acid V.S., shaking the liquids for one minute, and separating as before. Add the aqueous solution to the other separator, and reject the ether. Now add to the combined acid liquids 20 Cc. of ether, a small piece of red litmus paper, and sufficient ammonia water to render the mixture distinctly alkaline, and shake the

liquids for one or two minutes. Draw off the separated aqueous layer into the other separator and the ether-layer into a beaker. Repeat the extraction of the aqueous layer in the other separator with two portions (15 Cc. each) of ether, and add the resulting ether-solutions to the beaker. Now evaporate the ether from the beaker, and, when dry, add to it 5 Cc. of tenth-normal sulphuric acid V.S., and stir until the alkaloidal residue is dissolved. Then add 5 drops of cochineal T.S. or iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken, and multiply the remainder by 0.03, and this product by 10, to obtain the weight in grammes of ether-soluble alkaloids contained in 100 Cc. of the Fluidextract of Coca.

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM COLCHICI SEMINIS. U. S. Fluidextract of Colchicum Seed

[EXTRACTUM COLCHICI SEMINIS FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Colchicum Seed,** in No. 50 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Mix 600 Cc. [old form 29 fl. oz.] of Alcohol with 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Colchicum Seed is exhausted. Reserve the first 750 Cc. [old form 36 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of colchicine in the remainder of the liquid, and add to this enough menstruum to make each 100 Cc. of the Fluidextract contain 0.4 Gm. of colchicine.

Assay of Fluidextract of Colchicum Seed

Fluidextract of Colchicum Seed	10 Cc.
Ether,	
Chloroform,	
Alcohol,	
Ammonia Water,	
Distilled Water, each, a sufficient quantity	

Measure into a separator 10 Cc. of Fluidextract of Colchicum Seed, add 1 Cc. of ammonia water, and shake out the alkaloid with three successive portions, 15, 15, and 10 Cc., of chloroform. Collect the chloroformic solutions in a beaker or dish, and evaporate it nearly to dryness by applying a very gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether is evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container and filter with a little water, and shake the aqueous solution well for one minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a tared flask, and again shake out the aqueous liquid, successively, with three portions of 10 Cc. each of chloroform, collecting these solutions in the tared flask. Evaporate the chloroform completely; dissolve the residue in a little alcohol, evaporate the latter, redissolve it in alcohol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.) until the weight, after cooling in a desiccator, remains constant. Multiply the weight of the residue by 10, to obtain the weight in grammes of colchicine contained in 100 Cc. of the Fluidextract of Colchicum Seed.

Average dose.—3 minims (0.2 Cc.).

FLUIDEXTRACTUM CONII. U. S. Fluidextract of Conium

[Extractum Conii Fluidum, Pharm. 1890]

	Metric	Old form
* **Conium,** in No. 40 powder	1000 Gm.	50 oz. av.
Acetic Acid	20 Cc.	1 fl. oz.
Diluted Alcohol, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Mix the Acetic Acid with 980 Cc. [old form 47 fl. oz.] of Diluted Alcohol, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then Diluted Alcohol, until the Conium is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of coniine in the remainder of the liquid, and add to this enough Diluted Alcohol to make each 100 Cc. of the Fluidextract contain 0.45 Gm. of coniine.

Assay of Fluidextract of Conium

Fluidextract of Conium	10 Cc.
Ether,	
Alcohol,	
Absolute Alcohol,	
Ammonia Water,	
Normal Sulphuric Acid V.S.,	
Sodium Carbonate T.S.,	
Hydrochloric Acid Solution (5 percent. HCl),	
Distilled Water, each, a sufficient quantity	

Transfer 10 Cc. of Fluidextract of Conium by means of a graduated pipette to an evaporating dish containing a little clean sand, and evaporate it to dryness at a gentle heat. Mix the sand uniformly with the extract and transfer it to an Erlenmeyer flask of about 200 Cc. capacity, rinse the dish with 100 Cc. of a mixture of ether 100 Cc., alcohol 7 Cc., and ammonia water 3 Cc., added in portions, and transfer the rinsings to the flask. Insert the stopper securely and shake the flask at intervals during one hour. Decant 50 Cc. of the liquid (representing 5 Cc. of the Fluidextract of Conium) into a beaker, and add sufficient normal sulphuric acid V.S. to produce a distinctly acid reaction. Evaporate the ether at a gentle heat by the aid of a water-bath; then add 15 Cc. of absolute alcohol, and set the

beaker aside in a cool place for two hours to allow the ammonium sulphate to deposit. Filter the liquid; wash the residue and filter with a little absolute alcohol, and add the washings to the filtrate; neutralize any excessive amount of acid with sodium carbonate T.S., being careful to retain a slight acidity. Concentrate the liquid to 3 Cc. by the aid of a gentle heat on a water-bath, add 3 Cc. of distilled water and 2 drops of normal sulphuric acid V.S. Add 15 Cc. of ether to remove traces of fatty matter, pour off the ether-solution, and repeat the washing. Then transfer the acid liquid to a separator, introduce a small piece of red litmus paper, and add sufficient sodium carbonate T.S. to render the liquid slightly alkaline; then shake out with successive portions of 15, 10, and 10 Cc. of ether. To the combined ether-solutions in a tared beaker add, drop by drop, sufficient hydrochloric acid solution (5 percent.) to insure an excess of acid, and then evaporate the ether by a gentle heat on a water-bath. Remove the excess of hydrochloric acid by adding to the residue 3 Cc. of alcohol and heating gently to evaporate the liquid, repeat this operation once, and dry the residue at a temperature not exceeding 60° C. (140° F.) until the weight, after cooling in a desiccator, remains constant. Multiply the weight of the residue by 0.777, and the product by 20, to obtain the weight in grammes of coniine contained in 100 Cc. of the Fluidextract of Conium.

Average dose.— 3 minims (0.2 Cc.).

FLUIDEXTRACTUM CONVALLARIÆ. U.S. Fluidextract of Convallaria

[EXTRACTUM CONVALLARIÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Convallaria,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 650 Cc. [old form 31 fl. oz.] of Alcohol with 350 Cc. [old form 17 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, until the Convallaria is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—8 minims (0.5 Cc.).

FLUIDEXTRACTUM CUBEBÆ. U.S. Fluidextract of Cubeb

[EXTRACTUM CUBEBÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Cubeb,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 200 Cc. [old form 9½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Cubeb is exhausted. Reserve the first 900

Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—15 minims (1 Cc.).

FLUIDEXTRACTUM CYPRIPEDII. U.S. Fluidextract of Cypripedium

[EXTRACTUM CYPRIPEDII FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Cypripedium,** in No. 60 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Cypripedium is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—15 minims (1 Cc.).

FLUIDEXTRACTUM DIGITALIS. U.S. Fluidextract of Digitalis

[EXTRACTUM DIGITALIS FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Digitalis,** in No. 60 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Digitalis is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—1 minim (0.05 Cc.).

FLUIDEXTRACTUM ERGOTÆ. U.S. Fluidextract of Ergot

[EXTRACTUM ERGOTÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Ergot,** recently ground and in No. 60 powder	1000 Gm.	50 oz. av.
Acetic Acid	20 Cc.	1 fl. oz.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Acetic Acid with 980 Cc. [old form 47 fl. oz.] of Diluted Alcohol, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then Diluted Alcohol, until the Ergot is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM ERIODICTYI. U.S. Fluidextract of Eriodictyon

[EXTRACTUM ERIODICTYI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Eriodictyon,** in No. 60 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Eriodictyon is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM EUCALYPTI. U.S. Fluidextract of Eucalyptus

[EXTRACTUM EUCALYPTI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Eucalyptus,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to

drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Eucalyptus is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM EUONYMI. U.S. Fluidextract of Euonymus

	Metric	Old form
* **Euonymus,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Euonymus is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 8 minims (0.5 Cc.).

FLUIDEXTRACTUM EUPATORII. U.S. Fluidextract of Eupatorium

[Extractum Eupatorii Fluidum, Pharm. 1890]

	Metric	Old form
* **Eupatorium,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Eupatorium is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM FRANGULÆ. U.S. Fluidextract of Frangula

[Extractum Frangulæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Frangula,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 500 Cc. [old form 24 fl. oz.] of Alcohol with 800 Cc. [old form 38½ fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Frangula is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—15 minims (1 Cc.).

FLUIDEXTRACTUM GELSEMII. U.S. Fluidextract of Gelsemium

[Extractum Gelsemii Fluidum, Pharm. 1890]

	Metric	Old form
* **Gelsemium,** in No. 60 powder	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 300 Cc. [old form 14½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Gelsemium is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—1 minim (0.05 Cc.).

FLUIDEXTRACTUM GENTIANÆ. U.S. Fluidextract of Gentian

[Extractum Gentianæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Gentian,** in No. 30 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Gentian is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—15 minims (1 Cc.).

FLUIDEXTRACTUM GERANII. U.S. Fluidextract of Geranium

[EXTRACTUM GERANII FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Geranium,** in No. 30 powder	1000 Gm.	50 oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Glycerin with 600 Cc. [old form 29 fl. oz.] of Alcohol, and 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of 600 Cc. [old form 29 fl. oz.] of Alcohol to 400 Cc. [old form 19 fl. oz.] of Water, until the Geranium is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—15 minims (1 Cc.)

FLUIDEXTRACTUM GLYCYRRHIZÆ. U.S. Fluidextract of Glycyrrhiza

[EXTRACTUM GLYCYRRHIZÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Glycyrrhiza,** in No. 20 powder	1000 Gm.	50 oz. av.
Glycerin	250 Cc.	12 fl. oz.
Ammonia Water	50 Cc.	2½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Pour 400 Cc. [old form 19 fl. oz.] of boiling Water upon the Glycyrrhiza, contained in a suitable vessel, and allow it to stand for one hour. Pack the moistened powder loosely in a metallic percolator, pour boiling Water upon it, and allow the percolation to proceed, supplying boiling Water until the Glycyrrhiza is exhausted. Evaporate the percolate at a moderate heat, until it measures 450 Cc. [old

form 21½ fl. oz.], and, when cool, add 450 Cc. [old form 21½ fl. oz.] of Alcohol, mix well and set aside for three days. After filtering the liquid, distil it until 500 Cc. [old form 21½ fl. oz.] of distillate have been obtained; transfer the liquid in the still to a suitable container, add the Glycerin, Ammonia Water, and 200 Cc. [old form 9½ fl. oz.] of Alcohol. Finally, add sufficient Water to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—30 minims (2 Cc.).

FLUIDEXTRACTUM GRANATI. U.S. **Fluidextract of Pomegranate**

	Metric	Old form
* **Granatum**, in No. 30 powder	1000 Gm.	50 oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Glycerin with 900 Cc. [old form 43 fl. oz.] of Diluted Alcohol, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Pomegranate is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—30 minims (2 Cc.).

FLUIDEXTRACTUM GRINDELIÆ. U.S. **Fluidextract of Grindelia**

[EXTRACTUM GRINDELIÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Grindelia**, in No. 30 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 750 Cc. [old form 36 fl. oz.) of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, until the Grindelia is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—30 minims (2 Cc.).

FLUIDEXTRACTUM GUARANÆ. U.S. Fluidextract of Guarana

[Extractum Guaranæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Guarana,** in No. 60 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Moisten the powder with 200 Cc. [old form 9½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Guarana is exhausted. Reserve the first 700 Cc. [old form 33½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 5 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of alkaloids contained in the reminder of the liquid; add to this enough Diluted Alcohol to make each 100 Cc. of the finished Fluidextract contain 3.5 Gm. of the alkaloids from Guarana.

Assay of Fluidextract of Guarana

Fluidextract of Guarana	5 Cc.
Chloroform,	
Ether,	
Ammonia Water,	
Normal Sulphuric Acid V.S.,	
Distilled Water, each, a sufficient quantity	

Transfer to a separator 5 Cc. of Fluidextract of Guarana, add 15 Cc. of chloroform and 1 Cc. of ammonia water. Shake well and allow the liquid to separate completely. Draw off the chloroform into a beaker. Shake out the fluid remaining in the separator with two additional portions of chloroform of 10 Cc. each, evaporate the combined chloroformic solutions carefully to dryness. Dissolve the alkaloidal residue in a mixture of 2 Cc. of normal sulphuric acid V.S. and 20 Cc. of warm distilled water. Allow it to cool, and filter the solution into a separator, rinse the flask and filter with distilled water, adding the rinsings to the separator, then add 20 Cc. of chloroform and 2 Cc. of ammonia water and shake the separator for one minute. Draw off the chloroform into a tared flask, and repeat the extraction with two portions of 10 C. each of chloroform, adding this to the tared flask. Distil off the chloroform, and, when dry, add 2 Cc. of ether, and evaporate this very carefully with the aid of a water-bath (to avoid decrepitation). Dry the residue to a constant weight on the water-bath. Multiply the weight by 20, which will give the weight in grammes of alkaloids contained in 100 Cc. of Fluidextract of Guarana.

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM HAMAMELIDIS FOLIORUM. U.S. Fluidextract of Hamamelis Leaves

[Extractum Hamamelidis Fluidum, Pharm. 1890]

	Metric	Old form
* **Hamamelis Leaves,** in No. 40 powder	1000 Gm.	50 oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Glycerin with 300 Cc. [old form 14½ fl. oz.] of Alcohol and 600 Cc. [old form 29 fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then a mixture of Alcohol and Water, made in the proportion of 300 Cc. [old form 14½ fl. oz.] of Alcohol to 600 Cc. [old form 29 fl. oz.] of Water, until the Hamamelis Leaves are exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM HYDRASTIS. U.S. Fluidextract of Hydrastis

[EXTRACTUM HYDRASTIS FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Hydrastis,** in No. 60 powder	1000 Gm.	50 oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Mix the Glycerin with 600 Cc. [old form 29 fl. oz.] of Alcohol and 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then a mixture of Alcohol and Water, made in the proportion of 600 Cc. [old form 29 fl. oz.] of Alcohol to 300 Cc. [old form 14½ fl. oz.] of Water, until the Hydrastis is exhausted. Reserve the first 750 Cc. [old form 36 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of hydrastine in the remainder of the liquid; add to this enough menstruum to make each 100 Cc. of the finished Fluidextract contain 2 Gm. of hydrastine.

Assay of Fluidextract of Hydrastis

Fluidextract of Hydrastis	10 Cc.
Distilled Water,	
Potassium Iodide,	
Ammonia Water,	
Ether, each, a sufficient quantity	

Transfer 10 Cc. of Fluidextract of Hydrastis by means of a graduated pipette to a 100 Cc. measuring flask, add 85 Cc. of distilled water in which 2 Gm. of potas-

sium iodide have been previously dissolved, and sufficient water to make 100 Cc., and shake the liquid for several minutes. Then filter 50 Cc. of the liquid into a measuring cylinder and transfer it to a separator. Render the liquid alkaline with ammonia water, add 30 Cc. of ether, and shake the separator at intervals during several minutes. When separated, draw off the aqueous layer into a beaker, and the ether-solution into a tared beaker. Return the aqueous solution to the separator, and shake it with 20 Cc. more of ether for one minute. Draw off and reject the aqueous layer, and run the ether-solution into the tared beaker. Allow the combined ether-solutions to evaporate at a gentle heat, and dry the residue in the beaker to a constant weight on a water-bath. Multiply the weight by 20, which will give the weight in grammes of hydrastine contained in 100 Cc. of Fluidextract of Hydrastine.

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM HYOSCYAMI. U.S. Fluidextract of Hyoscyamus

[EXTRACTUM HYOSCYAMI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Hyoscyamus**, in No. 60 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about . . . . :	1000 Cc.	3 pints

Mix 600 Cc. [old form 29 fl. oz.] of Alcohol with 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Hyoscyamus is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 50 Cc. of this liquid, as directed below; from the results thus obtained, ascertain by calculation the amount of the alkaloids in the remainder of the liquid; add to this enough menstruum to make each 100 Cc. of the finished Fluidextract contain 0.075 Gm. of the alkaloids from Hyoscyamus.

Assay of Fluidextract of Hyoscyamus

The method to be employed is identical with that given on page 384, using 50 Cc. of Fluidextract of Hyoscyamus, instead of the quantity of Fluidextract of Belladonna Root there directed, and multiplying the product by 2 instead of 10.

Average dose.— 3 minims (0.2 Cc.).

FLUIDEXTRACTUM IPECACUANHÆ. U.S. Fluidextract of Ipecac

[EXTRACTUM IPECACUANHÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Ipecac**, in No. 80 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 350 Cc.

[old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Ipecac is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of the alkaloids in the remainder of the liquid; add to this enough menstruum to make each 100 Cc. of the finished Fluidextract contain 1.5 Gm. of the alkaloids from Ipecac.

Assay of Fluidextract of Ipecac

Fluidextract of Ipecac . . . . **10 Cc.**
Ammonia Water,
Ether,
Normal Sulphuric Acid V.S.,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Cochineal T.S., each, a sufficient quantity

Transfer 10 Cc. of Fluidextract of Ipecac by means of a graduated pipette to a porcelain evaporating dish. Evaporate off the alcohol with the aid of a water-bath, and, when almost cool, add 5 Cc. of normal sulphuric acid V.S. and 20 Cc. of distilled water, and stir the liquid at intervals for three minutes. Filter the liquid into a separator, rinse the dish, and wash the filter successively with 10 Cc. and 5 Cc. of distilled water, and add these liquids to the separator. To the separator add 20 Cc. of ether and a small piece of red litmus paper; render the liquid alkaline with ammonia water and shake the separator for one minute. Draw off the aqueous layer into a beaker, and the ether-layer into another beaker. Return the aqueous solution to the separator, add 10 Cc. more of ether and shake the liquid, adding the ether-solution to that already in the beaker, and returning the aqueous solution to the separator; repeat the extraction with 10 Cc. more of ether, and then add the ether-layer to that already in the beaker. Allow the combined ether-solutions to evaporate, either spontaneously or with the aid of a water-bath containing warm water, and then add 10 Cc. of tenth-normal sulphuric acid V.S. Stir the liquid carefully with a glass rod to facilitate the solution of the alkaloids, and when these have all dissolved, add 5 drops of cochineal T.S. From a graduated burette, add sufficient fiftieth-normal potassium hydroxide V.S. until a pink color is produced. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 10 (the 10 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0238, and this product by 10, which will give the weight in grammes of alkaloids contained in each 100 Cc. of Fluidextract of Ipecac.

Average dose.— { Emetic, 15 minims (1 Cc.).
{ Expectorant, 1 minim (0.05 Cc.).

FLUIDEXTRACTUM KRAMERIÆ. U.S. Fluidextract of Krameria

[EXTRACTUM KRAMERIÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Krameria,** in No. 40 Powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical glass percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Krameria is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM LAPPÆ. U.S. **Fluidextract of Lappa**

[Extractum Lappæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Lappa,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Lappa is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM LEPTANDRÆ. U.S. **Fluidextract of Leptandra**

[Extractum Leptandræ Fluidum, Pharm. 1890]

	Metric	Old form
* **Leptandra,** in No. 60 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Leptandra is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dis-

solve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM LOBELIÆ. U.S. Fluidextract of Lobelia

	Metric	Old form
* **Lobelia,** in No. 50 powder	1000 Gm.	50 oz. av.
Acetic Acid,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 275 Cc. [old form 13 fl. oz.] of Acetic Acid with 725 Cc. [old form 35 fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Acetic Acid and Water as before, until the Lobelia is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50 C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to made the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 8 minims (0.5 Cc.).

FLUIDEXTRACTUM LUPULINI. U.S. Fluidextract of Lupulin

[Extractum Lupulini Fluidum, Pharm. 1890]

	Metric	Old form
* **Lupulin**	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Pack the Lupulin firmly in a cylindrical percolator; then add enough Alcohol to saturate the Lupulin and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Lupulin is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 8 minims (0.5 Cc.).

FLUIDEXTRACTUM MATICO. U.S. Fluidextract of Matico

[Extractum Matico Fluidum, Pharm. 1890]

	Metric	Old form
* **Matico,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Matico is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 1 fluidrachm (4 Cc.).

FLUIDEXTRACTUM MEZEREI. U.S. Fluidextract of Mezereum

[EXTRACTUM MEZEREI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Mezereum,** in No. 30 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Mezereum is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

FLUIDEXTRACTUM NUCIS VOMICÆ. U.S. Fluidextract of Nux Vomica

[EXTRACTUM NUCIS VOMICÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Nux Vomica,** in No. 40 powder	1000 Gm.	50 oz. av.
Acetic Acid	50 Cc.	2½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Mix Alcohol and Water in the proportion of 750 Cc. [old form 36 fl. oz.] of Alcohol and 250 Cc. [old form 12 fl. oz.] of Water. Moisten the powder with 1000 Cc. [old form 3 pints] of the mixture, to which the Acetic Acid had previously been added, and let it digest, in a well-covered vessel, in a warm place, during forty-eight hours. Then pack it in a cylindrical glass percolator, gradually pour menstruum upon it, and allow the percolation to proceed slowly until the Nux Vomica is practically exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of strychnine in the remainder of the liquid; add to this enough menstruum to make each 100 Cc. of the finished Fluidextract contain 1 Gm. of strychnine.

Assay of Fluidextract of Nux Vomica

Fluidextract of Nux Vomica	10 Cc.
Ammonia Water,	
Ether,	
Chloroform,	
Distilled Water,	
Normal Sulphuric Acid V.S.,	
Sulphuric Acid Solution (3 percent. H_2SO_4),	
Sodium Hydroxide Solution (1 in 10),	
Nitric Acid (sp. gr. 1.42),	
Tenth-normal Sulphuric Acid V.S.,	
Fiftieth-normal Potassium Hydroxide V.S.,	
Iodeosin T.S., each, a sufficient quantity	

Transfer 10 Cc. of Fluidextract of Nux Vomica by means of a graduated pipette to a porcelain dish, evaporate it to dryness with the aid of a water-bath, and dissolve the residue, while warm, in a mixture of 16 Cc. of ether, 5 Cc. of chloroform, and 4 Cc. of ammonia water, and transfer the solution to a separator, rinsing the dish with a little chloroform, which is to be added to the separator, and shake the separator carefully for a few minutes. When the fluids have separated, draw off the aqueous layer into another separator, wash the chloroform-ether liquid and separator with a little water, and add this to the second separator. Then shake the aqueous liquid with two successive portions of 15 and 10 Cc., respectively, of chloroform, and add these to the first separator. If a small portion of the liquid left in the second separator still shows, after acidifying, a reaction with mercuric potassium iodide T.S., repeat the shaking out with 10 Cc. more of chloroform. Now shake the combined liquids in the first separator with three successive portions, respectively, of 15, 10, and 10 Cc. of normal sulphuric acid V.S., and collect the combined acid solutions in another separator. To this acid solution add a small piece of red litmus paper, and sufficient ammonia water to render it alkaline, then shake out successively with three portions, respectively, of 25, 10, and 10 Cc. of chloroform, and collect the chloroform solutions in a beaker. Evaporate the chloroform with the aid of a water-bath, dissolve the alkaloidal residue in 15 Cc. of 3 percent. sulphuric acid solution, by the aid of a water-bath, and allow the liquid to cool. To this solution add 3 Cc. of a cooled mixture of equal volumes of nitric acid (specific gravity 1.42) and distilled water, and, after rotating the liquid a few times, set it aside for exactly ten minutes, stirring it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous solution of sodium hydroxide (1 in 10), wash the beaker three times with very small amounts of distilled water, and add the washings to the separator. If the liquid is not quite turbid, add 2 Cc. more of the solution of sodium hydroxide. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter, wetted with chloroform, into a flask. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the flask, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath, very carefully, to avoid decrepitation. To the alkaloidal residue, add 10 Cc. of tenth-normal sulphuric acid V.S., 5 drops of iodeosin T.S., about 80 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the

excess of acid with fiftieth-normal potassium hydroxide V.S., until the aqueous liquid just turns pink. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. taken, by 5, subtract this number from 10 (the 10 Cc. of tenth-normal sulphuric acid V.S taken), multiply the remainder by 0.0332, and this product by 10, which will give the weight in grammes of strychnine contained in 100 Cc. of the Fluidextract of Nux Vomica.

Average dose.— 1 minim (0.05 Cc.).

FLUIDEXTRACTUM PAREIRÆ. U. S. Fluidextract of Pareira

[Extractum Pareiræ Fluidum, Pharm. 1890]

	Metric	Old form
* **Pareira,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Glycerin	**100 Cc.**	4 fl. oz. 384 min.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix the Glycerin with 600 Cc. [old form 29 fl. oz.] of Alcohol and 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of 600 Cc. [old form 29 fl. oz.] of Alcohol to 400 Cc. [old form 19 fl. oz.] of Water, until the Pareira is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM PHYTOLACCÆ. U. S. Fluidextract of Phytolacca

[Extractum Phytolaccæ Radicis Fluidum, Pharm. 1890]

	Metric	Old form
* **Phytolacca,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Phytolacca is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— { Emetic, 15 minims (1 Cc.).
{ Alterative, 1½ minims (0.1 Cc.).

FLUIDEXTRACTUM PILOCARPI. U. S. **Fluidextract of Pilocarpus**

[EXTRACTUM PILOCARPI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Pilocarpus,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make about	**1000 Cc.**	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Pilocarpus is exhausted. Reserve the first 750 Cc. [old form 36 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of alkaloid in the remainder of the liquid; add to this enough menstruum to make each 100 Cc. of Fluidextract contain 0.4 Gm. of the alkaloids from Pilocarpus.

Assay of Fluidextract of Pilocarpus

Fluidextract of Pilocarpus	**10 Cc.**
Chloroform,	
Ammonia Water,	
Normal Sulphuric Acid V.S.,	
Tenth-normal Sulphuric Acid V.S.,	
Fiftieth-normal Potassium Hydroxide V.S.,	
Cochineal T.S. or **Iodeosin T.S.,** each, a sufficient quantity	

Transfer 10 Cc. of Fluidextract of Pilocarpus by means of a graduated pipette to a porcelain dish containing a little clean sand, and evaporate it to dryness with the aid of a water-bath. Mix the sand uniformly with the extract and transfer the mixture to an Erlenmeyer flask of about 100 Cc. capacity, rinsing the dish with a mixture of 25 Cc. of chloroform and 2.5 Cc. of ammonia water. Transfer the rinsings to the flask, cork it securely, and shake it well at intervals during one hour. Decant the liquid, transfer to a separator, wash the sand with several portions of chloroform, draw off and filter the chloroformic liquid into another separator. Then shake out the chloroform solution with 15 Cc. of normal sulphuric acid V. S., transferring the acid aqueous solution to another separator. Repeat the shaking out with a mixture of 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, collecting the acid solutions in the second separator. Again repeat the shaking out with 10 Cc. of distilled water, and add the aqueous liquid to the second separator. Introduce into the second separator a small piece of red litmus paper, add enough ammonia water to render the liquid alkaline, and shake out the liquid with 20 Cc. of chloroform, drawing off the chloroformic solution into a beaker. Repeat the shaking out with two portions of 15 and 10 Cc. of chloroform, and add the chloroformic solutions to the beaker. Evaporate the chloroform by means of a water-bath, and dissolve the alkaloidal residue in 8 Cc. of tenth-normal sulphuric acid V.S. Add 5 drops of cochineal T.S. or iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 8 (the 8 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.02, and this product by 10, to obtain the

weight in grammes of alkaloids contained in 100 Cc. of the Fluidextract of Pilocarpus.

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM PODOPHYLLI. U. S. Fluidextract of Podophyllum

[Extractum Podophylli Fluidum, Pharm. 1890]

	Metric	Old form
* **Podophyllum,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator ; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Podophyllum is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract ; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 8 minims (0.5 Cc.).

FLUIDEXTRACTUM PRUNI VIRGINIANÆ. U.S. Fluidextract of Wild Cherry

[Extractum Pruni Virginianæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Wild Cherry,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin	**200 Cc.**	9½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix the Glycerin with 200 Cc. [old form 9½ fl. oz.] of Alcohol and 600 Cc. [old form 29 fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical glass percolator ; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours ; then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of 200 Cc. [old form 9½ fl. oz.] of Alcohol to 800 Cc. [old form 38½ fl. oz.] of Water, and allow the percolation to proceed very slowly, until the Fluidextract measures 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM QUASSIÆ. U.S. Fluidextract of Quassia

[Extractum Quassiæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Quassia**, in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 300 Cc. [old form 14½ fl. oz.] of Alcohol with 600 Cc. [old form 29 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Quassia is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 8 minims (0.5 Cc.).

FLUIDEXTRACTUM QUERCUS. U.S. Fluidextract of Quercus

	Metric	Old form
* **Quercus**, in No. 40 powder	1000 Gm.	50 oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Glycerin with 900 Cc. [old form 43 fl. oz.] of Diluted Alcohol, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Quercus is exhausted. Reserve the first 700 Cc. [old form 33½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM QUILLAJÆ. U.S. Fluidextract of Quillaja

	Metric	Old form
* **Quillaja**, in No. 40 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Quillaja is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fuidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 3 minims (0.2 Cc.).

FLUIDEXTRACTUM RHAMNI PURSHIANÆ. U.S. Fluidextract of Cascara Sagrada

[EXTRACTUM RHAMNI PURSHIANÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Cascara Sagrada,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 400 Cc. [old form 19 fl. oz.] of Alcohol with 600 Cc. [old form 29 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, until the Cascara Sagrada is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM RHAMNI PURSHIANÆ AROMATICUM. U.S. Aromatic Fluidextract of Cascara Sagrada

	Metric	Old form
* **Cascara Sagrada,** in No. 40 powder	1000 Gm.	50 oz. av.
Glycyrrhiza, in No. 30 powder	100 Gm.	5 oz. av.
Magnesium Oxide	125 Gm.	6¼ oz. av.
Glycerin	250 Cc.	12 fl. oz.
Compound Spirit of Orange	10 Cc.	½ fl. oz.
Alcohol,		
Diluted Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Cascara Sagrada, Glycyrrhiza, and Magnesium Oxide thoroughly, and, having added 2000 Cc. [old form 6 pints] of Water, allow the mixture to macerate for twelve hours, and then dry it at a gentle heat. Mix the Glycerin with 500 Cc. [old form 21 fl. oz.] of Alcohol and 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the powder is exhausted. Reserve the first 800 Cc. [old form $38\frac{1}{2}$ fl. oz.] of the percolate, and evaporate the remainder to a soft extract ; dissolve this in the reserved portion, add the Compound Spirit of Orange and enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM RHEI. U.S. Fluidextract of Rhubarb

[EXTRACTUM RHEI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Rhubarb,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 800 Cc. [old form $38\frac{1}{2}$ fl. oz.] of Alcohol with 200 Cc. [old form $9\frac{1}{2}$ fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a conical percolator ; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Rhubarb is exhausted. Reserve the first 750 Cc. [old form 36 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 70° C. (158° F.), to a soft extract ; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM RHOIS GLABRÆ. U.S. Fluidextract of Rhus Glabra

[EXTRACTUM RHOIS GLABRÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Rhus Glabra,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Glycerin	**100 Cc.**	4 fl. oz. 384 min.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix the Glycerin with 900 Cc. [old form 43 fl. oz.] of Diluted Alcohol, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator ; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Rhus Glabra is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM ROSÆ. U.S. Fluidextract of Rose

[EXTRACTUM ROSÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Red Rose,** in No. 20 powder	**1000 Gm.**	50 oz. av.
Glycerin	**100 Cc.**	4 fl. oz. 384 min.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix the Glycerin with 900 Cc. [old form 43 fl. oz.] of Diluted Alcohol, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Red Rose is exhausted. Reserve the first 750 Cc. [old form 36 fl. oz.] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM RUBI. U.S. Fluidextract of Rubus

[EXTRACTUM RUBI FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Rubus,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Rubus is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM SABINÆ. U.S. Fluidextract of Savin

[Extractum Sabinæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Savin,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 250 Cc. [old form 12 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Savin is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—5 minims (0.3 Cc.).

FLUIDEXTRACTUM SANGUINARIÆ. U.S. Fluidextract of Sanguinaria

	Metric	Old form
* **Sanguinaria,** in No. 30 powder	1000 Gm.	50 oz. av.
Acetic Acid,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 275 Cc. [old form 13 fl. oz.] of Acetic Acid with 725 Cc. [old form 35 fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, allow it to macerate, in a well-covered vessel, during forty-eight hours. Then pack it firmly in a cylindrical glass percolator, gradually pour menstruum upon it, using the same proportions of Acetic Acid and Water as before, and allow the percolation to proceed slowly, until the Sanguinaria is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—1½ minims (0.1 Cc.).

FLUIDEXTRACTUM SARSAPARILLÆ. U.S. Fluidextract of Sarsaparilla

[Extractum Sarsaparillæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Sarsaparilla,** in No. 30 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 300 Cc. [old form 14½ fl. oz.] of Alcohol with 600 Cc. [old form 29 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop

from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Sarsaparilla is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—30 minims (2 Cc.).

FLUIDEXTRACTUM SARSAPARILLÆ COMPOSITUM. U. S. Compound Fluidextract of Sarsaparilla

[Extractum Sarsaparillæ Fluidum Compositum, Pharm. 1890]

	Metric	Old form
* **Sarsaparilla,** in No. 30 powder	750 Gm.	37½ oz. av.
Glycyrrhiza, in No. 30 powder	120 Gm.	6 oz. av.
Sassafras, in No. 30 powder	100 Gm.	5 oz. av.
Mezereum, in No. 30 powder	30 Gm.	1½ oz. av.
Glycerin	100 Cc.	4 fl. oz. 384 min.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the Glycerin with 900 Cc. [old form 43 fl. oz.] of Diluted Alcohol, and, having moistened the mixed powders with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum and then Diluted Alcohol, until the powder is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—30 minims (2 Cc.).

FLUIDEXTRACTUM SCILLÆ. U. S. Fluidextract of Squill

	Metric	Old form
* **Squill,** in No. 20 powder	1000 Gm.	50 oz. av.
Acetic Acid,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 275 Cc. [old form 13 fl. oz.] of Acetic Acid with 725 Cc. [old form 35 fl. oz.] of Water, and, having added 800 Cc. [old form 38½ fl. oz.] of the mixture to the powder, allow it to macerate, in a well-covered glass or porcelain vessel, during forty-eight hours, then transfer it to a conical glass percolator, and allow the percolation to proceed slowly, adding menstruum gradually, using the same proportions of Acetic Acid and Water as before, until the Fluidextract measures 1000 Cc. [old form 3 pints].

Average dose.—1½ minims (0.1 Cc.).

FLUIDEXTRACTUM SCOPOLÆ. U. S. Fluidextract of Scopola

	Metric	Old form
* **Scopola,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	1000 Cc.	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with 350 Cc. [old form 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Scopola is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid as directed below; from the results thus obtained, ascertain by calculation the amount of mydriatic alkaloids in the remainder of the liquid and add to this enough menstruum to make each 100 Cc. of the finished Fluidextract contain 0.5 Gm. of the mydriatic alkaloids from Scopola.

Assay of Fluidextract of Scopola

The method to be employed is identical with that given for Fluidextract of Belladonna Root on page 384, using 10 Cc. of Fluidextract of Scopola.

Average dose.— 1 minim (0.05 Cc).

FLUIDEXTRACTUM SCUTELLARIÆ. U.S. Fluidextract of Scutellaria

[Extractum Scutellariæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Scutellaria,** in No. 40 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Scutellaria is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM SENEGÆ. U.S. **Fluidextract of Senega**

[Extractum Senegæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Senega,** in No. 40 powder	1000 Gm.	50 oz. av.
Solution of Potassium Hydroxide	30 Cc.	1½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix the solution of Potassium Hydroxide with 600 Cc. [old form 29 fl. oz.] of Alcohol and 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 450 Cc. [old form 21½ fl. oz.] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then a mixture of Alcohol and Water, made in the proportion of 600 Cc. [old form 29 fl. oz.] of Alcohol to 300 Cc. [old form 14½ fl. oz.] of Water until the Senega is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder, in a porcelain dish, to a soft extract; dissolve this in the reserved portion, and add enough of the last-mentioned mixture of Alcohol and Water to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

FLUIDEXTRACTUM SENNÆ. U.S. **Fluidextract of Senna**

[Extractum Sennæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Senna,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Diluted Alcohol, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 350 Cc. [old form 17 fl. oz.] of Alcohol, pack it firmly in a cylindrical percolator, and percolate it with Alcohol until the Senna is exhausted. The alcoholic percolate thus obtained is to be rejected. Remove the powder from the percolator, dry it, and, having moistened it with 400 Cc. [old form 19 fl. oz.] of Diluted Alcohol, pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Senna is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM SERPENTARIÆ. U.S. **Fluidextract of Serpentaria**

[EXTRACTUM SERPENTARIÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Serpentaria,** in No. 50 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Serpentaria is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—15 minims (1 Cc.).

FLUIDEXTRACTUM SPIGELIÆ. U.S. **Fluidextract of Spigelia**

[EXTRACTUM SPIGELIÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Spigelia,** in No. 40 powder	1000 Gm.	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 300 Cc. [old form 14½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Spigelia is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—1 fluidrachm (4 Cc.).

FLUIDEXTRACTUM STAPHISAGRIÆ. U.S. **Fluidextract of Staphisagria**

	Metric	Old form
* **Staphisagria,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 800 Cc. [old form 38½ fl. oz.] of Alcohol with 200 Cc. [old form 9½ fl. oz.] of Water, and, having moistened the powder with

300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Staphisagria is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—1 minim (0.05 Cc.).

FLUIDEXTRACTUM STILLINGIÆ. U.S. Fluidextract of Stillingia

[EXTRACTUM STILLINGIÆ FLUIDUM, PHARM. 1890]

	Metric	Old form
* **Stillingia,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Diluted Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 300 Cc. [old form 14½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Stillingia is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.—30 minims (2 Cc.).

FLUIDEXTRACTUM STRAMONII. U.S. Fluidextract of Stramonium

	Metric	Old form
* **Stramonium,** in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make about	**1000 Cc.**	3 pints

Mix 600 Cc. [old form 29 fl. oz.] of Alcohol with 300 Cc. [old form 14½ fl. oz. of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Stramonium is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.], of the percolate, and evaporate the remainder, at a temperature not exceed-

ing 50° C. (122° F.], to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid, as directed below; from the results thus obtained, ascertain by calculation the amount of mydriatic alkaloids in the remainder of the liquid, and add to this enough menstruum to make each 100 Cc. of the finished Fluidextract contain 0.25 Gm. of the mydriatic alkaloids from Stramonium.

Assay of Fluidextract of Stramonium

The method to be employed is identical with that given for Fluidextract of Belladonna Root on page 384, using 10 Cc. of Fluidextract of Stramonium.

Average dose.— 1 minim (0.05 Cc.).

FLUIDEXTRACTUM SUMBUL. U.S. Fluidextract of Sumbul

	Metric	Old form
* **Sumbul,** in No. 30 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Sumbul is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM TARAXACI. U.S. Fluidextract of Taraxacum

[Extractum Taraxaci Fluidum, Pharm. 1890]

	Metric	Old form
* **Taraxacum,** in No. 30 powder	1000 Gm.	50 oz. av.
Solution of Sodium Hydroxide	50 Cc.	2½ fl. oz.
Diluted Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 300 Cc. [old form 14½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Taraxacum is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, add the Solution of Sodium Hydroxide, and enough Diluted Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 2 fluidrachms (8 Cc.).

FLUIDEXTRACTUM TRITICI. U.S. **Fluidextract of Triticum**

[Extractum Tritici Fluidum, Pharm. 1890]

	Metric	Old form
* **Triticum,** finely cut	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Pack the Triticum in a cylindrical metallic percolator, pour boiling Water upon it, and allow the percolation to proceed, supplying boiling water, as required, until the Triticum is exhausted. Evaporate the percolate to 750 Cc. [old form 36 fl. oz.] and, having added to it 250 Cc. [old form 12 fl. oz.] of Alcohol, mix well and set it aside for forty-eight hours. Then filter the liquid and add to the filtrate enough of a mixture of Alcohol and Water made in the proportion of *one volume* of Alcohol to *three volumes* of Water to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 2 fluidrachms (8 Cc.).

FLUIDEXTRACTUM UVÆ URSI. U.S. **Fluidextract of Uva Ursi**

[Extractum Uvæ Ursi Fluidum, Pharm. 1890]

	Metric	Old form
* **Uva Ursi,** in No. 30 powder	**1000 Gm.**	50 oz. av.
Glycerin	**300 Cc.**	14½ fl. oz.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix the Glycerin with 200 Cc. [old form 9½ fl. oz.] of Alcohol and 500 Cc. [old form 24 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 19 fl. oz.] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of 200 Cc. [old form 9½ fl. oz.] of Alcohol to 500 Cc. [old form 24 fl. oz.] of Water, until the Uva Ursi is exhausted. Reserve the first 800 Cc. [old form 38½ fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough of the mixture of Alcohol and Water to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM VALERIANÆ. U.S. Fluidextract of Valerian

[Extractum Valerianæ Fluidum, Pharm. 1890]

	Metric	Old form
* **Valerian,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Valerian is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM VERATRI. U. S. Fluidextract of Veratrum

[Extractum Veratri Viridis Fluidum, Pharm. 1890]

	Metric	Old form
* **Veratrum,** in No. 60 powder	1000 Gm.	50 oz. av.
Alcohol, a sufficient quantity,		
To make	1000 Cc.	3 pints

Moisten the powder with 300 Cc. [old form 14½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Veratrum is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 1½ minims (0.1 Cc.).

FLUIDEXTRACTUM VIBURNI OPULI. U.S. Fluidextract of Viburnum Opulus

[Extractum Viburni Opuli Fluidum, Pharm. 1890]

	Metric	Old form
* **Viburnum Opulus,** in No. 40 powder	1000 Gm.	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	1000 Cc.	3 pints

Mix 600 Cc. [old form 29 fl. oz.] of Alcohol with 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Viburnum Opulus is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM VIBURNI PRUNIFOLII. U.S. Fluidextract of Viburnum Prunifolium

[Extractum Viburni Prunifolii Fluidum, Pharm. 1890]

	Metric	Old form
* **Viburnum Prunifolium**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, each, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 600 Cc. [old form 29 fl. oz.] of Alcohol with 300 Cc. [old form 14½ fl. oz.] of Water, and, having moistened the powder with 300 Cc. [old form 14½ fl. oz.] of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Viburnum Prunifolium is exhausted. Reserve the first 850 Cc. [old form 41 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM XANTHOXYLI. U.S. Fluidextract of Xanthoxylum

[Extractum Xanthoxyli Fluidum, Pharm. 1890]

	Metric	Old form
* **Xanthoxylum**, in No. 40 powder	**1000 Gm.**	50 oz. av.
Alcohol,		
Water, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Mix 750 Cc. [old form 36 fl. oz.] of Alcohol with 250 Cc. [old form 12 fl. oz.] of Water, and, having moistened the powder with 250 Cc. [old form 12 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to

drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Xanthoxylum is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 30 minims (2 Cc.).

FLUIDEXTRACTUM ZINGIBERIS. U.S. Fluidextract of Ginger

[Extractum Zingiberis Fluidum, Pharm. 1890]

	Metric	Old form
* **Ginger,** in No. 50 powder	**1000 Gm.**	50 oz. av.
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	3 pints

Moisten the powder with 250 Cc. [old form 12 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Ginger is exhausted. Reserve the first 900 Cc. [old form 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure 1000 Cc. [old form 3 pints].

Average dose.— 15 minims (1 Cc.).

CHAPTER XXVIII

OLEORESINOUS LIQUIDS MADE BY PERCOLATION

Oleoresinæ *Oleoresins*

THE oleoresins are official liquid preparations, consisting principally of natural oils and resins extracted from vegetable substances by percolation with acetone; ether was formerly used as the menstruum, but it was replaced by acetone in the U. S. Pharmacopœia (8th Rev.), because the latter is less inflammable and not so expensive, the oleoresin of cubeb is the exception in this class, its menstruum being alcohol. The oleoresins were formerly classed with fluidextracts, but they differ essentially from the latter: 1. They do not bear the uniform relation to the drug that the fluidextracts do, of gramme to cubic centimeter,—the yield of oleoresin obtained from the drug varying according to the proportion of oil and resin naturally present. 2. The menstruum (acetone) extracts principles which are often insoluble in alcohol, diluted alcohol or water. 3. They are without exception the most concentrated liquid preparations of the drugs that are produced.

FIG. 439

Percolator for volatile liquids

Oleoresins are prepared by percolating the powdered drug contained in a cylindrical percolator provided with a cover and receptacle suitable for volatile liquids, with acetone or alcohol, until exhausted, recovering the greater part of the liquid by distillation, and exposing the residue in a capsule to spontaneous evaporation until the remaining liquid has evaporated. Fig. 439 shows a convenient percolator for making oleoresins. The powder should not be packed too tightly in the narrow percolator; the exit tube affords a means of easily regulating the flow. A *continuous extraction apparatus* can be made of this percolator by enclosing the upper part in a suitable case and passing cold water between, arranging the apparatus like a Liebig's condenser (see page 149). A glass tube is connected with the top of the percolator and the mouth of the bottle by rubber tube connections, and if the receiving bottle is placed in a water-bath and the water gently heated, the acetone will evaporate from the percolate, the vapors rising in the tube and condensing in the upper part of the percolator.

Oleoresins which have not been evaporated sufficiently are frequently found in commerce; they have a decided odor of the menstruum, sometimes of benzin, showing in the latter case that a menstruum which is an inferior solvent has been substituted for the one authorized by the Pharmacopœia. *Six* oleoresins are official.

Table of Official Oleoresins

Name	Yield	Dose
Oleoresina Aspidii	10 to 15 percent.	fʒss to fʒi (2 Cc. to 4 Cc.)
Capsici	5 percent.	♏¼ to ♏i (0.01 Cc. to 0.05 Cc.)
Cubebæ	18 to 25 percent.	♏v to ♏xxx (0.3 Cc. to 2 Cc.)
Lupulini	50 percent.	♏ii to ♏v (0.15 Cc. to 0.3 Cc.)
Piperis	5 percent.	♏¼ to ♏i (0.01 Cc. to 0.05 Cc.)
Zingiberis	6 to 8 percent.	♏i (0.05 Cc.)

OLEORESINA ASPIDII. U.S. Oleoresin of Aspidium

	Metric	Old form
* **Aspidium,** recently reduced to No. 40 powder	**500 Gm.**	16 oz. av.
Acetone, a sufficient quantity		

Introduce the Aspidium into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until the Aspidium is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. (The product is usually about 60 Gm.) [old form 2 fl. oz.]. Keep the Oleoresin in a well-stoppered bottle.

NOTE.—Oleoresin of Aspidium usually deposits, on standing, a granular, crystalline substance (filicic acid). This should be thoroughly mixed with the liquid portion before use.

Average dose.— 30 grains (2 Gm.).

OLEORESINA CAPSICI. U.S. Oleoresin of Capsicum

	Metric	Old form
* **Capsicum,** in No. 40 powder	**500 Gm.**	32 oz. av.
Acetone, a sufficient quantity		

Introduce the Capsicum into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until 800 Cc. [old form 3 pints] of percolate have been obtained. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. Then pour off the liquid portion, transfer the remainder to a glass funnel provided with a pledget of cotton, and, when the separated fatty matter (which is to be rejected) has been completely drained, mix the liquid portions together. (The product is usually about 25 Gm.) [old form 1½ fl. oz.]. Keep the Oleoresin in a well-stoppered bottle.

Average dose.— ½ grain (0.030 Gm.).

OLEORESINA CUBEBÆ. U.S. Oleoresin of Cubeb

	Metric	Old form
* **Cubeb,** in No. 30 powder	**500 Gm.**	16 oz. av.
Alcohol, a sufficient quantity		

Introduce the Cubeb into a cylindrical glass percolator, pack the powder firmly, and percolate slowly with Alcohol, added in successive portions until the Cubeb is exhausted. Recover the greater part of the Alcohol from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Alcohol to evaporate, with constant stirring, in a warm place. (The product is usually about 125 Gm.) [old form 4 fl. oz.]. Keep the Oleoresin in a well-stoppered bottle.

NOTE.—Oleoresin of Cubeb deposits, after standing for some time, a waxy and crystalline matter, which should be rejected, the liquid portion only being used.

Average dose.— 7½ grains (0.500 Gm.).

OLEORESINA LUPULINI. U.S. Oleoresin of Lupulin

	Metric	Old form
* **Lupulin**	**500 Gm.**	16 oz. av.
Acetone, a sufficient quantity		

Introduce the Lupulin into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and a receptacle suitable for volatile liquids. Press the powder very lightly, and percolate slowly with Acetone, added in successive portions, until the Lupulin is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and having transferred the residue, to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. (The product is usually about 250 Gm.) [old form 8 fl. oz.]. Keep the Oleoresin in a well-stoppered bottle.

Average dose.—3 grains (0.200 Gm.).

OLEORESINA PIPERIS. U.S. Oleoresin of Pepper

	Metric	Old form
* **Pepper,** in No. 40 powder	**500 Gm.**	32 oz. av.
Acetone, a sufficient quantity		

Introduce the Pepper into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and a receptacle for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until the Pepper is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, set this aside in a warm place until the remaining Acetone has evaporated, and the deposition of crystals of piperine has ceased. Lastly, separate the Oleoresin from the piperine by straining through purified cotton. (The product is usually about 25 Gm.) [old form 1½ fl. oz.]. Keep the Oleoresin in a well-stoppered bottle.

Average dose.—½ grain (0.030 Gm.).

OLEORESINA ZINGIBERIS. U.S. Oleoresin of Ginger

	Metric	Old form
* **Ginger,** in No. 60 powder	**500 Gm.**	16 oz. av.
Acetone, a sufficient quantity		

Introduce the Ginger into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until the Ginger is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. (The product is usually about 30 Gm.) [old form 1 fl. oz.]. Keep the Oleoresin in a well-stoppered bottle.

Average dose.— $\frac{1}{2}$ grain (0.030 Gm.).

CHAPTER XXIX

ACETOUS LIQUIDS MADE BY PERCOLATION

Aceta *Vinegars*

THIS class of preparations is an old one, having been in use since the days of Hippocrates. Medicated vinegars are solutions of the active principles of drugs in diluted acetic acid, the latter being chosen as a menstruum because acetic acid is not only a good solvent but also possesses antiseptic properties.

Diluted acetic acid replaces the menstrua formerly used, wine and cider vinegar having been discarded on account of their variable quality. Acetic acid may be obtained in all parts of the country very cheaply and of unexceptionable quality, and by simple admixture with about five times its weight of water the menstruum is produced. The properties of acetic acid are noticed in Part IV of this work.

Two vinegars are official at present; one is made from a drug which owes its activity to alkaloids. The advantage of using acidulous menstruum is apparent in forming soluble salts with most of the active principles of drugs, and experience has proved the value of diluted acetic acid as a solvent in exhausting drugs. The medicated vinegars should not be made in larger quantities than can be used within a reasonable time, for, although possessed of most of the characters of permanent preparations, they are liable to deposit upon standing.

The official vinegars are now uniform in strength (10 percent.), each containing the soluble principles from the drug. They are both made by maceration.

Official Vinegars

Name	Ingredients
Acetum Opii	100 Gm. Powdered Opium; 30 Gm. Powdered Myristica; 200 Gm. Sugar, with sufficient Diluted Acetic Acid to make 1000 Cc.
Scillæ	100 Gm. Squill, No. 20 powder, with sufficient Diluted Acetic Acid to make 1000 Cc.

Unofficial Vinegars

Name	Ingredients	Method of Preparing
Acetum Cantharidis. Br.	100 Gm. Cantharides, bruised; Glacial Acetic Acid and Water, of each, to make 1000 Cc.	Macerate the Cantharides in 900 Cc. equal parts Glacial Acetic Acid and Water for twenty-four hours, then transfer to a percolator, and add enough menstruum to make 1000 Cc.
Ipecacuanhæ. Br.	50 Cc. Fluidextract of Ipecac; 100 Cc. Alcohol; 850 Cc. Diluted Acetic Acid (4.27 percent.)	Mix, filter and add Diluted Acetic Acid to make 1000 Cc.

ACETUM OPII. U.S. **Vinegar of Opium**

	Metric	Old form
* **Powdered Opium**	**100 Gm.**	365 grains
Myristica, in No. 30 powder	**30 Gm.**	109 grains
Sugar	**200 Gm.**	1 oz. av. 182 gr.
Diluted Acetic Acid, a sufficient quantity,		
To make	**1000 Cc.**	8 fl. oz.

Macerate the Opium and Myristica in 500 Cc. [old form 4 fl. oz.] of Diluted Acetic Acid during seven days, frequently stirring; then strain through muslin of close texture, and express the liquid. Mix the residue with 200 Cc. [old form 1½ fl. oz.] of Diluted Acetic Acid until a uniform magma is produced, then strain and express again. Mix and filter the strained liquids, dissolve the Sugar in the filtrate, and pass enough Diluted Acetic Acid through the filter to make the product measure 1000 Cc. [old form 8 fl. oz.]

Average dose.— 8 minims (0.5 Cc.).

ACETUM SCILLÆ. U.S. **Vinegar of Squill**

	Metric	Old form
* **Squill,** in No. 20 powder	**100 Gm.**	3 oz. av. 148 gr.
Diluted Acetic Acid, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Macerate the Squill with 900 Cc. [old form 29 fl. oz.] of Diluted Acetic Acid during seven days, frequently stirring; then strain through muslin, and wash the mass on the strainer with enough Diluted Acetic Acid to make the strained liquid measure nearly 1000 Cc. [old form 2 pints]. Heat this liquid to boiling, filter while hot, and when cooled add sufficient Diluted Acetic Acid to make the product measure 1000 Cc. [old form 2 pints.]

Average dose.— 15 minims (1 Cc.).

CHAPTER XXX

SOLID PREPARATIONS MADE BY PERCOLATION

Extracta *Extracts*

EXTRACTS are solid or semi-solid preparations produced by evaporating solutions of vegetable principles. The solutions may be made by percolating the drug with water, alcohol, diluted alcohol of various strengths, ether, diluted acetic acid, or diluted solution of ammonia, and the extracts made from such percolates are termed respectively *aqueous*, *alcoholic*, *hydro-alcoholic*, *ethereal*, *acetic*, or *ammoniated* extracts. In addition to this, the juices of fresh plants extracted by contusion and expression are evaporated, and such extracts are frequently called *Succi spissati*, or *inspissated juices.*

Preparation of Inspissated Juices.—The variation in the amount of extractive matter afforded by expressing fresh plants is so great that the quality of this class of extracts is necessarily very uncertain. Although alcoholic extracts are also subject to variations, experience has shown that they are much more reliable, when properly made, than extracts prepared from expressed juices. For this reason inspissated juices were not recognized in the U. S. Pharmacopœia (8th Rev.). The inspissated juices most largely consumed in America are made in Great Britain, and the general formula of the British Pharmacopœia is appended:

Bruise the fresh plant in a mortar, press out the juice, and heat it gradually to 130° F., and separate the green colouring matter by a calico filter. Heat the strained liquid to 200° F. (to coagulate the albumen) and filter again. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; add to it the green colouring matter previously separated and passed through a hair-sieve, stir the whole together, and evaporate at a temperature not exceeding 140° F. to the consistence of a soft extract. Four extracts from fresh plants or parts of plants are official in the British Pharmacopœia as follows: green extract of belladonna, green extract of hyoscyamus, extract of colchicum, and extract of taraxacum.

Prof. Herrara has proposed a plan of making extracts without the use of much heat,—*by freezing the juices.* He finds that by compressing the frozen juice the expressed liquid, or mother-liquor, is greatly strengthened, the water being largely removed as ice, which remains in the press-cloth, and the concentrated juice is then dried by exposure on plates to the sun.

The percolates, or expressed juices of drugs, contain, in addition to the active principles, certain inert substances, which exist in the liquids in varying quantities. The amount of inert matter found in the extract depends largely upon the manipulation, but the composition of extracts also varies with the nature of the drug, the character of the solvent, and the mode of preparation. The object is generally to obtain as much of the active principle of the plant, with as little of the inert matter, as possible; though sometimes it may be desirable to separate two active ingredients from each other, when their effects upon the system are materially different; this may be partially accomplished by employing a menstruum which, while it dissolves one, leaves the other untouched. The proximate principles most commonly present in extracts are *gum*, *sugar*, *starch*, *tannin*, *extractive*, *chlorophyl*, *coloring-matter*, *salts*, and the *peculiar principles of plants;* to which, when a spiritous solvent is employed, may usually be added *resinous substances*, *fatty matter*, and frequently more or less *volatile oil*, gum and starch being excluded when the menstruum is strong alcohol. Inert fixed oil or fat is often removed from powdered drugs by previous percolation with ether or petroleum benzin; these liquids do not, as a rule, extract the active principles, and thus a dry powdered extract can be made.

Extractive.—It has long been known that in most vegetable bodies there is a substance, soluble both in water and in alcohol, which, in the preparation of extracts, undergoes chemical change during the process of evaporation, imparting to the liquid, even if originally limpid, first, a greenish, then a yellowish-brown, and ultimately a deep brown color, and becoming itself insoluble. This substance has received the appropriate name of *extractive*, derived from its frequent presence in extracts. Its existence as a distinct principle is denied, or at least doubted, by some chemists, who consider the phenomena supposed to result from its presence as depending upon the mutual reaction of other principles. The most important property of extractive is its disposition to pass, by the influence of atmospheric air at a high temperature, into an insoluble substance. If a vegetable infusion or decoction be evaporated in the open air to the consistence of an extract, then diluted, filtered, and again evaporated, and the process repeated so long as any insoluble matter is formed, the whole of the extractive will be separated from the liquid, while the other ingredients may remain. If chlorine be passed through an infusion or decoction, a similar precipitate is formed with much greater rapidity. The change is usually ascribed to the absorption of oxygen by the extractive, which has, therefore, been called, in its altered condition, oxidized extractive; but De Saussure ascertained that, though oxygen is absorbed during the process, an equal measure of carbonic acid gas is given out, and the oxygen and hydrogen of the extractive unite to form water in such a manner as to leave the principle richer in carbon than it was originally. The name of oxidized extractive is, therefore, obviously incorrect; and Berzelius long ago proposed to substitute for it that of *apothem*, synonymous with deposit. According to Berzelius, apothem is not completely insoluble in water, but imparts a slight color to that liquid when cold, and is rather more soluble in boiling water, which becomes turbid upon cooling. It is still more soluble in alcohol, and is freely dissolved by solutions of the alkalies and alkaline carbonates, from which it is precipitated by acids. It has a great tendency, when precipitated from solutions, to unite with other principles and to carry them along with it, thus acquiring properties somewhat different according to the source from which it is obtained. In this way, also, even when the extractive of a plant is itself medicinally inert, its conversion into apothem may be injurious by causing a precipitation of a portion of the active principle; and in practical pharmaceutical operations this change should always, if possible, be avoided.

Variable Quality of Extracts.—*It is evident that there must be great variation in the quality of extracts of pilular consistence as found in commerce*, for, whether made by any of the processes commonly employed, or by a special patented process, the lack of a fixed standard to determine the amount of moisture which is to remain in the extracts renders them very variable in strength. The Pharmacopœia is necessarily compelled to avoid specifying an exact limit in this respect, and the approximate standard of "*pilular consistence*" has been adopted. The powdered extracts are more stable and the preparations considered in another place, called *abstracts*, have a great advantage over extracts in this respect. It should be said in addition that the variation in the strength of extracts of pilular consistence does not cease even after their manufacture. The exposure to the air to which they are subjected in dispensing, particularly if kept in the customary open queen's-ware jars, causes loss of moisture, and they become hard, and consequently stronger, in proportion to the quantity of moisture that is thus lost; this loss may in some cases amount to as much as 25 percent. In moist climates, however, some extracts absorb moisture and become thinner. One of the advantages of powdered extracts is that they may be kept in tightly corked vials, and thus protected from moisture. The greatest variation in the commercial extracts, however, arises from the difference in the alcoholic strength of the menstruum employed. This may be best illustrated by taking the case of extract of jalap. Alcohol always dissolves the active principles, while water is the best solvent for those that are inert. If a manufacturer in making extract of jalap uses equal parts of alcohol and water, he will obtain twice as much extract as the manufacturer who simply uses alcohol; but the alcoholic extract or resin has twice the strength of the hydro-alcoholic extract, and is worth double the price, because it has been shown by actual experiment that the aqueous extract of jalap is absolutely inert even in doses of two hundred and forty grains. The difference between the relative merits of alcoholic and aqueous extracts does not so clearly appear in many of the extracts as in the instance just noted, but it is shown in such important extracts as those from belladonna, hyoscyamus, digitalis, etc., for here the strength depends largely upon the menstrua used in exhausting them, water removing the inert principles, starch, gum, albumen, sugar, salt, etc. The relative value of commercial extracts must depend upon the amount of *active* principles present; and as the manufacturer never states upon the label the menstruum that he has employed in making the extract, nor the yield of the extract from the drug from which it is prepared, and as each manufacturer often uses the menstruum that he thinks best, the pharmacist and physician have no means of knowing the dose of the extract, nor can they usually form any correct judgment of its value without a therapeutical experiment or analytical assay. It will be seen, therefore, from the foregoing considerations that extracts are among the most *unreliable* of all classes of preparations. It is greatly to be regretted that manufacturers do not *strictly adhere* to the menstrua directed in the Pharmacopœia, for the sake of securing uniformity, if for no other reason.

Preparation of Extracts.—The manipulations necessary to produce extracts have been considered under the various heads of Maceration, Expression, Percolation, Decoction, Infusion, Evaporation, Use of Steam Heat, Vacuum Apparatus, etc. The special precautions necessary for each extract will be noticed in the official working formulas which follow. The details of the formulas vary so much that a general formula is of little value, except to serve as a type for the alcoholic extracts, which resemble one another more closely than do any of the others.

Preservation of Extracts.—The general practice is to take no especial care in the preservation of soft extracts. This arises from the incorrect impression that they are permanent preparations and do not need it. The manufacturers seal the jars or bottles which contain them, because experience has compelled them to be very careful about this, to avoid loss in transportation,—in the case of soft extracts, through inversion of the jar. The loosely fitting covers to the jars permit the exposure which causes the variation above noticed, and it is impracticable for the pharmacist on every occasion to seal the jar immediately after he has used a portion of the extract. Several expedients have been suggested to overcome these difficulties. It is good practice to enclose the jar in a tightly fitting tin can, or to put the extract in a jar with a screw-cap cover which has a thin cork disk in the top to aid in making a tight joint.

Powdered Extracts.—These extracts are largely superseding soft extracts for reasons given in a preceding paragraph; the difficulty of making them arises from the injurious influence of heat upon concentrated percolates of organic substances, but by the use of vacuum apparatus, suitable absorptive diluents and care they can be made successfully.

General Formula for Powdered Extracts.—Evaporate the Fluidextract of the drug at a temperature not exceeding 70° C. (158° F.) with constant stirring, to complete dryness. Reduce the product to a fine powder and add enough powdered glycyrrhiza to make the finished extract weigh —— Gm. Mix thoroughly. Permission is given by the U. S. P. (8th Rev.) to use instead of powdered glycyrrhiza the dried and powdered marc from the same drug.

Powdered extracts should be kept in tightly closed vials and in a cool place.

General Formula for Alcoholic Extracts.—Percolate the powdered drug with the menstruum directed, until it is exhausted; reserve the first third of the percolate, evaporate the remainder at a temperature not exceeding 50° C. (122° F.) until it weighs 10 per cent. of the weight of the drug. Mix this with the reserved portion, and evaporate both at the above temperature to a pilular consistence. Or, instead of reserving a part of the percolate, the whole quantity is distilled until the alcohol is recovered, and the residue evaporated to a pilular consistence. In the case of those extracts which are apt to become hard, 10 percent. of glycerin may be added to enable them to retain their consistence.

Official Extracts.—The official extracts are *twenty-eight* in number. Of these, *seventeen* are directed to be made with alcoholic menstrua of various strengths,—viz., Extracts of Belladonna Leaves, Cannabis Indica, Cascara Sagrada, Cimicifuga, Colocynth, Compound Colocynth, Digitalis, Ergot, Euonymus, Hyoscyamus, Leptandra, Physostigma, Rhubarb, Scopola, Stramonium, Sumbul, and Taraxacum.

Nine official extracts are made with aqueous menstrua,—viz., Extracts of Aloes, Hæmatoxylon, Gentian, Opium, Krameria, Malt, Quassia, Glycyrrhiza, and Pure Extract of Glycyrrhiza. Of these,

One extract is percolated with water containing 5 percent. of ammonia water,—*i.e.*, Pure Extract of Glycyrrhiza.

Two extracts are made with a menstruum composed of water containing official acetic acid,—*i.e.*, Extract of Colchicum Corm and Extract of Nux Vomica.

Nine extracts are made by evaporating fluidextracts,—*i.e*, Extracts of Cimicifuga, Digitalis, Euonymus, Hyoscyamus, Leptandra, Rhubarb, Scopola, Stramonium, and Sumbul.

One extract is made by mixing extracts with aromatics, etc,—*i.e.*, Compound Extract of Colocynth.

Ten powdered extracts are official in the U. S. Pharmacopœia (8th Revision).

Official Extracts arranged according to the Strength of their Menstrua, with Manipulative Notes

Name and Menstruum	Fineness of Powder	Quantity to moisten 1000 Gm. of Drug	Quantity of Percolate reserved for 1000 Gm. of Drug	Process and Notes
Alcoholic				
Extractum Cannabis Indicæ	20	300	. . .	Percolate to exhaustion, after forty-eight hours maceration, distil off the alcohol, and evaporate to a pilular consistence
Cimicifugæ	60	250	900	Made by evaporating 100 Cc. of Fluidextract of Cimicifuga, with constant stirring, to dryness, at a temperature not exceeding 70° C. (158° F.), powdering the product, adding enough powdered Glycyrrhiza to make the Extract weigh 25 Gm., and mixing
Physostigmatis	80	400	900	Percolate 1000 Gm. of drug to exhaustion, after forty-eight hours maceration, reserve 900 Cc. of percolate, evaporate the remainder to 100 Cc., mix with reserved portion, and evaporate the mixed liquids to a pilular consistence, at a temperature not exceeding 50° C. (122° F.). Assay and add sufficient sugar of milk, if necessary, to reduce it to the standard of 2 percent. of ether-soluble alkaloids
Alcohol, 4; Water, 1				
Extractum Euonymi	40	350	800	Made by evaporating 100 Cc. of Fluidextract of Euonymus, with constant stirring, to dryness, at a temperature not exceeding 70° C. (158° F.), powdering the product, adding enough powdered Glycyrrhiza to make the Extract weigh 25 Gm., and mixing

Official Extracts—*Continued*

Name and Menstruum	Fineness of Powder	Quantity to moisten 1000 Gm. of Drug	Quantity of Percolate reserved for 1000 Gm. of Drug	Process and Notes
Extractum Rhei	30	400	750	Made by evaporating 100 Cc. of Fluidextract of Rhubarb, with constant stirring, to a pilular consistence, at a temperature not exceeding 50° C. (122° F.)
Scopolæ	40	350	800	Made by evaporating 100 Cc. of Fluidextract of Scopola, with constant stirring, to a pilular consistence, at a temperature not exceeding 50° C. (122° F.), assaying and adding sufficient sugar of milk, if necessary, to reduce it to the standard of 2 percent. of mydriatic alkaloids
Alcohol, 3 ; Water, 1				
Extractum Leptandræ	40	400	850	Made by evaporating 100 Cc. of Fluidextract of Leptandra, with constant stirring, to dryness, at a temperature not exceeding 70° C. (158° F.), powdering the product, adding enough powdered Glycyrrhiza to make the Extract weigh 25 Gm., and mixing
Sumbul	30	400	850	Made by evaporating 100 Cc. of Fluidextract of Sumbul, with constant stirring, to a pilular consistence, at a temperature not exceeding 70° C. (158° F.)
Alcohol, 5 ; Water, 2				
Extractum Ergotæ	40	500	. . .	Percolate 1000 Gm. of drug to exhaustion, after forty-eight hours maceration, evaporate the liquid to 250 Gm., at a temperature not exceeding 50° C. (122° F.), and add 250 Cc. of Water. When cold, add 50 Cc. of Diluted Hydrochloric Acid and set aside for twenty-four hours, then filter, add 8.5 Gm. of Monohydrated Sodium Carbonate, evaporate the liquid at the above-named temperature to 150 Gm., add 12.5 Gm. of Glycerin, and continue evaporation until the Extract is reduced to 125 Gm.
Alcohol, 2 ; Water, 1				
Extractum Belladonnæ Foliorum	60	400	900	Percolate 1000 Gm. of drug to exhaustion, after forty-eight hours maceration, reserve 900 Cc. of percolate, evaporate the remainder to 100 Cc., mix with reserved portion and evaporate the mixed liquids to a pilular consistence at a temperature not exceeding 50° C. (122° F.). Assay and add sufficient sugar of milk, if necessary, to reduce it to the standard of 1.4 percent. of mydriatic alkaloids
Hyoscyami	60	400	800	Made by evaporating 100 Cc. of Fluidextract of Hyoscyamus, with constant stirring, to a pilular consistence, at a temperature not exceeding 50° C. (122° F.), assaying and adding sufficient sugar of milk, if necessary, to reduce it to the standard of 0.3 percent. of mydriatic alkaloids
Stramonii	40	400	800	Made by evaporating 100 Cc. of Fluidextract of Stramonium, with constant stirring, to a pilular consistence, at a temperature not exceeding 50° C. (122° F.), assaying and adding sufficient sugar of milk, if necessary, to reduce it to the standard of 1.4 percent. of mydriatic alkaloids
Diluted Alcohol				
Extractum Digitalis	60	400	850	Made by evaporating 100 Cc. of Fluidextract of Digitalis, with constant stirring, to a pilular consistence, at a temperature not exceeding 50° C. (122° F.)

Official Extracts—*Continued*

Name and Menstruum	Fineness of Powder	Quantity to moisten 1000 Gm. of Drug	Quantity of Percolate reserved for 1000 Gm. of Drug	Process and Notes
Extractum Colocynthidis (freed from seeds)	Coarse powder	. . .	. . .	Macerate for four days, express and strain the tincture through flannel, percolate the residue, distil the mixed tinctures to recover the alcohol, evaporate the residue to dryness, and make it into a powdered Extract
Alcohol, 1 ; Water, 7				
Extractum Rhamni Purshianæ	60	400	850	Percolate 1000 Gm. of drug to exhaustion, after forty-eight hours maceration, reserve the number of cubic centimeters directed, evaporate the remainder to the consistence of syrup, add the reserved portion, and continue the evaportion to dryness, at a temperature not exceeding 70° C. (158° F.). Finally, powder the product, adding enough powdered Glycyrrhiza to make the Extract weigh 250 Gm., and mix
Taraxaci	30	250	. . .	Percolate to exhaustion, after twenty-four hours maceration, and evaporate the liquid, on a water-bath, to a pilular consistence
Acetic Acid, Water				
Extractum Colchici Cormi	60	500	. . .	Percolate to exhaustion with 17.8 *percent. of official Acetic Acid,* after forty-eight hours maceration, and evaporate the liquid to a pilular consistence, at a temperature not exceeding 80° C. (176° F.). Assay and add sufficient sugar of milk, if necessary, to reduce it to the standard of 1.4 percent. of colchicine
Nucis Vomicæ	20	400	750	Percolate 1000 Gm. of drug to exhaustion with 27.7 *percent. of official Acetic Acid,* after forty-eight hours maceration, reserve the number of cubic centimeters directed, evaporate the remainder to a soft extract, add this to the reserved portion, and sufficient water to make the liquid measure 900 Cc. Add 3000 Cc. of Alcohol, shake and set aside for twenty-four hours with occasional agitation ; then filter and evaporate, on a water-bath, to dryness. Assay and add sufficient sugar of milk, if necessary, to reduce it to the standard of 5 percent. of strychnine. Finally, powder and mix
Water				Maceration
Extractum Aloes	. . .	. . .	. . .	*Macerate* in boiling water, with stirring, allow mixture to stand for twelve hours, decant the liquid, and evaporate to dryness
Hæmatoxyli	Rasped	. . .	. . .	*Macerate,* with cold water for forty-eight hours, then boil (avoiding the use of metallic vessels) until one-half the water has evaporated, strain the decoction while hot, and evaporate to dryness
Malti	12	. . .	. . .	*Macerate* 1000 Gm. of Malt with 1000 Cc. of water for six hours, then add 4000 Cc. of warm water, digest for one hour at a temperature not exceeding 55° C. (131° F.). Strain with strong expression and evaporate the liquid at a temperature not exceeding 55° C. (131° F.) to the consistence of thick honey
Opii	. . .	. . .	. . .	*Macerate,* with occasional agitation, in cold water during twelve hours, filter, evaporate the filtrate on a water-bath, assay, and add sufficient sugar of milk, if necessary, to reduce it to the standard of 20 percent. of morphine. Finally, powder and mix

Official Extracts—*Continued*

Name and Menstruum	Fineness of Powder	Quantity to moisten 1000 Gm. of Drug	Quantity of Percolate reserved for 1000 Gm. of Drug	Process and Notes
Extractum Gentianæ	20	400	. . .	Percolate to exhaustion, after twenty-four hours maceration, boil the liquid until reduced to three-fourths of its weight, strain, and evaporate, on a water-bath, to a pilular consistence
Glycyrrhizæ Purum	20	1000	. . .	Percolate to exhaustion, after twenty-four hours maceration with water, containing about *5 percent. of Ammonia Water,* to dissolve the Glycyrrhizin, evaporate the liquid to a pilular consistence, and add 5 percent. of its weight of Glycerin
Krameriæ	40	300	. . .	Percolate to exhaustion, heat the liquid to the boiling point, strain, and evaporate to dryness, at a temperature not above 70° C. (158° F.)
Quassiæ	20	400	. . .	Percolate to exhaustion, reduce the liquid to three-fourths of its weight by boiling, strain, and evaporate to dryness, on a water-bath, and add sufficient sugar of milk to make the Extract weigh 100 Gm. for every 1000 Gm. of drug taken. Mix and reduce to fine powder
Glycyrrhizæ	. . .	. . .	. . .	*Commercial Extract* in rolls: not less than 60 percent. of it should be soluble in cold water
Colocynthidis Compositum	**Compound Extract** Extract of Colocynth, 160 Gm.; Purified Aloes, 500 Gm.; Cardamom, No. 60 powder, 60 Gm.; Resin of Scammony, in fine powder, 140 Gm.; Soap, dried and in coarse powder, 140 Gm.; Alcohol, 100 Cc.			Melt the Aloes with the aid of heat, add the Alcohol, Soap, Extract of Colocynth, and Resin of Scammony, maintain a temperature not exceeding 120° C. (248° F.) until homogeneous, withdraw the heat and add the Cardamom; when cold, *reduce the product to a fine powder*

Extracts (*of pilular consistence*)

Extractum Belladonnæ Foliorum
- Cannabis Indicæ
- Colchici Cormi
- Digitalis
- Ergotæ
- Gentianæ
- Glycyrrhizæ Purum

Extractum Hyoscyami
- Malti (thick honey)
- Rhei
- Scopolæ
- Stramonii
- Sumbul
- Taraxaci

Extracts (*solid*)

Extractum Aloes
- Glycyrrhizæ

Extractum Hæmatoxyli
- Krameriæ

Extracts (*powdered*)

Extractum Cimicifugæ
- Colocynthidis
- Colocynthidis Compositum
- Euonymi
- Leptandræ

Extractum Nucis Vomicæ
- Opii
- Physostigmatis
- Quassiæ
- Rhamni Purshianæ

Unofficial Extracts

Name	Fineness of Powder	Quantity to moisten 1000 Gm. of Drug	Quantity of Percolate reserved for 1000 Gm. of Drug	Menstruum	Process
Extractum Aconiti. U. S. P. 1890	60	400	900	Alcohol	Percolate 1000 Gm. of Aconite to exhaustion, after forty-eight hours maceration, reserve 900 Cc. of percolate, evaporate the remainder to 100 Cc., mix with the reserved portion and evaporate the mixed liquids to a pilular consistence at a temperature not exceeding 50° C. (122° F.)
Aloes Barbadensis. Br.	. .	. . .	. . .	Boiling Water	Add 1000 Gm. of Barbadoes Aloes to 10 liters of boiling Water and mix thoroughly; set it aside for twenty-four hours, decant, strain, and evaporate the liquid to dryness at a temperature not exceeding 60° C. (140° F.)
Anthemidis. Br.	. .	. . .	. . .	Water	Boil 1000 Gm. of Chamomile Flowers with 10 liters of Water until reduced to about 5 liters, strain, press, filter the liquid, and then evaporate to a soft extract. Finally, add 2 Cc. Oil of Chamomile and mix
Arnicæ Radicis. U. S. P. 1890	60	400	900	Diluted Alcohol	Percolate 1000 Gm. of Arnica Root and continue the operation as directed under Extractum Aconiti
Belladonnæ Viride. Br.	. .	. . .	. . .	. . . . . .	Bruise the fresh leaves and young branches of Belladonna in a mortar, press out the juice and heat to 54.4° C. (130° F.). Separate the green coloring matter by straining, and evaporate the strained liquid, after heating to 93.3° C. (200° F.) and filtering, to a thin syrupy consistence. Then add the green coloring matter and evaporate the whole, at a temperature not exceeding 60° C. (140° F.), to a soft extract
Cinchonæ. U. S. P. 1890	60	350	. . .	Alcohol, 75; Water, 25; finishing with Diluted Alcohol	Percolate 1000 Gm. of Cinchona to exhaustion, after forty-eight hours maceration, using first, 4000 Cc. of menstruum made from Alcohol, 3; Water, 1, and finishing with Diluted Alcohol. Distil the Alcohol, and evaporate the residue on a water-bath to a pilular consistence
Colchici. Br.	. .	. . .	. . .	. . . . . .	Crush fresh Colchicum Corms, deprived of their coats; press, set the liquid aside, decant clear portion, heat to 100° C. (212° F.), strain and evaporate to a soft extract at a temperature not exceeding 71.1° C. (160° F.)
Conii. U. S. P. 1890	40	300	900	Diluted Alcohol	Add 2 percent of Acetic Acid (36 percent.) to the first 1000 Cc. of menstruum used, percolate 1000 Gm. of Conium, and continue the operation as directed under Extractum Aconiti
Iridis. U. S. P. 1890	60	400	. . .	Alcohol	Percolate 1000 Gm. of Iris to exhaustion, after forty-eight hours maceration, distil the Alcohol from the tincture, and evaporate the residue, on a water bath, to a pilular consistence

Unofficial Extracts—*Continued*

Name	Fineness of Powder	Quantity to moisten 1000 Gm. of Drug	Quantity of Percolate reserved for 1000 Gm. of Drug	Menstruum	Process
Extractum, Jalapæ. U.S.P. 1890	60	350	900	Alcohol	Percolate 1000 Gm. of Jalap and continue the operation as directed under Extractum Aconiti
Juglandis. U. S. P. 1890	30	400	. . .	Diluted Alcohol	Percolate 1000 Gm. of Juglans and continue the operation as directed under Extractum Iridis
Podophylli. U. S. P. 1890	60	300	. . .	Alcohol, 80 ; Water, 20	Percolate 1000 Gm. of Podophyllum and continue the operation as directed under Extractum Iridis
Stramonii Seminis. U. S. P. 1890	60	300	900	Diluted Alcohol	Percolate 1000 Gm. of Stramonium Seed and continue the operation as directed under Extractum Aconiti
Strophanthi. Br.	30	. . .	. . .	Alcohol	Exhaust 25 Gm. of Strophanthus Seeds with Purified Ether, dry the marc, and again percolate with Alcohol, after forty-eight hours maceration, to make 250 Cc. Evaporate the liquid until it thickens, and add sufficient powdered Sugar of Milk to make the product weigh 50 Gm. Powder
Uvæ Ursi. U. S. P. 1890	30	400	900	Alcohol, 20 ; Water, 50	Percolate 1000 Gm. of Uva Ursi and continue the operation as directed under Extractum Aconiti

EXTRACTUM ALOES. U.S. Extract of Aloes

	Metric	Old form
* **Aloes**	**100 Gm.**	32 oz. av.
Boiling Water	**1000 Cc.**	20 pints

Mix the Aloes with the Boiling Water in a suitable vessel, stirring constantly until the particles of Aloes are thoroughly disintegrated, and allow the mixture to stand for twelve hours ; then pour off the clear liquid, strain the residue, and evaporate the mixed liquids to dryness with the aid of a water-bath or steam-bath.

Average dose.— 2 grains (0.125 Gm.).

EXTRACTUM BELLADONNÆ FOLIORUM. U. S. Extract of Belladonna Leaves

[Extractum Belladonnæ Foliorum Alcoholicum, Pharm. 1890]

	Metric	Old form
* **Belladonna Leaves,** in No. 60 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity		

Mix 2000 Cc. [old form 4 pints] of Alcohol with 1000 Cc. [old form 2 pints] of Water, and, having moistened the powder with 400 Cc. [old form 12½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator ; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until 3000 Cc. [old form 6 pints] of tincture are obtained, or the Belladonna Leaves are exhausted. Reserve the first 900 Cc. [old form 28½ fl. oz.] of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 100 Cc. [old form 3 fl. oz.], mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence.

When assayed by the process given below, Extract of Belladonna Leaves should contain 1.4 percent. of mydriatic alkaloids. If the Extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.4 percent.

Assay of Extract of Belladonna Leaves

Extract of Belladonna Leaves . . . . **5 Gm.**
Alcohol,
Ammonia Water,
Distilled Water,
Chloroform,
Normal Sulphuric Acid V.S.,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-Normal Potassium Hydroxide V.S.,
Cochineal T.S. or **Iodeosin T.S.,** each, a sufficient quantity

Introduce the Extract of Belladonna Leaves into a small beaker and dissolve it in a mixture consisting of alcohol 5 Cc., distilled water 10 Cc., ammonia water 2 Cc., and chloroform 20 Cc. When dissolved, transfer it to a separator, rinsing the beaker with a little alcohol and adding the rinsings to the separator. Insert the stopper securely and shake the separator for half a minute. Draw off the chloroformic layer into a second separator, and add to the first separator 10 Cc. more of chloroform. Shake it for half a minute, allow to separate, and again draw off the chloroformic layer into the second separator. Repeat this with 10 Cc. more of chloroform. To the united chloroformic liquids in the second separator, add 5 Cc. of normal sulphuric acid V.S. and 10 Cc. of distilled water, and shake it for half a minute. Draw off the chloroformic layer, after the liquids have separated, into the first separator, after cleaning it thoroughly, and the aqueous layer into a beaker, and repeat the process by adding to the first separator, 10 Cc. of distilled water and 1 Cc. of normal sulphuric acid V.S. Draw off the chloroformic layer, rejecting the same, and then run the acid aqueous layer into the beaker. Pass the combined acid aqueous solutions through a pledget of purified cotton into the first separator, after cleaning it thoroughly, rinsing the second separator, the beaker, and the funnel with about 10 Cc. of distilled water. To the first separator, add 15 Cc. of chloroform, a small piece of red litmus paper, and enough ammonia water to produce a distinctly alkaline reaction. Shake the separator for half a minute, and when the liquids have separated, draw off the chloroformic layer into a beaker. Repeat this process with two portions of 10 Cc. each of chloroform, and evaporate the combined chloroformic liquids in the beaker to dryness on a water-bath containing warm water; dissolve the residue in 3 Cc. of ether and allow the latter to evaporate completely. To the alkaloidal residue add 5 Cc. of tenth-normal sulphuric acid V.S. and 5 drops of cochineal T.S. (or iodeosin T.S.), then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0287, and this product by 20, to obtain the percentage of mydriatic alkaloids contained in the Extract of Belladonna Leaves. The figure 0.0287 represents the weight in grammes of mydriatic alkaloids (mainly atropine) required to neutralize 1 Cc. of tenth-normal sulphuric acid V.S.

Average dose.—⅙ grain (0.010 Gm.).

EXTRACTUM CANNABIS INDICÆ. U.S. Extract of Indian Cannabis

	Metric	Old form
* **Indian Cannabis,** in No. 20 powder	1000 Gm.	32 oz. av.
Alcohol, a sufficient quantity		

Moisten the powder with 300 Cc. [old form 9½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol until the Indian Cannabis is exhausted. Distil off the Alcohol from the percolate by means of a water-bath, and evaporate the residue, in a porcelain dish, on a water-bath, to a pilular consistence.

Average dose.—⅕ grain (0.010 Gm.).

EXTRACTUM CIMICIFUGÆ. U.S. Extract of Cimicifuga

	Metric	Old form
* **Fluid Extract of Cimicifuga**	100 Cc.	3¾ fl. oz.
Glycyrrhiza (peeled, Russian), in No. 80 powder, a sufficient quantity,		
To make	25 Gm.	1 oz. av.

Evaporate the Fluidextract of Cimicifuga in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring, to complete dryness. Reduce the product to a fine powder and add enough powdered Glycyrrhiza to make the finished Extract weigh 25 Gm. [old form 1 oz. av.]. Mix thoroughly.

Average dose.—4 grains (0.250 Gm.).

EXTRACTUM COLCHICI CORMI. U.S. Extract of Colchicum Corm

[EXTRACTUM COLCHICI RADICIS, PHARM. 1890]

	Metric	Old form
* **Colchicum Corm,** in No. 60 powder	1000 Gm.	35 oz. av.
Acetic Acid	350 Cc.	11 fl. oz.
Water, a sufficient quantity		

Mix the Acetic Acid with 1500 Cc. [old form 3 pints] of Water, and, having moistened the powder with 500 Cc. [old form 1 pint] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then Water, until the Colchicum Corm is exhausted. Evaporate the percolate in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 80° C. (176° F.), to a pilular consistence.

When assayed by the process given below, Extract of Colchicum Corm should contain 1.4 percent. of colchicine. If the Extract should be found by assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.4 percent.

Assay of Extract of Colchicum Corm

Extract of Colchicum Corm	4 Gm.
Chloroform,	
Alcohol,	
Ether,	
Distilled Water,	
Ammonia Water, each, a sufficient quantity	

Dissolve the Extract of Colchicum Corm in 20 Cc. of distilled water, carefully transfer the solution to a graduated flask, and add sufficient alcohol to make the liquid measure 100 Cc. Shake the flask well, allow it to stand for five minutes, filter, and collect 50 Cc. of the filtrate (representing 2 Gm. of the Extract), and evaporate it to dryness in a porcelain dish by means of a water-bath. Add to the residue 10 Cc. of ether and 5 Cc. of distilled water, stir the mixture well and heat it gently until the ether is evaporated. After cooling, pour off the aqueous solution, filtering it into a separator, retaining as much of the insoluble matter in the dish as possible. Again treat the residue with 10 Cc. of ether, and 5 Cc. of water, and proceed as before; rinse the dish and filter with a little water and collect all of the aqueous liquids in the separator. Introduce a small piece of red litmus paper into the separator, add enough ammonia water to render the liquid alkaline, and then shake it out with three successive portions of chloroform, of 20, 15, and 10 Cc., respectively. Collect the combined chloroformic solutions in an Erlenmeyer flask, evaporate the chloroform, and add to the alkaloidal residue two successive small portions of alcohol, evaporating the alcohol each time. Now add to the residue a mixture of 5 Cc. of distilled water and 10 Cc. of ether, agitate the liquid gently and evaporate the ether; after cooling, filter the aqueous liquid into a separator. Rinse the flask with distilled water, pass the rinsings through the filter into the separator, and shake out the aqueous solutions with three successive portions of chloroform, 20, 15, and 10 Cc., respectively. Collect the combined chloroformic solutions in a tared Erlenmeyer flask, evaporate the chloroform, and treat the alkaloidal residue with two successive small portions of alcohol, evaporating the alcohol each time, and dry the residue at 100° C. (212° F.), to a constant weight. The weight multiplied by 50 will give the percentage of colchicine in the Extract of Colchicum Corm.

Average dose.— 1 grain (0.065 Gm.).

EXTRACTUM COLOCYNTHIDIS. U.S. Extract of Colocynth

	Metric	Old form
***Colocynth,** freed from the seeds	1000 Gm.	32 oz. av.
Diluted Alcohol, a sufficient quantity.		

Reduce the Colocynth to a coarse powder by grinding or bruising, and macerate it in 3500 Cc. [old form 7 pints] of Diluted Alcohol for four days, with occasional stirring; then express strongly and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and gradually pour Diluted Alcohol upon it until the tincture and expressed liquid, mixed together, measure 5000 Cc. [old form 10 pints]. Distil off the Alcohol from the mixture by means of a water-bath, evaporate the residue to dryness, and reduce the dry mass to powder.

Extract of Colocynth should be kept in well-stoppered bottles.

Average dose.— $\frac{1}{2}$ grain (0.030 Gm.).

EXTRACTUM COLOCYNTHIDIS COMPOSITUM. U.S. Compound Extract of Colocynth

	Metric	Old form
***Extract of Colocynth**	160 Gm.	16 oz. av.
Purified Aloes	500 Gm.	50 oz. av.
Cardamom, in No. 60 powder	60 Gm.	6 oz. av.
Resin of Scammony, in fine powder	140 Gm.	14 oz. av.
Soap, dried, and in coarse powder	140 Gm.	14 oz. av.
Alcohol	100 Cc.	12 fl. oz.

Heat the Purified Aloes, contained in a suitable vessel, on a water-bath, until it is completely melted; then add the Alcohol, Soap, Extract of Colocynth, and Resin of Scammony, and heat the mixture at a temperature not exceeding 120° C. (248° F.), until it is perfectly homogeneous, and a thread taken from the mass becomes brittle when cool. Then withdraw the heat, thoroughly incorporate the Cardamom with the mixture, and cover the vessel until the contents are cold. Finally, reduce the product to a fine powder.

Compound Extract of Colocynth should be kept in well-stoppered bottles.

Average dose.— 8 grains (0.500 Gm.).

EXTRACTUM DIGITALIS. U.S. Extract of Digitalis

	Metric	Old form
***Fluidextract of Digitalis**	**100 Cc.**	3 fl. oz.

Evaporate the Fluidextract of Digitalis in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), with constant stirring, until it is reduced to a pilular consistence.

Average dose.— $\frac{1}{5}$ grain (0.010 Gm.).

EXTRACTUM ERGOTÆ. U.S. Extract of Ergot

	Metric	Old form
***Ergot,** in No. 40 powder	**1000.0 Gm.**	32 oz. av.
Diluted Hydrochloric Acid	**50.0 Gm.**	1 oz. av. 263 gr.
Monohydrated Sodium Carbonate	**8.5 Gm.**	119 grains
Glycerin	**12.5 Gm.**	175 grains
Alcohol,		
Water, each, a sufficient quantity,		
To make	**125 Gm.**	4 oz. av.

Mix 1000 Cc. [old form 2 pints] of Alcohol with 400 Cc. [old form 12½ fl. oz.] of Water, and, having moistened the powder with 500 Cc. [old form 1 pint] of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Ergot is exhausted. Evaporate the percolate in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), to 250 Gm. [old form 8 oz. av.]; add 250 Cc. [old form 8 fl. oz.] of Water, and stir; filter when cold, rinse the dish with a little Water, and add this to the filter. Add the Diluted Hydrochloric Acid to the filtrate; then set it aside for twenty-four hours; filter, wash the contents of the filter with Water until the washings no longer have an acid reaction, and add the washings to the filtrate. To this, add gradually the Monohydrated Sodium Carbonate, and, when the evolution of carbon dioxide has ceased, evaporate the liquid in a tared dish until it weighs 150 Gm. [old form 4$\frac{4}{5}$ oz. av.]; add the Glycerin, and continue the evaporation, at the above-named temperature, until the weight of the Extract is reduced to 125 Gm. [old form 4 oz. av.].

Average dose.— 4 grains (0.250 Gm.).

EXTRACTUM EUONYMI. U.S. Extract of Euonymus

	Metric.	Old form
* **Fluid Extract of Eunonymus**	100 Cc.	3¾ fl. oz.
Glycyrrhiza (peeled, Russian), in No. 80 powder, a sufficient quantity,		
To make	25 Gm.	1 oz. av.

Evaporate the Fluidextract of Euonymus in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring to complete dryness. Reduce the product to a fine powder, and add enough powdered Glycyrrhiza to make the finished extract weigh 25 Gm. [old form 1 oz. av.]. Mix thoroughly.

Average dose.— 2 grains (0.125 Gm.).

EXTRACTUM GENTIANÆ. U.S. Extract of Gentian

	Metric	Old form
* **Gentian,** in No 20 powder	1000 Gm.	32 oz. av.
Water, a sufficient quantity		

Moisten the powder with 400 Cc. [old form 12½ fl. oz.] of Water, and let it macerate for twenty-four hours; then pack it in a conical percolator, and gradually pour Water upon it until the infusion passes but slighly imbued with the properties of Gentian. Reduce the liquid to three-fourths of its bulk by boiling, and strain; then, by means of a water-bath, evaporate to a pilular consistence.

Average dose.— 4 grains (0.250 Gm.).

EXTRACTUM GLYCYRRHIZÆ. U.S. Extract of Glycyrrhiza

The commercial extract of the root of *Glycyrrhiza glabra* Linné, or of *Glycyrrhiza glandulifera* Waldstein and Kitaibel (Fam. *Leguminosæ*).

In flattened cylindrical rolls, from 15 to 18 Cm. long, and from 15 to 30 Mm. thick; of a glossy black color. It breaks with a sharp, conchoidal, shining fracture, and has a very sweet, peculiar taste. Not less than 60 percent. of it should be soluble in cold water.

Average dose.— 15 grains (1 Gm.).

EXTRACTUM GLYCYRRHIZÆ PURUM. U.S. Pure Extract of Glycyrrhiza

	Metric	Old form
* **Glycyrrhiza,** peeled, in No. 20 powder	1000 Gm.	32 oz. av.
Ammonia Water	150 Cc.	4½ fl. oz.
Glycerin,		
Water, a sufficient quantity		

Mix the Ammonia Water with 3000 Cc. [old form 6 pints] of Water, and, having moistened the powder with 1000 Cc. [old form 2 pints] of the mixture, allow it to macerate in a closed vessel for twenty-four hours. Then pack it moderately in a cylindrical glass percolator, and gradually pour upon it, first the remainder of the menstruum, and then Water, until the Glycyrrhiza is exhausted. Lastly, evaporate the liquid in a tared porcelain dish, by means of a water-bath, to a pilular consistence, and while the mass is still warm, incorporate with it 5 percent. of its weight of Glycerin.

Average dose.— 15 grains (1 Gm.).

EXTRACTUM HÆMATOXYLI. U.S. Extract of Hematoxylon

	Metric	Old form
* **Hematoxylon,** rasped	1000 Gm.	32 oz. av.
Water	10000 Cc.	20 pints

Macerate the Hematoxylon with the Water for forty-eight hours. Then boil (avoiding the use of metallic vessels) until one-half of the Water has evaporated ; strain the decoction, while hot, and evaporate it to dryness.

Average dose.— 15 grains (1 Gm.).

EXTRACTUM HYOSCYAMI. U.S. Extract of Hyoscyamus

	Metric	Old form
* **Fluidextract of Hyoscyamus**	100 Cc.	4 fl. oz.

Evaporate the Fluidextract of Hyoscyamus in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence.

When assayed as directed below, Extract of Hyoscyamus should contain 0.3 percent. of mydriatic alkaloids. If the Extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 0.3 percent.

Assay of Extract of Hyoscyamus

The method to be employed is identical with that given on page 442, using 10 Gm. of Extract of Hyoscyamus instead of the quantity of Extract of Belladonna Leaves there directed, and multiplying the product by 10 instead of 20.

Average dose.— 1 grain (0.065 Gm.).

EXTRACTUM KRAMERIÆ. U.S. Extract of Krameria

	Metric	Old form
* **Krameria,** in No. 40 powder	1000 Gm.	32 oz. av.
Water, a sufficient quantity		

Moisten the powder with 300 Cc. [old form 9½ fl. oz.] of Water, pack it in a conical glass percolator, and gradually pour Water upon it, until the infusion passes but slightly imbued with the astringency of the Krameria. Heat the liquid to the boiling point, strain, and evaporate the strained liquid, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), to dryness.

Average dose.— 8 grains (0.500 Gm.).

EXTRACTUM LEPTANDRÆ. U.S. Extract of Leptandra

	Metric	Old form
* **Fluidextract of Leptandra**	100 Cc.	3¾ fl. oz.
Glycyrrhiza, peeled, Russian, in No. 80 powder, a sufficient quantity,		
To make	25 Gm.	1 oz. av.

Evaporate the Fluidextract of Leptandra in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring, to complete dryness. Reduce the product to a fine powder and add enough powdered Glycyrrhiza to make the finished Extract weigh 25 Gm. [old form 1 oz. av.]. Mix thoroughly.

Average dose.— 4 grains (0.250 Gm.).

EXTRACTUM MALTI. U.S. Extract of Malt

	Metric	Old form
* **Malt**, in coarse powder, not finer than No. 12	1000 Gm.	32 oz. av.
Water, a sufficient quantity		

Upon the powder, contained in a suitable vessel, pour 1000 Cc. [old form 2 pints] of Water, and macerate for six hours. Then add 4000 Cc. [old form 8 pints] of Water, heated to about 30° C. (86° F.), and digest for an hour at a temperature not exceeding 55° C. (131° F.). Strain the mixture with strong expression. Finally, by means of a water-bath, or vacuum apparatus, at a temperature not exceeding 55° C. (131° F.), evaporate the strained liquid rapidly to the consistence of thick honey.

Extract of Malt should be kept in well-closed vessels, in a cool place.

Average dose.— 4 fluidrachms (16 Cc.).

EXTRACTUM NUCIS VOMICÆ. U.S. Extract of Nux Vomica

	Metric	Old form
* **Nux Vomica**, in No. 20 powder	1000 Gm.	32 oz. av.
Acetic Acid,		
Water,		
Alcohol,		
Sugar of Milk, dried and in fine powder, each a sufficient quantity		

Mix 500 Cc. [old form 1 pint] of Acetic Acid with 1300 Cc. [old form 2 pints, 9½ fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 12½ fl. oz.] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then Water, until the percolate passes but faintly imbued with bitterness, and the Nux Vomica is exhausted. Reserve the first 750 Cc. [old form 1½ pints] of the percolate, and, having heated the remainder to boiling, filter, and evaporate the filtrate to a soft extract; dissolve this in the reserved portion, and add enough Water to make the liquid measure 900 Cc. [old form 28½ fl. oz.]. To the liquid thus obtained, add 3000 Cc. [old form 6 pints] of Alcohol, shake the mixture well, and set it aside for twenty-four hours, with occasional agitation. Filter the liquid through paper, and wash the residue in the filter with a mixture of Alcohol three volumes, and Water one volume, until the washings are only faintly bitter. Evaporate the filtrate and washings in a porcelain dish, on a water-bath, to dryness. Determine, by the method given below, the percentage of strychnine in the dry Extract; ascertain, by calculation, the amount of strychnine in the remainder of the Extract; add to this enough well-dried Sugar of Milk to bring the quantity of strychnine in the final dry extract of Nux Vomica to 5 percent. of the total weight; and, when thoroughly powdered and mixed, transfer the Extract to small, well-stoppered vials.

Extract of Nux Vomica, when assayed by the following process, should be found to contain 5 percent. of strychnine.

Assay of Extract of Nux Vomica

Extract of Nux Vomica . . . . 2 Gm.
Distilled Water,
Ether,
Chloroform,
Ammonia Water,
Sulphuric Acid Solution (3 percent. H_2SO_4),
Nitric Acid (sp. gr. 1.42),
Sodium Hydroxide Solution (1 in 10),
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Iodeosin T.S., each a sufficient quantity

Introduce the Extract of Nux Vomica into a beaker, and dissolve it in 25 Cc. of a mixture of 16 Cc. of ether, 5 Cc. of Chloroform, and 4 Cc. of ammonia water. When dissolved, transfer it to a separator, rinsing the beaker with a little Chloroform, and adding the rinsings to the separator. Insert the stopper securely and shake the separator carefully for a few minutes. Draw off the aqueous layer into another separator, washing the ether-solution and separator with a little water, and adding this to the second separator. Then shake out the aqueous liquid with two portions of 15 and 10 Cc., respectively, of chloroform, and add these to the first separator. If a few drops of the liquid left in the second separator still give a reaction with mercuric potassium iodide T.S. after acidulating, repeat the shaking out with 10 Cc. more of chloroform. Now shake out the chloroformic solution in the first separator with three portions of 15, 10, and 10 Cc. of sulphuric acid solution (3 percent.), and collect the combined acid solutions in another separator. Introduce a small piece of red litmus paper, add enough ammonia water to render the liquid alkaline, and extract the mixture with three portions, respectively, of 15, 10, and 10 Cc. of chloroform. Draw off the chloroformic solutions into a beaker, and evaporate the chloroform with the aid of a water-bath. Dissolve the alkaloidal residue in the beaker in 15 Cc. of 3 percent. sulphuric acid solution by the aid of a water-bath, and allow the liquid to cool. To this solution add 3 Cc. of a cool mixture of equal volumes of nitric acid (specific gravity 1.42) and distilled water, and after rotating the liquid a few times, set it aside for exactly ten minutes, stirring it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous solution of sodium hydroxide (1 in 10), and wash the beaker three times with very small amounts of distilled water, and add the washings to the separator. If the liquid is not quite turbid, add 2 Cc. more of the solution of sodium hydroxide. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter, wetted with chloroform, into a flask. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the flask, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath, very carefully, to avoid decrepitation. To the alkaloidal residue, add 10 Cc. of tenth-normal sulphuric acid V.S., 5 drops of iodeosin T.S., about 90 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. until the aqueous liquid just turns pink. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 10 (the 10 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.0332, and this product by 50, which will give the percentage of strychnine contained in the Extract of Nux Vomica.

Average dose.— $\frac{1}{4}$ grain (0.015 Gm.).

EXTRACTUM OPII. U.S. Extract of Opium

	Metric	Old form
* **Powdered Opium**	**100 Gm.**	3 oz. av. 231 gr.
Sugar of Milk, recently dried and in fine powder,		
Water, each, a sufficient quantity		

Rub the Powdered Opium, in a mortar, into a smooth paste with 250 Cc. [old form 8 fl. oz.] of Water; then transfer to a bottle of the capacity of 1000 Cc. [old form 2 pints], wash the mortar with 750 Cc. [old form 1½ pints] of water in successive portions, and add the washings to the contents of the bottle. Cork the bottle and shake it vigorously once every two hours during twelve hours. Then filter through a rapidly acting, double filter, and pour water on the magma slowly, until the filtrate passes nearly colorless and only faintly bitter.

Concentrate the filtrate and washings in a tared dish, on a water-bath, until the contents weigh about 200 Gm. [old form 7 oz. av.], and allow the Extract to become cold. Then weigh it accurately, transfer 12 Gm. to an Erlenmeyer flask having a capacity of about 100 Cc., and determine in this portion the amount of morphine by the process of assay given below, using the same quantities of liquids as there directed for 4 Gm. of the dry Extract. In another portion of 5 Gm. determine the amount of water by drying it in a flat-bottomed dish, at 100° C. (212° F.), until it ceases to lose weight. From the results thus obtained, ascertain by calculation the amount of morphine and of water contained in the remainder of the Extract, add to this enough well-dried Sugar of Milk to bring the quantity of morphine in the final dry Extract to 20 percent., then evaporate the whole to dryness, reduce it to powder, and transfer it to small, well-stoppered vials.

Assay of Extract of Opium

Extract of Opium, dried at 100° C. (212 F.)	4.0 Gm.
Ammonia Water	2.2 Cc.
Alcohol,	
Ether,	
Water,	
Lime Water, each, a sufficient quantity	

Dissolve the Extract of Opium in 30 Cc. of water, filter the solution through a small filter, and wash the filter and residue with water, until all soluble matters are extracted, collecting the washings separately. Evaporate, in a tared dish, on a water-bath, first, the washings to a small volume, then add the first filtrate, and evaporate the whole to a weight of 10 Gm. Rotate the concentrated solution in the dish, until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 Cc., and rinse the dish with a few drops of water at a time, until the entire solution weighs 15 Gm. Add 7 Gm. (or 8.5 Cc.) of alcohol, shake the flask well, then add 20 Cc. of ether, and repeat the shaking. Now add the ammonia water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least six hours, or over night.

Remove the stopper carefully, and, should any crystals adhere to it, brush them into the flask. Place in a small funnel two rapidly acting filters, of a diameter of 7 Cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with ether, and decant the ether-solution as completely as possible upon the inner filter. Add 15 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 15 Cc. of ether. Then pour into the filter the liquid in the flask, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when the liquid has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than about 10 Cc. in all. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-liquor, and afterwards wash them with alcohol (previously saturated with powdered morphine), added drop by drop from a pipette. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc., or more if necessary. Allow the

the filter to dry in a moderately warm place at a temperature not exceeding 60° C. (140° F.), until its weight remains constant, then carefully transfer the crystals of morphine to a tared watch-glass and weigh them.

Transfer the crystals (which are not quite pure) to an Erlenmeyer flask, add lime water in the proportion of 10 Cc. for each 0.1 Gm. of morphine, and shake the flask at intervals for twenty-five minutes. Pass the liquid through two counterpoised, rapidly acting, plainly folded filters, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), and rinse the flask with additional lime water, passing the washings through the filter until the filtrate, after acidulation, no longer yields a precipitate with mercuric potassium iodide T.S. Then press the filters between bibulous paper, dry them to a constant weight, and weigh the contents of the inner filter, using the outer as a counterpoise. Subtract the weight of the insoluble matter, on the filter, from the weight of the impure morphine previously found, and the difference, multiplied by 25, will be the percentage of pure crystalline morphine contained in the Extract of Opium.

Average dose.—½ grain (0.030 Gm.).

EXTRACTUM PHYSOSTIGMATIS. U.S. Extract of Physostigma

	Metric	Old form
* **Physostigma,** in No. 80 powder	1000 Gm.	32 oz. av.
Alcohol,		
Glycyrrhiza (peeled, Russian), in No. 80 powder, each, a sufficient quantity		

Moisten the Physostigma with 400 Cc. [old form 12½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until 3000 Cc. [old form 6 pints] of percolate are obtained, or the Physostigma is exhausted. Reserve the first 900 Cc. [old form 28½ fl. oz.] of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 100 Cc. [old form 3 fl. oz.]; mix this with the reserved portion, and evaporate, at or below the above-mentioned temperature, on a water-bath, to dryness. Remove 1 Gm. of the Extract, and assay this by the process given below; from the results thus obtained, ascertain by calculation the amount of ether-soluble alkaloids contained in the remainder of the Extract, add to this enough powdered Glycyrrhiza to bring the quantity of the alkaloids in the finished powdered Extract to 2 percent., reduce to powder, mix thoroughly, and transfer it at once to well-stoppered, amber-colored vials.

Extract of Physostigma, when assayed by the following process, should be found to contain 2 percent. of ether-soluble alkaloids.

Assay of Extract of Physostigma

Extract of Physostigma	1 Gm.
Alcohol,	
Diluted Alcohol,	
Ether,	
Sodium Bicarbonate,	
Normal Sulphuric Acid V.S.,	
Distilled Water,	
Tenth-normal Sulphuric Acid V.S.,	
Fiftieth-normal Potassium Hydroxide V.S.,	
Iodeosin T.S., each, a sufficient quantity	

Transfer the Extract of Physostigma to a small porcelain dish, add 5 Cc. of diluted alcohol, and digest for five minutes in a water-bath below boiling temperature; then add about 5 Gm. of very clean, fine quartz sand, and evaporate to dryness on a water-bath, triturating thoroughly with a pestle to secure uniform admixture. When dry, carefully transfer the contents of the dish to an Erlenmeyer flask, add a little more sand to the dish and, by rubbing, remove any adherent extract, which transfer to the flask, add 100 Cc. of ether, and shake the flask. Then add 10 Cc. of an aqueous solution of sodium bicarbonate (1 in 20), and shake the contents vigorously at intervals for one hour. Allow the mixture to stand, and, when settled, decant 50 Cc. of the ether-solution into a separator, to which add a small piece of blue litmus paper, sufficient normal sulphuric acid V.S. to render the liquid acid, and 10 Cc. of distilled water. Shake the separator well for one minute, and draw off the aqueous layer into another separator. Repeat the shaking-out process, using 2 Cc. of normal sulphuric acid V.S. and 8 Cc. of distilled water, and add the acid aqueous layer to the second separator; again repeat the extraction, using 1 Cc. of normal sulphuric acid V.S. and 9 Cc. of distilled water, and add this to the second separator. To the combined acid liquids in the second separator, add 25 Cc. of ether, a small piece of red litmus paper, and sufficient sodium bicarbonate solution (1 in 20) to render it alkaline. Shake the separator for one minute, allow the liquids to separate, and draw off the ether into a beaker. Repeat the shaking-out process with 20 Cc. and again with 15 Cc. of ether added to the separator; shake each time for one minute, allow the liquids to separate, and draw off the ether into the beaker. Carefully evaporate the ether from the combined solutions by means of a water-bath, and, when dry, dissolve the residue in 2 Cc. of tenth-normal sulphuric acid V.S.; rinse the solution carefully into a 200 Cc. flask with distilled water, add enough distilled water to bring the volume to about 90 Cc., add 25 Cc. of ether, and having shaken the flask, add 5 drops of iodeosin T.S., then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., until, after shaking, the aqueous liquid just acquires a pink color. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 2 (the 2 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0273, and this product by 200; the result will be the percentage of ether-soluble alkaloids contained in the Extract of Physostigma.

Average dose.— $\frac{1}{8}$ grain (0.008 Gm.).

EXTRACTUM QUASSIÆ. U.S. Extract of Quassia

	Metric	Old form
* **Quassia**, in No. 20 powder	1000 Gm.	32 oz. av.
Water,		
Sugar of Milk, recently dried and in fine powder, each, a sufficient quantity,		
To make	100 Gm.	3 oz. av. 231 gr.

Moisten the Quassia with 400 Cc. [old form 12½ fl. oz.] of Water, pack it firmly in a conical percolator, and gradually pour Water upon it until the infusion passes but slightly imbued with bitterness. Reduce the liquid to three-fourths of its bulk by boiling, and strain; then evaporate, by means of a water-bath, to dryness and add enough Sugar of Milk to make the Extract weigh 100 Gm. [old form 3 oz. av. 231 gr.]. Mix thoroughly, reduce to fine powder, and transfer to well-stoppered bottles.

Average dose.— 1 grain (0.065 Gm.).

EXTRACTUM RHAMNI PURSHIANÆ. U.S. Extract of Cascara Sagrada

	Metric	Old form
* **Cascara Sagrada**, in No. 60 powder	1000 Gm.	32 oz. av.
Alcohol,		
Water,		
Glycyrrhiza (peeled, Russian), in No. 80 powder, each, a sufficient quantity,		
To make	250 Gm.	8 oz. av.

Mix 125 Cc. [old form 4 fl. oz.] of Alcohol with 875 Cc. [old form 28 fl. oz.] of Water, and, having moistened the powder with 400 Cc. [old form 12½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the drug is exhausted. Reserve the first 850 Cc. [old form 27 fl. oz.] of the percolate, and evaporate the remainder on a water-bath, at a temperature not exceeding 70° C. (158° F.), to the consistence of syrup. Mix this with the reserved portion, and continue the evaporation, at or below the above-mentioned temperature, to dryness. Reduce the Extract to fine powder, and add enough powdered Glycyrrhiza to make the product weigh 250 Gm. [old form 8 oz. av.]. Mix thoroughly.

Average dose.— 4 grains (0.250 Gm.).

EXTRACTUM RHEI. U.S. Extract of Rhubarb

	Metric	Old form
* Fluidextract of Rhubarb	100 Cc.	4 fl. oz.

Evaporate the Fluidextract of Rhubarb in a porcelain dish, by means of a water-bath, with constant stirring, at a temperature not exceeding 50° C. (122° F.), to a pilular consistence.

Average dose.— 4 grains (0.250 Gm.).

EXTRACTUM SCOPOLÆ. U.S. Extract of Scopola

	Metric	Old form
* Fluidextract of Scopola	100 Cc.	4 fl. oz.

Evaporate the Fluidextract of Scopola in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), with constant stirring, to a pilular consistence.

When assayed as directed below, Extract of Scopola should contain 2 percent. of mydriatic alkaloids. If the Extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 2 percent.

Assay of Extract of Scopola

The method to be employed is identical with that given on page 442, using 2 Gm. of Extract of Scopola instead of the quantity of Extract of Belladonna Leaves there directed. The product must be multiplied by 50 instead of 20.

Average dose.— ⅕ grain (0.010 Gm.).

EXTRACTUM STRAMONII. U.S. Extract of Stramonium

	Metric	Old form
* Fluidextract of Stramonium	100 Cc.	4 fl. oz.

Evaporate the Fluidextract of Stramonium in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), with constant stirring, to a pilular consistence.

When assayed as directed below, Extract of Stramonium should contain 1.0 percent. of mydriatic alkaloids. If the Extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.0 percent.

Assay of Extract of Stramonium

The method to be employed is identical with that given for Extract of Belladonna Leaves, on page 442, using 5 Gm. of Extract of Stramonium.

Average dose.— $\frac{1}{5}$ grain (0.010 Gm.).

EXTRACTUM SUMBUL. U.S. Extract of Sumbul

	Metric	Old form
* **Fluidextract of Sumbul**	100 Cc.	4 fl. oz.

Evaporate the Fluidextract of Sumbul in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring, to a pilular consistence.

Average dose.— 4 grains (0.250 Gm.).

EXTRACTUM TARAXACI. U.S. Extract of Taraxacum

	Metric	Old form
* **Taraxacum,** in No. 30 powder	1000 Gm.	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity		

Mix 125 Cc. [old form 4 fl. oz.] of Alcohol with 875 Cc. [old form 28 fl. oz.] of Water, and, having moistened the powder with 250 Cc. [old form 8 fl. oz.] of the mixture, pack it in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Taraxacum is exhausted. Evaporate the percolate, by means of a water-bath, to a pilular consistence.

Average dose.— 15 grains (1 Gm.).

Abstracta U. S. 1880 *Abstracts*

Abstracts are solid powdered preparations containing the soluble constituents of the drugs from which they are made, and bearing a definite and uniform relation to the drug. These preparations were first introduced into the U. S. Pharmacopœia of 1880, and have many advantages over ordinary extracts. They are prepared by evaporating an alcoholic tincture of a drug spontaneously or at a low temperature, mixing it with a sufficient quantity of dried sugar of milk to make the final product when dry weigh one-half the weight of the drug, and then powdering it. The following general formula exhibits the typical process. Abstracts are not official in the U. S. P. 8th Rev., not having been used sufficiently during 1880–1900 by physicians to justify their reintroduction. One of their disadvantages is that they are not as concentrated as extracts. The present official powdered extracts closely resemble abstracts.

General Formula

Drug, in No. 60 powder, *two hundred parts* [or four ounces av.]; Sugar of Milk, recently dried and in fine powder, Alcohol, each, *a* *sufficient quantity*, To make *one hundred parts* [or two ounces av.]. Moisten the drug with *eighty parts* [or one and three-quarter fluidounces] of Alcohol, and pack firmly in a cylindrical glass percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the drug is exhausted. Reserve the first *one hundred and seventy parts* [or three and one-half fluidounces] of the percolate, evaporate the remainder to *thirty parts* [or half a fluidounce], at a temperatnre not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or one ounce av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or two ounces av.], reduce it to a fine, uniform powder. Preserve the powder in a well-stoppered bottle.

The advantages possessed by abstracts may be briefly stated as follows:

1. Each abstract represents twice the strength of the drug or fluidextract from which it is prepared.
2. They are dry powders, if properly made, and thus are permanent and portable; not subject to precipitation as fluidextracts are; not liable to become hard, tough, and variable in strength, as is the case with extracts.
3. Injurious exposure to heat is entirely avoided, and the official process of 1880 requires no apparatus but such as either is at hand in the pharmacy, or can be easily obtained by a pharmacist operating upon the small scale.
4. The final thorough trituration of the dry powder reduces the soluble and active constituents of the drug to a pulverulent condition, the diluent is soluble, and the fine state of division of abstracts is the most favorable condition that a powder can possess to secure efficient medication.

The improvement suggested for the processes for abstracts is that the temperature 50° Ce. (122° F.), which is lower than need be, for abstracts of aconite, belladonna, digitalis, hyoscyamus, ignatia, jalap, nux vomica, podophyllum, and senega, be increased to 80° C. (176° F.).

Conium and valerian require a very low temperature, but the temperature of 80° C. (176° F.) is not injurious to those first mentioned if the evaporation of the fluidextract is quickly and carefully effected. An alcoholic fluidextract may be used in preparing an abstract, if the menstruum used in making it is not too aqueous, and if it is free from glycerin. Dr. Squibb's modification for making abstracts from fluidextracts, as shown in the case of fluidextract of aconite, is as follows: "Put the fluidextract (a weighed quantity) upon a flat-bottomed dinner-plate and allow it to evaporate spontaneously, without heating, for twenty-four or thirty-six hours. At the end of that time there will remain upon the plate a thin layer of solid extract.

Add to this extract about double its weight of powdered sugar of milk, warm the plate and contents until it can be just comfortably held in the hand, and incorporate the melted extract and powder by means of a stiff spatula. When thoroughly incorporated and cold, remove the mixture from the plate, weigh it, and add enough powdered sugar of milk to make the whole weigh one-half the original weight of the fluidextract. Finally, rub it to a fine, uniform powder, sifting it through a No. 60 sieve." Abstracts are *not* well made when the dry powdered solid extract is simply rubbed up with dry powdered sugar of milk, as suggested by some writers, because such mixtures of dry powder invariably *stratify* in time. This fault may be easily discovered on close examination, a darker layer of powdered extract being succeeded by a lighter one containing variable proportions of sugar of milk ; this arrangement of the particles is largely owing to the vibration to which the bottles containing them are continually subjected on the shelves of the dispensing counter and by use elsewhere. If the U. S. 1880 process is employed, this fault does not exist, because the particles of sugar of milk become thoroughly saturated with the concentrated liquid extract when mixed together, and when the alcohol evaporates the solid extract is thoroughly diffused among, and is closely adherent to, the particles of sugar of milk ; hence a dose taken from the portion at the top or at the middle of the bottle would have the same medicinal effect as one taken from the portion at the bottom.

Preservation and Administration.—Abstracts should be carefully protected from exposure to moist air. They should be kept in small bottles with mouths wide enough to admit the end of a spatula. Corks of the best quality should be used, and the bottles should not be kept near a hot flue, but in as cool a place as possible.

The following table exhibits the *eleven* U. S. 1880 abstracts in a form convenient for study :

Abstracta U. S. 1880 *Abstracts*

Name	Fineness of Powder	Menstruum	To moisten 200 Parts	Quantity reserved	Name and additions
Abstractum Aconiti	60	Alcohol	80	170	2 per cent. Tartaric Acid added to menstruum to exhaust Aconite Root
Belladonnæ	60	"	80	170	From Belladonna Root
Conii	40	"	80	170	6 per cent. Hydrochloric Acid added to menstruum to exhaust Conium Fruit
Digitalis	60	"	80	170	
Hyoscyami	60	"	80	170	
Jalapæ	40	"	100	170	
Podophylli	60	"	80	170	
Senegæ	60	"	80	170	
Valerianæ	60	"	80	170	
Ignatiæ	60	Alcohol, 8 Water, 1	100	170	
Nucis Vomicæ	60	Alcohol, 8 Water, 1	100	170	

Resinæ U. S. *Resins*

The official resins are solid preparations consisting principally of the resinous principles from vegetable bodies. The officially prepared resins differ from alcoholic extracts in the fact that the latter contain all the principles in the drug which alcohol is capable of dissolving, while the resins contain only those principles which are soluble in alcohol and are insoluble in water. It is obvious that the resins prepared from those drugs which owe their activity exclusively to resinous principles, which are insoluble in water, are stronger preparations than the alcoholic extracts from such drugs. *Four* resins are official :

Official Resins

Name	Preparation
Resina	By-product, the residue left after distilling Oil of Turpentine
Jalapæ	Percolate Jalap, in No. 60 powder, with Alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, and add the concentrated tincture to water, collect, wash, drain, and dry the precipitate
Podophylli	Percolate Podophyllum, in No. 60 powder, with Alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, and add the concentrated tincture to cold water, acidulated with 1 percent. of Hydrochloric Acid, collect, wash, drain, and dry the precipitate
Scammonii	Digest Scammony with boiling Alcohol until exhausted, mix the tinctures, distil off the alcohol, add the concentrated tincture to water, wash, and dry the precipitate

RESINA. U.S. **Rosin**

The residue left after distilling off the volatile oil from turpentine.

Usually in sharp, angular fragments, translucent, amber-colored, usually covered with a yellowish dust ; at ordinary temperatures brittle, pulverizable ; fracture shiny and shallow-conchoidal ; odor and taste faintly terebinthinate.

The specific gravity of Rosin is 1.070 to 1.080 ; it is easily fusible, and burns with a dense yellowish smoke, yielding no appreciable ash ; soluble in alcohol, ether, benzene, carbon disulphide, acetic acid, fixed or volatile oils, and in solutions of potassium or sodium hydroxide ; acid number not less than 150. (See U. S. P. Test No. 98, Chap. LXII.)

Average dose.— 4 grains (0.250 Gm.).

RESINÆ JALAPÆ. U.S. **Resin of Jalap**

	Metric	Old form
* **Jalap,** in No. 60 powder	1000 Gm.	32 oz. av.
Alcohol,		
Water, a sufficient quantity		

Moisten the powder with 300 Cc. [old form 9½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator ; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until 2500 Cc. [old form 5 pints] of percolate are obtained, or until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, by means of a water-bath, until the percolate is reduced in weight to 250 Gm. [old form 8 oz. av.], and add the latter slowly, with constant stirring, to 3000 Cc. [old form 6 pints] of water. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of hot water. After having drained off all the liquid, transfer the Resin to a porcelain dish and heat it to dryness on a water-bath.

Yellow to brown masses or fragments, breaking with a resinous, glossy fracture, translucent at the edges, or a yellowish-gray to yellowish-brown powder, having a slight, peculiar odor, and a somewhat acrid taste. Permanent in the air. Soluble in alcohol in all proportions; insoluble in carbon disulphide, benzene, and fixed or volatile oils. Its alcoholic solution has a faintly acid reaction to blue litmus paper. Not more than 15 percent. of Resin of Jalap should be soluble in ether, and not more than 35 percent. in chloroform.

Slowly but completely soluble in 5 times its weight of ammonia water; when this solution is acidified with hydrochloric acid, only a slight turbidity should appear (absence of *rosin, guaiac*, and *other resins*).

Resin of Jalap should not suffer any material loss of weight when heated at 100° C. (212° F.) (absence of *water*). Anhydrous Resin of Jalap melts at about 150° C. (302° F.).

Water triturated with Resin of Jalap should neither become colored nor dissolve any portion of it (absence of *soluble impurities*).

No greenish-blue color should be produced on adding a few drops of ferric chloride T.S. to some of the powder moistened with alcohol (absence of *guaiac*).

One Gm. of Resin of Jalap when dissolved in 50 Cc. of alcohol containing 1 Cc. of phenolphthalein T.S. should require not more than 0.5 Cc. of half-normal alcoholic potassium hydroxide V.S. to produce a red color (limit of *acid resins*).

If to 1 Gm. of Resin of Jalap, dissolved in 50 Cc. of alcohol in a flask, 25 Cc. of half-normal alcoholic potassium hydroxide V.S. be added, and the mixture be heated on a water-bath for one hour, and if the excess of alkali be titrated with half-normal sulphuric acid V.S., using 5 drops of phenolphthalein T.S. as indicator, at least 20 Cc. of half-normal sulphuric acid V.S. should be required (limit of *saponifiable substances*).

Average dose.— 2 grains (0.125 Gm.).

RESINA PODOPHYLLI. U.S. Resin of Podophyllum

	Metric	Old form
* **Podophyllum,** in No. 60 powder	**1000 Gm.**	32 oz. av.
Hydrochloric Acid	**10 Cc.**	150 minims
Alcohol,		
Water, each, a sufficient quantity		

Moisten the powder with 480 Cc. [old form 15 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until 1600 Cc. [old form 3¼ pints] of percolate are obtained, or until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, by means of a water-bath, until the percolate is reduced to the consistence of a thin syrup, and pour it slowly, with constant stirring, into 1000 Cc. [old form 2 pints] of water previously cooled to a temperature below 10° C. (50° F.), and mixed with the Hydrochloric Acid. When the precipitate has subsided, decant the supernatant liquid and wash the precipitate twice, by decantation, with fresh portions of cold Water.

Spread it in a thin layer, upon a strainer, and dry the Resin by exposure to the air, in a cool place, protected from the light. Should it coalesce during the drying, or aggregate into lumps, having a varnish-like surface, it should be removed, broken in pieces, and rubbed in a mortar.

It should be kept in amber-colored, well-stoppered vials.

An amorphous powder, varying in color from grayish-white to pale greenish-yellow, turning darker when subjected to a heat exceeding 35° C. (95° F.) or when exposed to light. It has a slight, peculiar odor and a faintly bitter taste; very irritating to the mucous membrane, especially to that of the eyes.

Soluble in alcohol in all proportions; not less than 75 percent. of Resin of Podophyllum should be soluble in ether, not less than 65 percent. in chloroform, and not more than 25 percent. in boiling water. A hot aqueous solution deposits most of its contents on cooling, and if the cool liquid be filtered, the filtrate has a bitter taste, and turns brown upon the addition of a few drops of ferric chloride T.S. Soluble in potassium or sodium hydroxide T.S., forming a deep yellow liquid, which gradually becomes darker on standing, and from which the resin is reprecipitated by acids.

Not less than 99 percent. of Resin of Podophyllum should be soluble in alcohol; the solution should be clear or, at most, slightly opalescent, and should have a faintly acid reaction.

Upon incineration, Resin of Podophyllum should yield not more than 1 per cent. of ash.

Average dose.— Purgative, $\frac{1}{4}$ grain (0.015 Gm.).
Laxative, $\frac{1}{10}$ grain (0.005 Gm.).

RESINA SCAMMONII. U.S. Resin of Scammony

	Metric	Old form
* **Scammony,** in No. 60 powder	**1000 Gm.**	32 oz. av.
Alcohol,		
Water, each, a sufficient quantity		

Digest the Scammony with successive portions of boiling Alcohol until it is exhausted. Mix the liquids, filter, and reduce the mixture to a syrupy consistence by distilling off the Alcohol. Then add the residue in a thin stream, with active stirring, to 2500 Cc. [old form 5 pints] of Water, separate the precipitate formed, wash it thoroughly with Water, and dry it at a gentle heat.

Yellowish-brown or brownish-yellow masses or fragments, breaking with a glossy resinous fracture, translucent at the edges; or a yellowish-white or grayish-white powder, having a faint, characteristic odor, and a slight, peculiar taste.

Soluble in alcohol in all proportions, completely soluble in oil of turpentine, and almost completely soluble in ether and chloroform. Ammonia water and solutions of alkalies dissolve it with the aid of a gentle heat, and from these solutions the Resin is not reprecipitated by acids.

When incinerated it should not yield more than 1 percent. of ash.

Average dose.— 3 grains (0.200 Gm.).

Unofficial Resin

Name	Description	Tests
Resina Copaibæ. U. S. P. 1890	The residue left after distilling off the volatile oil from copaiba	A yellowish or brownish-yellow brittle resin, having a slight odor and taste of copaiba. Soluble in alcohol, ether, chloroform, carbon disulphide, benzene, or amylic alcohol

CHAPTER XXXI

SOLID OFFICIAL PREPARATIONS MADE WITHOUT PERCOLATION

It is not the intention in this chapter to consider *in detail* the classes of solid official preparations included in the above title, because their manufacture either belongs to the domain of magistral pharmacy or is intimately connected with it. They are more appropriately treated in the final chapters of the work, because their preparation generally demands a higher degree of skill, and a more intimate knowledge of the physical properties of medicinal substances, than are necessary in making those which have been heretofore considered. For these reasons it has been the author's custom, in lecturing upon the subjects treated of in this work, to reserve the consideration of the solid official preparations made without percolation, and those which are embraced under the general term "extemporaneous," until after the student has studied the physical and chemical properties of the various substances which compose the materia medica. It is well for the student to have sufficient knowledge of these preparations to be able to define each class, so that when they are incidentally mentioned in Parts III. and IV. he may be able to describe the use and appearance of a powder, troche, plaster, pill, etc. If it is considered desirable to deviate from this plan, the chapters on these subjects are so constructed that the student may easily turn to them and study them out of the order given here. They will be found in Part V.

It will be well, however, in this place, in order to keep the classification in view, to enumerate them briefly. They are Pills, Troches, Masses, Confections, Powders, Triturations, Suppositories, Cerates, Ointments, Plasters, and Papers. Among those intended for internal administration pills and troches are largely used, and, because their preparation requires the drugs to be in the form of powder, the classes termed powders and triturations, which are dispensed extemporaneously, are grouped with them. Masses and confections are, of course, considered in connection with pills, because they are used in their preparation. Suppositories stand alone as a class, while cerates, ointments, plasters, and papers form a natural group, being preparations that are used externally.

PART III

INORGANIC SUBSTANCES

INTRODUCTORY

THE various operations and processes which are used in the practice of pharmacy having been treated of in their general relations to one another in the preceding chapters, it is now necessary to consider in detail the physical and chemical properties of the substances that enter into the preparations which are used in medicine.

The plan which will be followed presupposes on the part of the student a knowledge of elementary chemistry, and hence chemical physics, nomenclature, the theoretical construction of formulæ, etc., will not be entered into. The great number of valuable text-books on chemistry, now accessible to every student, renders the introduction of even brief articles on these subjects unnecessary, and the space will be reserved for the consideration of the chemical substances of the materia medica from a pharmaceutical standpoint. For reasons which need not be entered into here, the latest (and to some extent conflicting) views of modern chemists upon the classification of these substances are not adopted, but a method is employed which, while it does not do violence to the accepted theories, is simple and practical. The substances are grouped together according to their physical or therapeutical properties, while their supposed chemical analogies have not been entirely overlooked. This plan has the merit of giving the student a different view of the chemical substances from that to which he is accustomed in his study of chemistry, and will, perhaps, enhance the interest and impress the points of difference in the substances more forcibly upon the mind.

As an illustration, the chemical properties of such non-metallic elements as Hydrogen, Oxygen, and Nitrogen will not be noticed at length; they are not recognized articles of the materia medica in their free state; but the acids, bases, and salts containing them are largely used, and they form substances which can be advantageously grouped together for profitable study by the pharmacist.

The table which follows gives the symbols and atomic weights of the elements; those which are of special interest from a pharmaceutical point of view are distinguished from the rest by being printed in heavier type.

TABLE OF ATOMIC WEIGHTS. U. S.

Adopted by the International Committee on Atomic Weights (1904)

H = 1.000

Name	Symbol	Atomic Weight	Name	Symbol	Atomic Weight
Aluminum	Al	26.9	Neodymium	Nd	142.5
Antimony	Sb	119.3	Neon	Ne	19.9
Argon	Ar	39.6	Nickel	Ni	58.3
Arsenic	As	74.4	**Nitrogen**	N	13.93
Barium	Ba	136.4	Osmium	Os	189.6
Bismuth	Bi	206.9	**Oxygen**	O	15.88
Boron	B	10.9	Palladium	Pd	105.7
Bromine	Br	79.36	**Phosphorus**	P	30.77
Cadmium	Cd	111.6	Platinum	Pt	193.3
Cæsium	Cs	131.9	**Potassium**	K	38.86
Calcium	Ca	39.8	Praseodymium	Pr	139.4
Carbon	C	11.91	Radium	Ra	223
Cerium	Ce	139.2	Rhodium	Rh	102.2
Chlorine	Cl	35.18	Rubidium	Rb	84.8
Chromium	Cr	51.7	Ruthenium	Ru	100.9
Cobalt	Co	58.56	Samarium	Sm	148.9
Columbium	Cb	93.3	Scandium	Sc	43.8
Copper	Cu	63.1	Selenium	Se	78.6
Erbium	Er	164.8	**Silicon**	Si	28.2
Fluorine	F	18.9	**Silver**	Ag	107.12
Gadolinium	Gd	155	**Sodium**	Na	22.88
Gallium	Ga	69.5	**Strontium**	Sr	86.94
Germanium	Ge	71.9	**Sulphur**	S	31.83
Glucinum	Gl	9.03	Tantalum	Ta	181.6
Gold	Au	195.7	Tellurium	Te	126.6
Helium	He	4	Terbium	Tb	158.8
Hydrogen	H	1.000	Thallium	Tl	202.6
Indium	In	113.1	Thorium	Th	230.8
Iodine	I	125.90	Thulium	Tu	169.7
Iridium	Ir	191.5	Tin	Sn	118.1
Iron	Fe	55.5	Titanium	Ti	47.7
Krypton	Kr	81.2	Tungsten	W	182.6
Lanthanum	La	137.9	Uranium	U	236.7
Lead	Pb	205.35	Vanadium	V	50.8
Lithium	Li	6.98	Xenon	Xe	127
Magnesium	Mg	24.18	Ytterbium	Yb	171.7
Manganese	Mn	54.6	Yttrium	Yt	88.3
Mercury	Hg	198.5	**Zinc**	Zn	64.9
Molybdenum	Mo	95.3	Zirconium	Zr	89.9

CHAPTER XXXII

HYDROGEN, OXYGEN, AND WATER

H ; 1. O ; 15.88. H_2O ; 17.88

Hydrogen is a colorless, inodorous, and combustible gas ; it is the lightest of all substances. Chemically, it is one of the most important and interesting of the elements, the atomic weights of all usually being referred to it as unity. Pharmaceutically, in its uncombined state, it is of very little importance, and the reader is referred, for further information, to the chemical text-books.

Oxygen, as usually seen, is a colorless, inodorous gas which aids combustion; it is the most abundant of the elements, forming about one-fifth of the total weight of our atmosphere. Water contains nearly ninety percent. by weight of oxygen, and it is present in varying quantities in most vegetable and animal substances. The compounds which it forms with other bodies are termed oxides : these are of great pharmaceutical interest, and they will be considered hereafter under their appropriate heads. Oxygen in its free, gaseous condition is frequently used medicinally, and is supplied by manufacturers, compressed and in cylinders.

AQUA. U.S. Water

$H_2O = 17.88$

Potable Water in its purest obtainable state.

Water is the most important and useful compound known to the pharmacist : its molecule, H_2O, is composed of two parts of hydrogen and one part of oxygen.

The purity of water is specified in the official description, which is as follows :

Official Description.—A colorless, limpid liquid.

Odor, Taste, and Reaction.—Without odor or taste at ordinary temperatures ; odorless when heated ; perfectly neutral reaction.

Impurities and Tests for Impurities.—*Heavy metals.* 1000 Cc., when concentrated by evaporation to 20 Cc., should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of soluble salts. On evaporating 1000 Cc. of Water on a water-bath, it should not leave a residue weighing more than 0.5 Gm.

This residue, when ignited, should not carbonize, nor evolve *ammoniacal* or *acid* vapors.

Limit of sulphates. If 200 Cc. of Water be acidulated with hydrochloric acid, heated to boiling, and 0.5 Cc. of barium chloride T.S. be added, the liquid, when cooled and filtered, should give no further precipitate on the addition of a few drops of barium chloride T.S., even on standing.

Limit of chlorides. If 200 Cc. of Water be acidulated with nitric acid, heated to boiling, and 0.5 Cc. of tenth-normal silver nitrate V.S. be added, the liquid, when cooled and filtered, should not be affected by the subsequent addition of a few drops of silver nitrate T.S.

Limit of nitrates. If 10 Cc. of Water mixed with a few drops of diphenylamine T.S. be carefully poured upon about 3 Cc. of sulphuric acid, free from nitrous compounds, contained in a test-tube, so as to form a separate layer, no blue color should be formed at the line of contact of the two liquids.

Limit of nitrites. If to 50 Cc. of Water contained in a glass cylinder 2 Cc. each of sulphanilic acid T.S. and naphthylamine acetate T.S. are added, and the solution well mixed, no distinct pink coloration should appear within five minutes, if the cylinder be placed upon a white surface and viewed from above.

Limit of ammonia. If to 50 Cc. of Water contained in a glass cylinder 2 Cc. of alkaline mercuric potassium iodide T.S. (Nessler's Reagent) be added and thoroughly mixed, no yellow or brownish tint should be produced immediately; the cylinder should be placed upon a white surface and viewed from above.

Limit of organic or other oxidizable substances. On heating to boiling 100 Cc. of Water, acidulated with 10 Cc. of diluted sulphuric acid, and subsequently adding 0.4 Cc. of tenth-normal potassium permanganate V.S., the pink color of the liquid should not be completely destroyed after it has been boiled for ten minutes.

Uses.—The powers and uses of water as a solvent have been already noticed in the previous chapters. The United States Pharmacopœia directs water, under the name of Aqua, or distilled water, under the name of Aqua Destillata, to be used in the various processes according to the necessities of the occasion. Ordinary water always contains solid matter and traces of various salts in solution or suspension; these do not unfit it for drinking purposes, but would often seriously interfere with the purity of many chemical substances if such water were used in their preparation. The official processes err on the safe side, and direct distilled water in all cases where the use of ordinary water might be injurious or of doubtful propriety. In some sections of the country the drinking water might be pure enough for the processes, or at least not contain serious impurities; in other sections the water would be totally unfit for the preparations. The purity of official distilled water is beyond question, and its use therefore removes all doubts.

AQUA DESTILLATA. U.S. Distilled Water

For process, see page 277. The official tests for the purity of distilled water are, of course, much more exacting than those for water (see below).

Official Description.—A colorless, limpid liquid.

Odor, Taste, and Reaction.—Without odor or taste, and perfectly neutral to litmus paper.

Impurities and Tests for Impurities.—*Heavy metals.* Distilled Water should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXVII).

Sulphates. Nor should the slightest turbidity result upon the addition to separate portions of barium chloride T.S., or

Chlorides. Silver nitrate T.S., or

Calcium. Ammonium oxalate T.S.

Carbonic acid. Nor should its transparency be affected when mixed with twice its volume of calcium hydroxide T.S.

Nitrates, nitrites, or ammonia. It should give no reaction for nitrates, nitrites, or ammonia when tested as described under *Aqua.*

Residue. When 1000 Cc. of Distilled Water are evaporated on a water-bath to dryness, not more than 0.050 Gm. of *residue* should remain.

Organic or other oxidizable substances. On heating to boiling 100 Cc. of Distilled Water, acidulated with 10 Cc. of diluted sulphuric acid, and subsequently adding 0.1 Cc. of tenth-normal potassium permanganate V.S., the color of the liquid should not be completely destroyed by boiling for ten minutes, nor should it wholly disappear if the vessel be afterwards set aside in a dark place, covered, for ten hours.

Uses.—Distilled water is used in pharmacy principally as a solvent for delicate chemical salts, and for purposes for which ordinary water is unfitted (see page 464).

AQUA HYDROGENII DIOXIDI. U.S. Solution of Hydrogen Dioxide

[SOLUTION OF HYDROGEN PEROXIDE]

A slightly acid, aqueous solution of Hydrogen Dioxide [$H_2O_2 = 33.76$], which should contain, when freshly prepared, about 3 percent., by weight, of absolute Hydrogen Dioxide, corresponding to about 10 volumes of available oxygen. It should be kept in a cool place. Upon removing the stopper from the bottle not more than a slight pressure should be observed.

Solution of Hydrogen Dioxide is made commercially now on a large scale. The former official method of preparation consisted of decomposing barium dioxide with phosphoric acid.

$$BaO_2 + 2H_3PO_4 = Ba(H_2PO_4)_2 + H_2O_2$$

Any trace of barium salt in the solution of hydrogen dioxide remaining after the decomposition is removed by the cautious addition of sulphuric acid, which precipitates an insoluble barium sulphate.

Other methods are, however, in use. Phosphoric acid has been replaced by hydrochloric acid or hydrofluoric acid. Oxalic acid in small amount is sometimes added to the solution by manufacturers, thus fraudulently raising its indicated strength when assayed.

Official Description.—A colorless liquid, liable to deteriorate upon keeping or protracted agitation. If the stopper in the bottle be replaced by a pledget of cotton, deterioration is retarded.

Odor and Taste.—Without odor, slightly acidulous to the taste, and producing a peculiar sensation and soapy froth in the mouth.

Tests for Identity.—When exposed to the air at the ordinary temperature, or when heated on a water-bath at a temperature not exceeding 60° C. (140° F.), the solution loses chiefly water. When rapidly heated, it frequently decomposes suddenly.

On adding to 10 Cc. of water in a test-tube, 1 drop of potassium chromate T.S., then 10 drops of diluted sulphuric acid, and pouring a few Cc. of ether on top, the subsequent addition of a few drops of Solution of Hydrogen Dioxide, even when considerably diluted, will cause a blue color to appear at the zone of contact of the two liquids. After shaking, the ether-layer will separate with a blue color.

Impurities and Tests for Impurities.—*Limit of free acids.* If to 25 Cc. of the Solution, 5 Cc. of tenth-normal potassium hydroxide V.S. be added, and the mixture be evaporated to about 10 Cc., and 3 drops of phenolphthalein T.S. added, not less than 2.5 Cc. of tenth-normal sulphuric acid V.S. should be required to discharge the red color of the solution after continued boiling.

Limit of total solids. If 20 Cc. of the Solution be evaporated to dryness upon a water-bath, and the drying completed at 120° C. (248° F.), not more than 0.03 Gm. of solid residue should remain.

Arsenic. If to 1 Cc. of the Solution, 1 Cc. of ammonia water be added, and the liquid evaporated to dryness upon a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Heavy metals. If 1 Cc. of the Solution, be evaporated to dryness upon a water-bath, the residue, when dissolved in 10 Cc. of distilled water containing 1 Cc. of diluted hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Hydrofluoric acid. On evaporating to dryness, upon a water-bath, 50 Cc. of the Solution, previously rendered alkaline by sodium hydroxide T.S., transferring the dry residue to a watch-glass, moistening it with sulphuric acid, and setting the glass in a moderately warm place for a few hours, the surface of the glass, after being washed, should exhibit no sign of corrosion.

Barium. The addition of a few drops of diluted sulphuric acid to 10 Cc. of the Solution should produce no turbidity or precipitate.

Assay.—Dilute 10 Cc. of the solution with sufficient distilled water to measure 100 Cc. Transfer 16.9 Cc. of this liquid (containing 1.69 Cc. of the Solution) to a beaker, add 5 Cc. of diluted sulphuric acid, and then, from a burette, slowly add, with constant stirring, tenth-normal potassium permanganate V.S. until the liquid just retains a faint pink tint. Each Cc. of tenth-normal potassium permanganate V.S. consumed corresponds to 0.1 percent. of absolute Hydrogen Dioxide, or 0.329 volumes of oxygen. If the Solution be of full strength, 30 Cc. of tenth-normal potassium permanganate V.S. will be required.

Uses.—Solution of hydrogen dioxide (or peroxide, as it is usually termed) is an energetic antiseptic and disinfectant; it is oxygenated water, another atom of oxygen being chemically combined; as found in commerce it is designated as a 15 vol., 10 vol., 8 vol. solution, etc., by which is meant a solution of the hydrogen dioxide which will yield 15 volumes, 10 volumes, or 8 volumes of active oxygen when used. Diluted solutions are employed as local applications and in inflammations of mucous membranes. It is probably free from poisonous properties. *Great care must be exercised to prevent decomposition; the bottles containing the solution must be kept in a cool place, and the stopper may be advantageously replaced by a pledget of cotton.*

CHAPTER XXXIII

THE INORGANIC ACIDS

THE official inorganic acids form one of the most important classes of compounds used in pharmacy. They are distinguished from other bodies by the following properties: 1. They all contain hydrógen, and are sometimes called hydrogen salts. The hydrogen is capable of being replaced by metals. 2. They have a characteristic sour taste and corrosive action. 3. They act on litmus and other vegetable substances, changing their color.

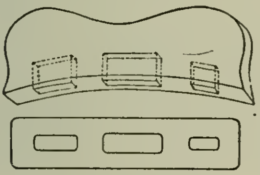
The official inorganic acids will be considered in the following order: 1. those which do not contain oxygen or *hydracids*, and which are derived from non-metallic elements,—viz., Hydrochloric, Hydriodic, and Hydrobromic Acids. 2. The non-metallic oxygen acids,—Nitric, Nitrohydrochloric, Sulphuric, Sulphurous, Hypophosphorous, and Phosphoric Acids. 3. Arsenic Trioxide and Chromium Trioxide (formerly known as Arsenous and Chromic Acids) and the weak acid obtained from Boron, will not be treated as acids, but will be described under the headings of the elements from which they are formed.

The name of the acids which contain oxygen vary in their terminations like the salts of certain metals,—the suffixes *ous* and *ic* being used, the former to denote the lower proportion of oxygen, the latter the higher. Thus sulphur*ous* acid, H_2SO_3, contains less oxygen than sulphur*ic* acid H_2SO_4; nitr*ous* acid, HNO_2, less than nitr*ic* acid, HNO_3, etc.

Practical Points in handling Strong Acids.—The strong inorganic acids are never made by the pharmacist for commercial purposes, as they can be manufactured much more economically upon a large scale. They are corrosive in their action, and must be handled very cautiously to avoid personal injury. They are usually sent out by manufacturers in one pound, or in five pint, glass-stoppered bottles, or in carboys holding about ten gallons. One of the common annoyances is the liability of the glass stopper to become so tightly fastened in the neck of the bottle that it is extracted with difficulty. As this always happens with bottles which have well-fitting and hence most valuable stoppers, it becomes an object to extract the stopper without injury. This may frequently be done by grasping the bottle firmly, and, after cleaning off the lute, carefully tapping the stopper *gently* with the *wooden* handle of a pestle or spatula. If very moderate measures do not succeed, the stopper wrench (see Fig. 440) should be used. This is made of hard wood, of the shape shown in the cut, the lower cut giving the end view and showing the relative sizes of three holes in the wrench. These should be made somewhat larger than the stoppers of the bottles for which the wrench is likely to be used. The upper cut gives the side view of the wrench, which is shaped to fit the hand, and shows the relative depths of the holes. The refractory stopper is placed in the hole, and the operator grasps the wrench with the right hand and endeavors to twist the stopper out. If it does not yield to moderate treatment, the neck of the bottle may be cautiously heated by wrapping it in a cloth wet with hot water, or by means of a spirit-lamp or Bunsen burner with a low flame, passing the flame quickly around it several times so that it shall be uniformly heated. This will cause expansion of the neck, and if the right moment be seized, which is just before the outer surface of the stopper becomes correspondingly heated, the stopper may be easily extracted, the principle of action depending upon unequal expansion. If these means do not succeed, the bottle should be inverted in a vessel of warm water to a depth sufficient to cover the neck and allowed to remain several hours ; if the wrench is then used, success is generally assured. Corks should not be used as stoppers for the strong acids, because of the corrosive action of the latter on them,—a portion of the cork almost invariably contaminating and discoloring the acid.

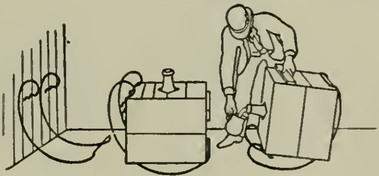
The handling of carboys containing strong acids is sometimes attended with difficulty and danger. The simplest method known to the author is by the use of Stevenson's carboy rocker (see Fig. 441).

FIG. 440



Stopper wrench

FIG. 441



Use of carboy rocker

This consists of a solid elastic steel rod bent into the shape shown in the cut. To place it in position, the carboy is tilted until it rests on a bottom corner; the closed end of the rocker is then pushed into place on the bottom edge, and the springs adjust themselves to the upper edge of the carboy. The latter can then be tilted easily and without spilling the contents. The last drop can be poured out readily.

Quality of Commercial Acids.—Two grades of acids are found in commerce. The first is designated as C. P. (chemically pure), and this is the quality indicated by the U. S. Pharmacopœia to be used in making preparations and for tests, etc. The lower grade is sometimes known as medicinally pure, and is intended to be employed in the arts and for common uses.

Too much importance cannot be attached to the duty of securing pure and strong acids. The introduction of full and reliable tests in the Eighth Decennial Revision of the Pharmacopœia leaves the pharmacist without excuse if he neglects their careful examination. They are used in many of the qualitative and quantitative official tests. If the reagent used for testing is impure itself, the substance which is suspected and is being tested will fall under condemnation when it may be absolutely faultless. Then, again, loss and annoyance in making many preparations, like the iron salts and solutions, will surely follow the use of acids deficient in strength and purity.

Strength of the Official Acids.—The official inorganic acids are mostly solutions of gaseous acids in water, and no uniformity is to be found among them in the amount of water contained in the strong acids. For instance, hydrochloric acid contains 31.9 percent. of gaseous hydrochloric acid; nitric acid contains 68 percent. of gaseous nitric acid; and sulphuric acid contains 92.5 percent. of absolute sulphuric acid. On the other hand, the *diluted* acids are intended to be uniform,—diluted hydriodic, hydrobromic, hydrochloric, hypophosphorous, nitric, phosphoric, and sulphuric acids each containing 10 percent. of absolute acid.

Medical Properties.—The inorganic acids are generally tonic and refrigerant when administered in a diluted condition; externally, if applied undiluted, they are caustic and corrosive, and should be used with the greatest care. Brushes made of spun glass are sometimes employed to apply strong acids externally to ulcers. Test bottles with elongated stoppers, or the bottle shown in Fig. 442, are also advantageously used. One of the principal difficulties attendant upon the internal administration of acids is their injurious action upon the teeth. To avoid the destructive contact with the enamel, the diluted acid should be sucked through a narrow glass tube.

Fig. 442

Acid-dropper

Antidotes.—The strong acids are sometimes accidentally taken internally in poisonous doses; their corrosive action is rapidly manifested, and dangerous results may be justly apprehended. *Mild* alkalies in large doses should at once be administered in connection with some bland fixed oil. Lime liniment is usually upon the shelf already prepared, and valuable time may often be saved by at once giving it to the patient in large doses. Soap or sodium bicarbonate in dilute solution also may be given.

Official Inorganic Acids

Official Name	Sp. Gr. at 25° C. (77° F.)	Composition
Hydracids		
Acidum Hydriodicum Dilutum	1.106	10 percent. HI
Hydrobromicum Dilutum	1.076	10 percent. HBr
Hydrochloricum	1.158	31.9 percent. HCl
Hydrochloricum Dilutum	1.049	10 percent. HCl
Oxyacids		
Acidum Hypophosphorosum	1.130	30 percent. HPH_2O_2
Hypophosphorosum Dilutum	1.042	10 percent. HPH_2O_2
Nitricum	1.403	68 percent. HNO_3
Nitricum Dilutum	1.054	10 percent. HNO_3
Nitrohydrochloricum	. . . . .	180 Cc. Nitric Acid 820 Cc. Hydrochloric Acid
Nitrohydrochloricum Dilutum	. . . . .	40 Cc. Nitric Acid 182 Cc. Hydrochloric Acid 778 Cc. Distilled Water
Phosphoricum	1.707	85 percent. H_3PO_4
Phosphoricum Dilutum	1.057	10 percent. H_3PO_4
Sulphuricum	1.826	92.5 percent. H_2SO_4
Sulphuricum Aromaticum	0.933	111 Cc. Sulphuric Acid 50 Cc. Tincture of Ginger 1 Cc. Oil of Cinnamon 838 Cc. Alcohol
Sulphuricum Dilutum	1.067	10 percent. H_2SO_4
Sulphurosum	1.028	6 percent. SO_2

ACIDUM HYDROCHLORICUM. U.S. Hydrochloric Acid

A liquid composed of 31.9 percent., by weight, of absolute Hydrochloric Acid [$HCl = 36.18$], and 68.1 percent. of water. It should be kept in glass-stoppered bottles.

Preparation.—Hydrochloric acid, the only known compound of chlorine and hydrogen, is made on a very large scale both abroad and in this country. It is obtained most cheaply as a by-product resulting from the manufacture of soda-ash, by decomposing common salt heated to a high temperature with sulphuric acid. Sodium sulphate is formed, and gaseous hydrochloric acid is liberated. The latter is conducted into a tall tower filled with coke, called a coke scrubber; the ascending gas is met by a descending flow of water, which trickles from a reservoir near the top. The gas readily dissolves in the water, and the relative quantities are so arranged that a strong solution passes out at the bottom of the tower. A purer product is formed by selecting the sodium chloride and sulphuric acid and using a series of stoneware jars shaped like Woulfe's bottles. About 120 parts of the salt require 100 parts of strong sulphuric acid. Two steps in the process are recognized. In the first reaction but one-half of the sodium chloride is decomposed, the decomposition of the remainder being effected at a temperature of 220° C. (428° F.) or over. The reaction is thus shown:

$$\underset{\substack{\text{Sodium}\\\text{Chloride}}}{2NaCl} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{HCl} + \underset{\substack{\text{Sodium}\\\text{Chloride}}}{NaCl} + \underset{\substack{\text{Acid Sodium}\\\text{Sulphate}}}{NaHSO_4}$$

and the residue, when heated, yields the rest of the hydrochloric acid, as follows:

$$\underset{\substack{\text{Sodium}\\\text{Chloride}}}{NaCl} + \underset{\substack{\text{Acid Sodium}\\\text{Sulphate}}}{NaHSO_4} = \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{HCl} + \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{Na_2SO_4}$$

Hydrochloric acid, or, more properly, solution of hydrochloric acid, is used in pharmacy to make the official preparations of the diluted hydrochloric acid, nitrohydrochloric acid, and diluted nitrohydrochloric acid, in the preparation of chlorine water, chlorides, and many other compounds. The yellow color of the common acid (*muriatic acid*,) is generally due to organic substances or a trace of iron; the white fumes produced when the acid is exposed to the air are caused by the gaseous acid combining with the moisture in the air, and also with a trace of ammonia usually present, forming ammonium chloride. The official description and tests are as follows:

Official Description.—A colorless, fuming liquid.

Odor, Taste, and Reaction.—Pungent odor; intensely acid taste; the fumes and odor disappear on diluting the Acid with 2 volumes of water. Intensely acid reaction.

Specific Gravity.—About 1.158 at 25° C. (77° F.).

Solubility.—*Water.* Miscible in all proportions.

Alcohol. Miscible in all proportions.

Tests for Identity.—On distilling it, at first a stronger acid passes over, until at 110° C. (230° F.), a liquid containing 20.13 percent. of the absolute acid remains (specific gravity about 1.098 at 25° C.), which distils unchanged, leaving no residue.

Heated with manganese dioxide it evolves chlorine.

With silver nitrate T.S. it yields a white, curdy precipitate, insoluble in nitric acid, but readily soluble in ammonia water.

Impurities and Tests for Impurities.—*Limit of non-volatile impurities.* If 10 Cc. of the Acid be evaporated from a platinum or porcelain dish, and dried at 110° C. (230° F.), no appreciable residue should remain.

Bromine or iodine. If to 5 Cc. of Hydrochloric Acid diluted with an equal volume of water, 1 Cc. of chloroform be added, and if chlorine water which has been diluted with an equal volume of water be then cautiously added, a drop at a time, with constant agitation, the chloroform should remain free from any yellow, orange, or violet color.

Free chlorine or bromine. If 1 Cc. of the Acid be diluted with 5 Cc. of water, and if 1 Cc. of potassium iodide T.S. with 1 Cc. of chloroform be added, and the mixture agitated, the chloroform should be free from any violet coloration.

Arsenic. Five Cc. of diluted Hydrochloric Acid (1 in 10), should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Sulphuric acid or sulphates. If 1 Cc. of the Acid be diluted with 5 Cc. of water, and a few drops of barium chloride T.S. be added, no precipitate or turbidity should appear within one hour.

Sulphurous Acid. Nor should the addition to this mixture of a few drops of tenth-normal iodine V.S. produce any turbidity.

Heavy metals. Hydrochloric Acid when diluted with distilled water (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—Introduce into a stoppered weighing bottle 3 Cc. of Hydrochloric Acid and weigh accurately. Dilute the Acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 3.618, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Hydrochloric Acid in the latter.

Uses.—Hydrochloric acid is largely used in making chlorides and other preparations. Medicinally it is usually prescribed in a diluted form. The dose is five to ten minims (0.3 to 0.6 Cc.).

ACIDUM HYDROCHLORICUM DILUTUM. U.S. Diluted Hydrochloric Acid

Diluted Hydrochloric Acid should contain 10 percent., by weight, of absolute Hydrochloric Acid [$HCl = 36.18$], and 90 percent. of water. It should be kept in glass-stoppered bottles.

	Metric	Old form
* **Hydrochloric Acid**	**100 Gm.**	4½ fl. oz.
Distilled Water	**219 Gm.**	11½ fl. oz.
To make	**319 Gm.**	16 fl. oz.

Mix them.

Official Specific Gravity.—About 1.049 at 25° C. (77° F.).

Tests for Identity.—It does not fume in the air and is without odor, but otherwise it should conform to the reactions and tests given under *Acidum Hydrochloricum.*

Quantitative Test.—If to 3.62 Gm. of Diluted Hydrochloric Acid there be added about 20 Cc. of water, it should require 10 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Hydrochloric Acid), methyl-orange T.S. being used as indicator.

Uses.—Diluted hydrochloric acid is used as a refrigerant and tonic in doses of fifteen to thirty minims (1 to 2 Cc.), largely diluted with water. It should be sucked through a glass tube or straw, to avoid injury to the teeth.

ACIDUM HYDROBROMICUM DILUTUM. U.S. Diluted Hydrobromic Acid

A liquid composed of not less than 10 percent., by weight, of absolute Hydrobromic Acid [$HBr = 80.36$], and about 90 percent. of water. It should be kept in amber-colored, glass-stoppered bottles, protected from light.

Preparation.—Two methods are generally used for making this preparation,—one by distillation, the other by double decomposition and precipitation. The former method yields the purer product, the latter is the more convenient. For other methods of preparation, see U. S. Dispensatory.

Diluted Hydrobromic Acid (*Distillation Process*).—Take of Potassium Bromide and Sulphuric Acid, each, 150 parts (by weight), Distilled Water, a sufficient quantity. Add the Sulphuric Acid to

25 parts of Distilled Water, and cool the mixture. Then dissolve the Potassium Bromide in 150 parts of water by the aid of heat, supplying the loss of water by evaporation during the heating. Carefully pour the diluted Sulphuric Acid into the hot solution with constant stirring, and set the mixture aside for twenty-four hours, in order that the Acid Potassium Sulphate may crystallize. Pour off the liquid into a retort, break up the crystalline mass, transfer it to a funnel, and, having drained the crystals, drop slowly upon them 50 parts of cold Distilled Water so as to wash out the acid liquid. Add this liquid to that in the retort, and distil nearly to dryness at a moderate heat. If red fumes of bromine are given off during any stage of the distillation, change the receiver until such fumes cease to appear. Finally, determine in the distillate the amount of absolute Hydrobromic Acid (10 Gm. of the diluted acid should require 12.4 Cc. normal potassium hydroxide V.S. for neutralization), and add to the remaining weighed distillate such an amount of cold Distilled Water as shall cause the finished acid to contain 10 percent. by weight of absolute Hydrobromic Acid.

This process is based upon that proposed by Dr. E. R. Squibb, the acid preferred by him having, however, the strength of 34 percent. instead of 10 percent.

$$\underset{\substack{\text{Potassium}\\ \text{Bromide}}}{KBr} + \underset{\substack{\text{Sulphuric}\\ \text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Acid Potassium}\\ \text{Sulphate}}}{KHSO_4} + \underset{\substack{\text{Hydrobromic}\\ \text{Acid}}}{HBr}$$

Diluted Hydrobromic Acid (*Precipitation Process*).—Dissolve 340 grains of Potassium Bromide in 4 fluidounces of Water, add 430 grains of Tartaric Acid to the solution, cool the mixture to 40° F., allowing it to stand without agitation as long as possible before pouring off the clear solution from the precipitated acid potassium tartrate. If it can be kept in a cool place for several weeks before it is used, it will be improved ; it will contain about 10 percent. of absolute Hydrobromic Acid. This method is a modification of Wade's and Fothergill's processes, and has the advantage of separating the acid potassium tartrate more effectually. The crystals which form upon the bottom and sides of the bottle act as nuclei, and in time serve to abstract all of the acid tartrate from the liquid.

Official Description.—A clear, colorless liquid.
Odor, Taste, and Reaction.—Odorless ; strongly acid taste and reaction.
Specific Gravity.—About 1.076 at 25° C. (77° F.).
Solubility.—*Water.* Miscible in all proportions.
Alcohol. Miscible in all proportions.

Tests for Identity.—On distilling it, water and weak acid first pass over ; when the temperature of 126° C. (258.8° F.) is reached, an acid of 48 percent. remains, which may be distilled unchanged.

Silver nitrate T.S. causes a yellowish-white precipitate, which is insoluble in diluted nitric acid, but slowly soluble in an excess of stronger ammonia water, and readily soluble in solutions of sodium thiosulphate or potassium cyanide.

If copper sulphate T.S. be added to the Acid, a deep red color is produced upon the addition of sulphuric acid.

The Acid should not become colored on keeping.

Impurities and Tests for Impurities.—*Limit of sulphuric acid.* Ten Cc. of the Acid should not be rendered more than slightly cloudy by the addition of 1 Cc. of barium chloride T. S.

Barium. Ten Cc. of the Acid should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S.

Limit of non-volatile impurities. If 10 Cc. of Diluted Hydrobromic Acid be evaporated to dryness, and heated to 110° C. (230° F.), no appreciable residue should remain.

Heavy metals. Ten Cc. of the Diluted Acid without further acidulation, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Free bromine. If 10 Cc. of the Acid be shaken with 2 Cc. of chloroform, no color should be imparted to the latter.

Iodine. Upon subsequently adding chlorine water, which has been previously diluted with an equal volume of water, drop by drop, with shaking, the chloroform should be colored orange, with no trace of violet.

Arsenic. Five Cc. of Diluted Hydrobromic Acid should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of hydrochloric acid and chlorides. If 0.5 Cc. of Diluted Hydrobromic Acid be mixed with 10 Cc. of water, and 8 Cc. of silver nitrate T.S. with 6 Cc. of ammonium carbonate T.S., be added, and if the mixture, after digesting for ten minutes on a bath of boiling water, be cooled and filtered, the filtrate, on supersaturating with nitric acid, should not become more than slightly opalescent.

Quantitative Test.—If 10 Gm. of Diluted Hydrobromic Acid be diluted with sufficient distilled water to measure 100 Cc., and if to 8.04 Cc. of this solution, after exact neutralization with diluted ammonia water (litmus T.S. being used as indicator), there be added 3 drops of potassium chromate T.S., then not less than 10 Cc. of tenth-normal silver nitrate V.S. should be required to impart to the liquid a permanent red tint (each Cc. corresponding to 1 percent. of absolute Hydrobromic Acid).

Uses.—Diluted hydrobromic acid is used as a nervine and hypnotic, in doses of two fluidrachms (8 Cc.).

ACIDUM HYDRIODICUM DILUTUM. U.S. Diluted Hydriodic Acid

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

	Metric	Old form
* **Potassium Iodide**	135.0 Gm.	4 oz. av. 431 gr.
Potassium Hypophosphite	10.0 Gm.	161 grains
Tartaric Acid	136.5 Gm.	5 oz. av. 16 gr.
Distilled Water,		
Diluted Alcohol, each, a sufficient quantity,		
To make	1000 Gm.	2 pints

Dissolve the Potassium Salts in 250 Cc. [old form 8 fl. oz.] of Distilled Water with the aid of heat, and the Tartaric Acid in 400 Cc. [old form 12 fl. oz.] of Diluted Alcohol. Having poured the solution of Tartaric Acid into a bottle of about 1000 Cc. [old form 2 pints] capacity, add the solution of the Potassium Salts and shake the mixture briskly. Place the bottle in a bath of ice-water for several hours and, having inserted a pledget of cotton tightly in the throat of a funnel, transfer the contents of the bottle to the funnel. When all the liquid has passed through, wash the bottle and crystalline precipitate with Diluted Alcohol in successive small portions until 1000 Gm. [old form 2 pints] of clear solution have been obtained. Evaporate the liquid at a moderate temperature, on a water-bath, until all of the Alcohol has been dissipated, and add sufficient Distilled Water to make the product weigh 1000 Gm. [or measure 2 pints].

Diluted Hydriodic Acid was introduced into the U. S. Pharmacopœia (8th Revision) for the purpose of quickly preparing syrup of hydriodic acid (see page 290). The process is similar to that for preparing diluted hydrobromic acid (see page 470), potassium iodide being decomposed by tartaric acid, acid potassium tartrate crystallizing out; the use of diluted alcohol and the cooling of the liquid are depended upon to assist in separating the crystals.

$$\underset{\text{Potassium Iodide}}{KI} + \underset{\text{Tartaric Acid}}{H_2C_4H_4O_6} = \underset{\text{Hydriodic Acid}}{HI} + \underset{\text{Acid Potassium Tartrate}}{KHC_4H_4O_6}$$

The object of adding potassium hypophosphite is to protect the diluted acid from discoloration through the possible liberation of iodine, hypophosphorous acid, an oxidizing agent being produced by the action of the tartaric acid on potassium hypophosphite; the phosphoric acid and hydriodic acid produced by the action of the hypophosphorous acid on the iodine are colorless.

$$\underset{\text{Hypophosphorous Acid}}{H_3PO_2} + \underset{\text{Iodine}}{2I_2} + \underset{\text{Water}}{2H_2O} = \underset{\text{Hydriodic Acid}}{4HI} + \underset{\text{Phosphoric Acid}}{H_3PO_4}$$

Traces of potassium iodide, acid potassium tartrate, or hypophosphorous acid will not affect the medicinal action of the finished product.

Official Description.—A clear, colorless liquid.

Odor, Taste, and Reaction.—Odorless; acid taste; strongly acid reaction.

Specific Gravity.—About 1.106 at 25° C. (77° F.).

Solubility.—*Water.* Miscible in all proportions.

Alcohol.—Miscible in all proportions.

Tests for Identity.—On distilling Diluted Hydriodic Acid, water with some weak acid first passes over; at the temperature of 127° C. (260.6° F.), an acid of the strength of 57.5 percent. distils over unchanged.

Silver nitrate T.S. produces a yellow, curdy precipitate, insoluble in nitric acid, almost insoluble in ammonia water, but soluble in solutions of sodium thiosulphate and potassium cyanide.

If a few drops of ferric chloride T.S. or chlorine water be added to the Acid, diluted with twice its volume of water, iodine will be liberated and impart to the solution a reddish-brown color. On agitating the mixture with a few drops of chloroform, the latter will acquire a violet color.

The Acid should not become colored on keeping.

Diluted Hydriodic Acid, when evaporated to dryness on a bath of boiling water, and then heated to 115° C. (239° F.), should not leave more than 8.3 percent. of residue.

Impurities and Tests for Impurities—*Limit of sulphuric acid.* Ten Cc. of the Acid should not be rendered more than slightly cloudy by the addition of 1 Cc. of barium chloride T.S.

Barium. The Acid should not be rendered turbid by the addition of potassium sulphate T.S.

Heavy metals. Ten Cc. of the Diluted Acid, without further acidulation, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. If 5 Cc. of Diluted Hydriodic Acid be measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water, and then evaporated to dryness on a bath of boiling water, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Quantitative Test.—Into a flask provided with a well fitting stopper, introduce 2.54 Gm. of Diluted Hydriodic Acid, diluted with 50 Cc. of distilled water, followed by 25 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of ferric ammonium sulphate T.S., and 3 to 4 Cc. of nitric acid (free from nitrous compounds); then securely stopper the flask, and shake it well. Not more than 5 Cc. of tenth-normal potassium sulphocyanate V.S. should then be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 0.5 percent. of absolute Hydriodic Acid).

Uses.—Although this liquid is used mainly for dilution with syrup (see Syrupus Acidi Hydriodici, page 290), it is sometimes given internally in doses of five to ten minims (0.3 to 0.6 Cc.)

ACIDUM NITRICUM. U.S. Nitric Acid

A liquid composed of 68 percent., by weight, of absolute Nitric Acid [HNO_3 or $NO_2.OH = 62.57$], and 32 percent. of water. It should be kept in glass-stoppered bottles.

Preparation.—Nitric acid is prepared from N_2O_5, one of the five compounds of nitrogen and oxygen; these are nitrogen monoxide, or hyponitrous oxide (laughing gas), N_2O; nitrogen dioxide, N_2O_2 or $(NO)_2$; nitrous oxide, N_2O_3; nitrogen tetroxide or peroxide, N_2O_4; and nitric oxide, N_2O_5. From this latter, by the addition of water, nitric acid is formed, $N_2O_5 + H_2O = (HNO_3)_2$. Nitric acid is prepared commercially by reacting on sodium nitrate or *Chili saltpetre* with sulphuric acid. Sodium nitrate is preferred as the source, because it is cheaper than potassium nitrate, and, in addition, it affords a larger yield of nitric acid. If two molecules of the sodium salt and one of sulphuric acid be taken, the reactions will be as follows:

$$\underset{\substack{\text{Sodium}\\\text{Nitrate}}}{NaNO_3} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Acid Sodium}\\\text{Sulphate}}}{NaHSO_4} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{HNO_3}$$

Then, by raising the heat, the acid sodium sulphate acts upon the second molecule of sodium nitrate:

$$\underset{\substack{\text{Sodium}\\\text{Nitrate}}}{NaNO_3} + \underset{\substack{\text{Acid Sodium}\\\text{Sulphate}}}{NaHSO_4} = \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{Na_2SO_4} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{HNO_3}$$

Nitric acid has been made from atmospheric nitrogen, and an economical process may yet be devised.

The specific gravity of the official acid, or, as it is technically termed, 43° acid, is 1.403 at 25° C. (77° F.). That which is usually furnished in commerce is not so strong as this, but has the specific gravity of 1.355, and is known as 38° acid. Care should always be observed to specify, in ordering from the manufacturing chemist or dealer, the specific gravity of the acid desired, for if preparations are to be made, like the official solutions of iron, success cannot be expected if acids of official strength are not used. The reddish acid, called *nitrous acid*, is nitric acid containing more or less nitrogen tetroxide (N_2O_4). The same acid may be formed by passing nitrogen dioxide (N_2O_2) into nitric acid.

Official Description.—A colorless, fuming liquid, very caustic and corrosive.

Odor and Reaction.—Peculiar, somewhat suffocating odor; acid reaction.

Specific Gravity.—About 1.403 at 25° C. (77° F.).

Tests for Identity.—It boils and is completely volatilized at 120.5° C. (248.9° F.).

It dissolves copper, mercury, silver, and other metals with evolution of red fumes, and stains woollen fabrics and animal tissues a bright yellow.

Heated with indigo T.S., it discharges the blue color of the reagent.

Impurities and Tests for Impurities.—*Limit of non-volatile impurities.* If 10 Cc. of the Acid be evaporated to dryness and further heated to 110° C. (230° F.), no appreciable residue should remain.

Arsenic. Five Cc. of diluted Nitric Acid (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Sulphuric acid. Other portions of this dilution should not yield a precipitate upon the addition of barium chloride T.S., or

Hydrochloric acid. Silver nitrate T.S.

Heavy metals. Nitric Acid when neutralized with ammonia water and diluted with distilled water (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Iodine or bromine. If the diluted Acid (1 in 3) be shaken with a few drops of chloroform, the latter should remain colorless.

Iodic or bromic acid. The above solution should remain colorless, even after the introduction of a small piece of metallic tin.

Quantitative Test.—Introduce into a stoppered weighing bottle 3 Cc. of Nitric Acid and weigh accurately. Dilute the Acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 6.257, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Nitric Acid in the latter.

Uses.—Nitric acid, sometimes called *aqua fortis*, is used in pharmaceutical operations to form nitrates and as an oxidizing agent. Free nitric acid, however, will evolve oxygen at a red heat, according to the following reaction:

$$\underset{\text{Nitric Acid}}{4HNO_3} = \underset{\substack{\text{Nitrogen}\\\text{Tetroxide}}}{2N_2O_4} + \underset{\text{Oxygen}}{O_2} + \underset{\text{Water}}{2H_2O}$$

It oxidizes sulphur and phosphorus (giving rise to sulphuric and phosphoric acids) and all the metals, with a few exceptions. It combines with salifiable bases and forms nitrates. Medicinally, nitric acid, when taken internally in doses of five to ten minims (0.3 to 0.6 Cc.), largely diluted, is tonic, antiseptic, and astringent; when applied to the skin it is escharotic, producing a yellow stain, due to the formation of *xanthoproteic acid.*

ACIDUM NITRICUM DILUTUM. U.S. Diluted Nitric Acid

Diluted Nitric Acid should contain 10 percent., by weight, of absolute Nitric Acid [HNO_3 or $NO_2.OH = 62.57$], and 90 percent. of water.

	Metric	Old form
* **Nitric Acid**	**100 Gm.**	1¾ fl. oz.
Distilled Water	**580 Gm.**	14¼ fl. oz.
To make	**680 Gm.**	16 fl. oz.

Mix them. Keep the product in dark amber-colored, glass-stoppered bottles.

Diluted nitric acid contains about 14.7 percent. of official nitric acid, corresponding to 10 percent. of absolute nitric acid.

Official Specific Gravity.—About 1.054 at 25° C. (77° F.).
Tests for Identity.—It should respond to the reactions and tests given under *Acidum Nitricum.*
Quantitative Test.—To neutralize 6.26 Gm. (6.257 Gm.) of Diluted Nitric Acid should require 10 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 1 percent. of absolute Nitric Acid), methyl-orange T.S. being used as indicator.

Uses.—It is used medicinally for the same purposes as the strong nitric acid; when taken internally, the dose is fifteen to twenty minims (0.9 to 1.3 Cc.).

ACIDUM NITROHYDROCHLORICUM. U.S. Nitrohydrochloric Acid

[NITROMURIATIC ACID]

	Metric	Old form
* **Nitric Acid**	**180 Cc.**	1 fl. oz.
Hydrochloric Acid	**820 Cc.**	4½ fl. oz.
To make about	**1000 Cc.**	5½ fl. oz.

Mix the Acids in a capacious glass vessel, and, when effervescence has ceased, pour the product into dark amber-colored, glass-stoppered bottles, which should not be more than half filled, and which should be kept in a cool place.

When nitric acid is mixed with hydrochloric acid, mutual decomposition takes place, according to the reaction

$$\underset{\text{Nitric Acid}}{HNO_3} + \underset{\substack{\text{Hydrochloric}\\ \text{Acid}}}{3HCl} = \underset{\substack{\text{Nitrosyl}\\ \text{Chloride}}}{NOCl} + \underset{\text{Chlorine}}{Cl_2} + \underset{\text{Water}}{2H_2O}$$

and a liquid is formed, capable of dissolving gold, called *aqua regia.*

The value of this acid depends upon the completion of the above reaction and the production of nitrosyl chloride and free chlorine. It should be kept in a cool dark place, on account of its liability to lose chlorine by heat, and to have its chlorine converted into hydrochloric acid by the action of light and the decomposition of water. On account of its tendency to decomposition, it should not be made in large quantities, nor be kept on hand very long; care should be taken not to transfer it to the bottle in which it is to be dispensed, until effervescence has ceased, lest the pressure within should drive out the stopper or cause the bottle to explode violently.

Official Description.—A golden-yellow, fuming, and very corrosive liquid.
Odor.—Strong odor of chlorine.
Tests for Identity.—Completely volatilized by heat. It readily dissolves gold leaf, and a drop of it, when added to potassium iodide T.S., liberates iodine.

Uses.—Nitrohydrochloric acid, or, as it is still called, nitromuriatic acid, is given internally in hepatic affections, in doses of three minims (0.2 Cc.) and upward, well diluted with water. Great care should be taken in dispensing this acid, particularly if directed in combination with infusions, tinctures, etc. ; the reaction occurring upon mixing should be permitted to cease entirely before dispensing, to avoid the possibility of an explosion taking place when the preparation is in the patient's hands.

ACIDUM NITROHYDROCHLORICUM DILUTUM. U. S. Diluted Nitrohydrochloric Acid

[DILUTED NITROMURIATIC ACID]

	Metric	Old form
* **Nitric Acid**	40 Cc.	1 fl. oz.
Hydrochloric Acid	182 Cc.	4½ fl. oz.
Distilled Water	778 Cc.	19½ fl. oz.
To make about	1000 Cc.	25 fl. oz.

Mix the Acids in a capacious glass vessel, and, when effervescence has ceased, add the Distilled Water. Diluted Nitrohydrochloric Acid should be kept in dark amber-colored, glass-stoppered bottles, in a cool place. It should not be dispensed unless recently prepared.

It should be made strictly according to the official directions. The acids must be mixed while concentrated, otherwise the nitrosyl chloride and chlorine are not produced. Hence the "rapid method," so frequently used, of mixing the acids and immediately diluting with water, does not produce an official preparation, and is reprehensible in practice.

Official Description.—A colorless or pale yellowish liquid.
Odor and Taste.—Faint odor of chlorine; very acid taste.
Tests for Identity.—It is completely volatilized by heat. When it is added to potassium iodide T.S., iodide is liberated.

Uses.—Diluted nitrohydrochloric acid is given in doses of fifteen minims (1 Cc.), properly diluted, as a tonic and stimulant to the liver.

ACIDUM SULPHURICUM. U. S. Sulphuric Acid

A liquid composed of not less than 92.5 percent., by weight, of absolute Sulphuric Acid [H_2SO_4 or $SO_2(OH_2) = 97.35$], and about 7.5 percent. of water. It should be kept in glass-stoppered bottles.

Preparation.—Sulphuric acid is obtained by burning sulphur or iron pyrites, FeS_2, and allowing the product of combustion, sulphur dioxide SO_2, to mix with nitrous fumes obtained from the decomposition of sodium nitrate, which change SO_2 into sulphur trioxide SO_3, and this uniting with steam yields sulphuric acid H_2SO_4. If the sulphur were burned by itself, the product would be sulphur dioxide, which contains only two-thirds as much oxygen as sulphur trioxide. The object of the sodium nitrate is to furnish, by its decomposition, the requisite additional quantity of oxygen. To understand the process, it is necessary to remember that several of the oxides of nitrogen have oxidizing power. The reactions are thus expressed :

$$\underset{\substack{\text{Sulphur}\\ \text{Dioxide}}}{2SO_2} + \underset{\substack{\text{Nitrogen}\\ \text{Tetroxide}}}{N_2O_4} = \underset{\substack{\text{Sulphur}\\ \text{Trioxide}}}{2SO_3} + \underset{\substack{\text{Nitrogen}\\ \text{Dioxide}}}{N_2O_2} ;$$

then

$$\underset{\substack{\text{Nitrogen}\\ \text{Dioxide}}}{N_2O_2} + \underset{\text{Oxygen}}{O_2} = \underset{\substack{\text{Nitrogen}\\ \text{Tetroxide}}}{N_2O_4} ;$$

then

$$\underset{\substack{\text{Sulphur}\\ \text{Trioxide}}}{SO_3} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Sulphuric}\\ \text{Acid}}}{H_2SO_4} ;$$

in which the sulphur dioxide, from the burning pyrites or sulphur, is oxidized to sulphur trioxide by the nitrogen tetroxide, which readily parts with two atoms of oxygen to such bodies as sulphur dioxide, and then takes two atoms of oxygen again from the atmosphere, regenerating the original tetroxide. The nitrogen tetroxide thus acts simply as a carrier of atmospheric oxygen, whereby the SO_2 is changed into SO_3. This latter compound then unites with steam to form H_2SO_4, the final product.

This acid is made on an immense scale, the reactions taking place in leaden chambers. Sulphur is used most largely in the United States as the source of production, while pyrites is used almost exclusively abroad. As the latter nearly always contains arsenical compounds, the foreign commercial product is contaminated with them.

Sulphuric Acid is now made by the "contact method," in which the nitrogen tetroxide, used as a carrier of oxygen in the above process, is replaced by a "solid" contact, which by its catalytic action changes sulphur dioxide to sulphur trioxide. This process promises to revolutionize the older methods.

Official Description.—A colorless liquid, of oily consistence, and very caustic and corrosive.

Odor, Taste, and Reaction.—Inodorous; acid reaction.

Specific Gravity.—Not below 1.826 at 25° C. (77° F.).

Solubility.—Miscible, in all proportions, with water or alcohol, with evolution of much heat; the Acid should be added with great caution to the diluent.

Tests for Identity.—It boils at 338° C. (640.4° F.). When heated on platinum foil, it is vaporized, with the evolution of dense fumes, without leaving a residue.

If Sulphuric Acid be dropped upon cane-sugar or wood, it chars them.

Diluted with 20 volumes of water, it yields with barium chloride T.S. a copious white precipitate, insoluble in hydrochloric acid.

Impurities and Tests for Impurities.—*Lead.* On mixing the Acid carefully with 4 or 5 volumes of alcohol, no precipitate should be formed within one hour.

Limit of nitric or nitrous acid. If there be carefully poured upon it, in a test-tube, a layer of ferrous sulphate T.S., and the liquid cooled, the zone of contact should not assume a brown or reddish color.

Hydrochloric acid. Sulphuric Acid, diluted with 20 volumes of water, should yield no precipitate upon the addition of silver nitrate T.S.

Heavy metals. Nor should the solution respond to the Time Limit Test for *heavy metal* (see U. S. P. Test No. 121, Chap. LXII).

Non-volatile impurities. Nor upon supersaturating with ammonia water should the solution leave any appreciable fixed residue on evaporation and ignition.

Limit of sulphurous or nitrous acid. One Cc. of Sulphuric Acid, diluted with 5 Cc. of water and cooled, should not at once discharge the color of 0.1 Cc. of tenth-normal potassium permanganate V. S.

Arsenic. If Sulphuric Acid be diluted with water (1 in 10), 5 Cc. should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of selenium. If 2 Cc. of hydrochloric acid in which a fragment of sodium sulphite has been dissolved be carefully poured upon 2 Cc. of Sulphuric Acid contained in a test-tube, the zone of contact should not assume a pink or red color upon standing, nor should a precipitate form after heating.

Quantitative Tests.—Introduce into a stoppered weighing bottle 3 Cc. of Sulphuric Acid and weigh accurately. Dilute the acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 4.8675, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Sulphuric Acid in the latter.

Uses.—Sulphuric acid is the most powerful of the official inorganic acids. It is employed in making many preparations, mostly on account of its energetic action in decomposing salts, and the large use made of its compounds with metals, alkaloids, and other bodies. It is rarely used in the pure state as an escharotic, owing to its tendency to spread. When accidentally dropped upon the skin, a quick and profuse application of magnesia will prove effective. Unless the quantity of acid is very small, care should be used in applying water, except when a very large quantity can be applied at once, as the amount of heat produced when water is mixed with sulphuric acid would increase the pain. Internally, sulphuric acid is administered either in its diluted form or as aromatic sulphuric acid.

ACIDUM SULPHURICUM AROMATICUM. U.S. Aromatic Sulphuric Acid

Aromatic Sulphuric Acid should contain not less than 20 percent., by weight, of absolute Sulphuric Acid [H_2SO_4 or $SO_2(OH)_2 = 97.35$], partly in the form of ethyl-sulphuric acid.

	Metric	Old form
* **Sulphuric Acid**	**111 Cc.**	3 fl. oz. 265 min.
Tincture of Ginger	**50 Cc.**	1 fl. oz. 288 min.
Oil of Cinnamon	**1 Cc.**	15 minims
Alcohol, a sufficient quantity,		
To make	**1000 Cc.**	2 pints

Add the Sulphuric Acid gradually, and with great caution, to 700 Cc. [old form 22½ fl. oz.] of Alcohol, and allow the mixture to cool. Then add to it the Tincture of Ginger and the Oil of Cinnamon, and afterwards enough Alcohol to make the whole measure 1000 Cc. [old form 2 pints]. Keep the product in glass-stoppered bottles.

Official Specific Gravity.—About 0.933 at 25° C. (77° F.).

Quantitative Test.—If 10 Gm. of Aromatic Sulphuric Acid be mixed in a small flask with 30 Cc. of water and be boiled for four hours, cooled and diluted with water to measure 100 Cc., then 48.68 Cc. of this solution, to which exactly 25 Cc. of normal potassium hydroxide V.S. have been added, should require not more than 5 Cc. of normal sulphuric acid V.S. for complete neutralization (each Cc. of the normal potassium hydroxide V.S. consumed corresponding to 1 percent. of absolute Sulphuric Acid), methyl-orange T.S. being used as indicator.

Uses.—This preparation, known as *elixir of vitriol*, and largely used, is employed principally as a remedy in the night-sweats of phthisis. It is used somewhat as an excipient for quinine pills, to reduce their size and render them more soluble. The introduction of the acid sulphate of quinine has diminished this use. The dose is from ten to thirty minims (0.6 to 2 Cc.).

ACIDUM SULPHURICUM DILUTUM. U.S. Diluted Sulphuric Acid

Diluted Sulphuric Acid should contain not less than 10 percent., by weight, of absolute Sulphuric Acid [H_2SO_4 or $SO_2(OH)_2 = 97.35$], and about 90 percent. of water.

	Metric	Old form
***Sulphuric Acid**	100 Gm.	1 fl. oz.
Distilled Water	825 Gm.	15 fl. oz.
To make	925 Gm.	16 fl. oz.

Pour the Acid gradually, with constant stirring, into the Distilled Water. Keep the product in glass-stoppered bottles.

The strong acid is added gradually to the water, to guard against the too sudden production of heat, which might cause the fracture of a glass vessel. During the dilution, when commercial sulphuric acid is used, the liquid becomes slightly turbid, and in the course of a few days deposits a grayish-white powder, which is lead sulphate, and from which the diluted acid should be poured off.

The formation of this precipitate does not occur if official or chemically pure sulphuric acid is used. The lead salt is present only in sulphuric acid which has not been purified.

Specific Gravity.—About 1.067 at 25° C. (77° F.).
Tests for Identity.—It should respond to the reactions and tests given under *Acidum Sulphuricum.*
Quantitative Tests.—To neutralize 4.868 Gm. of Diluted Sulphuric Acid not less than 10 Cc. of normal potassium hydroxide V.S. should be required (each Cc. corresponding to 1 percent. of absolute Sulphuric Acid), methyl-orange T.S. being used as indicator.

Uses.—Diluted sulphuric acid has the same properties as the acid from which it is made, except those which are dependent upon the strength of the latter. It is given internally, properly diluted, in doses of ten to thirty minims (0.6 to 2 Cc.).

ACIDUM SULPHUROSUM. U.S. Sulphurous Acid

An aqueous solution containing not less than 6 percent., by weight, of sulphur dioxide [$SO_2 = 63.59$], and about 94 percent. of water.

	Metric	Old form
***Sulphuric Acid**	60 Cc.	2 fl. oz. 14 min.
Charcoal, in coarse powder	20 Gm.	309 grains.
Distilled Water	500 Cc.	16 fl. oz. 435 min.

Introduce the Charcoal into a glass flask having a capacity of about 500 Cc. [old form 1 pint], add the Acid, and mix them well. Connect the flask by means of bent glass tubing, about 50 Cm. [old form about 20 inches] in length, with a wash bottle having a capacity of about 200 Cc. [old form 6½ fl. oz.] containing about 50 Cc. [old form 1½ fl. oz.] of water so that the end of the inlet tube shall be below the surface of the water. Through the triply perforated rubber stopper of the wash bottle pass a safety tube, which should reach nearly to the bottom of the bottle, and connect the latter by means of glass tubing, with a bottle provided with a doubly perforated rubber stopper, having a capacity of about 1000 Cc. [old form 2 pints], and containing 500 Cc. [old form 1 pint] of well-cooled Distilled Water. The inlet tube should dip about 25 Mm. [old form about 1 inch] below the surface of the Distilled Water. By means of a second tube connect this bottle with another containing water, the end of the tube extending 5 Cm. [old form about 2 inches] below the surface. Having ascertained that all the connections are air-tight, apply a moderate heat to the flask containing the Sulphuric Acid and Charcoal, until the evolution of gas has nearly ceased, and, during the passage of the gas, keep the bottle containing the Distilled Water at or below 10° C. (50° F.), by surrounding it with cold water or ice. Assay a small portion of the Sulphurous Acid by the method given below. Then add to the remainder sufficient Distilled water to bring the product to the strength of 6.4 percent., by weight, of sulphur dioxide. Finally pour the Sulphurous Acid into dark amber-colored, glass-stoppered bottles, which should be completely filled, and kept in a cool place, protected from light.

Owing to its rapid deterioration, Sulphurous Acid should be frequently assayed, and none should be dispensed, if it fails to conform to the assay given below.

The reactions which take place are simple. When the sulphuric acid (H_2SO_4) and charcoal are heated together, two molecules of the former each give up an atom of oxygen to the latter, and there are thus produced sulphur dioxide and carbon dioxide which, having been first passed through a wash bottle containing a little water to absorb impurities, are received into the distilled water, where the sulphur dioxide is absorbed, while the greater part of the carbonic acid gas escapes.

$$\underset{\substack{\text{Sulphuric}\\ \text{Acid}}}{4H_2SO_4} + \underset{\text{Carbon}}{C_2} = \underset{\substack{\text{Sulphur}\\ \text{Dioxide}}}{4SO_2} + \underset{\substack{\text{Carbon}\\ \text{Dioxide}}}{2CO_2} + \underset{\text{Water}}{4H_2O}$$

The mounted flask figured on page 141 is well adapted for preparing sulphurous acid (the thermometer may be omitted). The wash-bottle illustrated upon page 197 can be used in lieu of the bottle directed in the official formula; as the generation of the gas progresses, the liquid in the wash bottle accumulates. Care must be observed in making sulphurous acid to disconnect the wash bottle from the tube leading to the flask the instant the gas ceases to come over, otherwise a portion of the liquid in the wash bottle will be sucked into the flask by the partial vacuum produced, almost certainly involving fracture of the flask.

Official Description.—A colorless liquid.

Odor, Taste, and Reaction.—Characteristic odor of burning sulphur; acid sulphurous taste. Blue litmus paper moistened with the Acid is first reddened and afterwards bleached.

Specific Gravity.—Not less than 1.028 at 25° C. (77° F.).

Tests for Identity.—By heat it is completely volatilized.

On gently heating a few Cc. of the Acid in a test-tube, the gas evolved will blacken a strip of paper moistened with mercurous nitrate T.S., but will not affect one moistened with lead acetate T.S.

On mixing, in a test-tube, 1 Cc. of Sulphurous Acid with 5 Cc. of diluted hydrochloric acid, and adding a small piece of pure zinc, hydrogen sulphide gas will be evolved, which will blacken a strip of paper moistened with lead acetate T.S.

Impurity and Test.—*Limit of sulphuric acid.* If 1 Cc. of Sulphurous Acid be diluted with 99 Cc. of water and there be added 1 Cc. of diluted hydrochloric acid, and afterwards 1 Cc. of barium chloride T.S., not more than a slight turbidity should be at once produced.

Assay.—Introduce into a stoppered weighing bottle 2 Cc. of Sulphurous Acid and weigh accurately. To this add 50 Cc. of tenth-normal iodine V.S., and allow it to stand for five minutes, then slowly add tenth-normal sodium thiosulphate V.S. until the mixture is just decolorized. Subtract the number of cubic centimeters of the tenth-normal sodium thiosulphate V.S. used, from 50, and multiply the difference by 0.318, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Sulphurous Acid in the latter. Dilute the Sulphurous Acid with distilled water, as directed in the process above, so that it shall have the strength of 6.4 percent. of sulphur dioxide.

Uses.—Sulphurous acid is principally used to prevent the growth of the microscopic organisms which induce fermentation. Internally, it is rarely administered, its salts, the sulphites, being preferred. The dose is from three minims to one fluidrachm (0.2 to 4 Cc.) diluted with water.

ACIDUM PHOSPHORICUM. U.S. Phosphoric Acid

A liquid composed of 85 percent., by weight, of absolute Orthophosphoric Acid [H_3PO_4 or $PO(OH)_3 = 97.29$], and 15 percent. of water. It should be kept in glass-stoppered bottles.

The above-mentioned percentage (85) is that used for Phosphoric Acid in the formulas of pharmacopœial preparations. It is sometimes termed *syrupy phosphoric acid* on account of its consistence.

The process for making phosphoric acid was abandoned by the U. S. P. 1890 on account of the danger usually attending the operation, and because it can be made much more profitably on the large scale.

A modification of this process, which obviates any likelihood of danger, is as follows: Pour 12 fluidounces of distilled water, mixed with 11 fluidounces of nitric acid, into a two-pint flask. Add 40 grains of bromine, and shake it gently until it is dissolved. Now add two ounces of phosphorus, and set the flask aside, where the nitrous vapors may be carried off without injury. In winter-time, or if the acid is needed at once, it will be necessary to aid the reaction by a gentle heat; but if sufficient time can be allowed, the phosphorus will disappear gradually at the ordinary temperature, and no particular attention will be needed until the phosphorus is oxidized. The nearly colorless liquid remaining in the flask is then evaporated, tested for impurities by the official method, and diluted to the proper strength.

The most dangerous impurity likely to be found in the finished preparation is arsenic,—its presence being traced to the sulphuric acid made from pyrites, which is often used in making the phosphorus.

Official Description.—A colorless liquid of a syrupy consistence.

Odor, Taste, and Reaction.—Without odor; strongly acid taste; acid reaction.

Specific Gravity.—About 1.707 at 25° C. (77° F).

Solubility.—*Water.* Miscible in all proportions.

Alcohol. Miscible in all proportions.

Tests for Identity.—When heated the liquid loses water; at 200° C. (392° F.), it gradually begins to change to pyrophosphoric acid. At a still higher temperature it is converted into metaphosphoric acid, which volatilizes in dense fumes, or, on cooling, forms a transparent mass of glacial phosphoric acid.

If a small portion of Phosphoric Acid be supersaturated with ammonia water, the addition of magnesium sulphate T.S. (or of magnesia mixture) produces a white, crystalline precipitate. If this precipitate be collected, washed, and dissolved in diluted acetic acid, the solution yields a yellow precipitate with silver nitrate T.S. (distinction from *metaphosphoric* or *pyrophosphoric acid*).

Impurities and Tests for Impurities.—*Nitric acid.* If a crystal of ferrous sulphate be dropped into a cooled mixture of 1 Cc., each, of Phosphoric Acid, sulphuric acid, and water, no brown or brownish-black color should appear around the crystal.

Phosphorous acid. If 1 Cc. of Phosphoric Acid be diluted with 5 Cc. of water, and the liquid gently warmed, it should not be blackened upon the addition of a few drops of silver nitrate T.S., or rendered turbid by mercuric chloride T.S.

Arsenic. If Phosphoric Acid be diluted with water (1 in 10), 5 Cc. should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Phosphates. Upon adding to 1 Cc. of Phosphoric Acid a mixture of 3 Cc. of alcohol and 1 Cc. of ether, no turbidity should appear.

Heavy metals. If Phosphoric Acid be diluted with water (1 in 20), 10 Cc. should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Hydrochloric acid. After diluting a portion of the Acid with 5 volumes of water, no precipitate should be produced, in separate portions of the liquid, by silver nitrate T.S., or

Metaphosphoric acid. When dropped into albumin T.S.

Pyrophosphoric and metaphosphoric acids. Nor should any precipitate be formed, even after several hours, by the addition of an equal volume of official tincture of ferric chloride.

Limit of sulphuric acid.—If 0.1 Cc. of the Acid be diluted with water to 7 Cc. and 1 Cc. of barium chloride T.S. be added, no cloudiness or precipitate should appear within 30 seconds.

Quantitative Test.—If 10 Gm. of Phosphoric Acid be diluted to measure 100 Cc., then 9.73 Cc. of this solution, when diluted with a cold saturated aqueous solution containing 5 Gm. of sodium chloride, should require 17 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 5 percent. of absolute Phosphoric Acid), phenolphthalein T.S. being used as indicator.

Uses.—Phosphoric acid is used to make diluted phosphoric acid.

ACIDUM PHOSPHORICUM DILUTUM. U. S. Diluted Phosphoric Acid

Diluted Phosphoric Acid should contain 10 percent., by weight, of absolute Orthophosphoric Acid [H_3PO_4 or $PO(OH)_3 = 97.29$], and 90 percent of water.

	Metric	Old form
***Phosphoric Acid**	**100 Gm.**	**1¼ fl. oz.**
Distilled Water	**750 Gm.**	**16 fl. oz.**
To make	**850 Gm.**	**17¼ fl. oz.**

Mix them. Keep the product in glass-stoppered bottles.

The precipitation which sometimes occurs when this acid is mixed with tincture of ferric chloride is generally due to the presence of pyrophosphoric acid. Ferric pyrophosphate is precipitated in the form of an insoluble gelatinous precipitate.

Official Specific Gravity.—About 1.057 at 25° C. (77° F.).

Tests for Identity.—It corresponds in chemical properties and should conform to the reactions and tests given under *Acidum Phosphoricum.*

Quantitative Test.—If 4.87 Gm. of Diluted Phosphoric Acid be diluted with 5 Cc. of a cold saturated solution of sodium chloride, it should require 10 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Phosphoric Acid), phenolphthalein T.S. being used as indicator.

Uses.—Diluted phosphoric acid is tonic and refrigerant in doses of thirty minims (2 Cc.).

ACIDUM HYPOPHOSPHOROSUM. U.S. Hypophosphorous Acid

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

Preparation.—Hypophosphorous Acid may be made in several ways, but probably the most satisfactory method is that of carefully decomposing barium hypophosphite with diluted sulphuric acid.

Official Description.—A colorless liquid.

Odor, Taste, and Reaction.—Without odor, and having an acid taste; acid reaction.

Specific Gravity.—About 1.130 at 25° C. (77° F.).

Solubility.—*Water.* Miscible in all proportions.

Tests for Identity.—When heated in a porcelain dish, water evaporates, and the acid becomes more concentrated. On further heating between 130° and 140° C. (266° and 284° F.), it decomposes, forming hydrogen phosphide, which ignites, and phosphorous acid; the latter between 160° and 170° C. (320° and 338° F.) decomposes into hydrogen phosphide and phosphoric acid; the pasty residue finally reddens, ignites, and the last portions of unoxidized phosphorus burn out at a higher temperature.

The addition of silver nitrate T.S. to Hypophosphorous Acid, diluted with an equal volume of water, produces a black precipitate of metallic silver; the addition of mercuric chloride T.S., a white precipitate of mercurous chloride.

When the Acid is gently heated with copper sulphate T.S., a yellow precipitate forms, which rapidly assumes a reddish-brown color.

Impurities and Tests for Impurities.—*Limit of barium.* If 10 Cc. of the Acid be neutralized with ammonia water, not more than a slight precipitate should result, and after filtering, the filtrate should not become turbid upon the addition of potassium sulphate T.S.

Heavy metals. Ten Cc. of the Acid should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of potassium. Neither platinic chloride T.S. nor sodium cobaltic nitrite T.S. should produce more than a slight yellow turbidity in the diluted Acid.

Arsenic. If 2 Cc. of Hypophosphorous Acid be measured into a beaker containing 3 Cc. of nitric acid, which has been previously diluted with about 10 Cc. of water, and the whole evaporated to dryness on a bath of boiling water, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Quantitative Test.—If 10 Gm. of Hypophosphorous Acid be diluted with distilled water to measure 100 Cc., then 65.5 Cc. of this solution should require 30 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent of absolute Hypophosphorous Acid), methyl-orange T.S. being used as indicator.

Uses.—This acid is used solely to prepare diluted hypophosphorous acid.

ACIDUM HYPOPHOSPHOROSUM DILUTUM. U. S. Diluted Hypophosphorous Acid

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

	Metric	Old form
* **Hypophosphorous Acid**	200 Gm.	5 fl. oz.
Distilled Water	400 Gm.	11½ fl. oz.
To make	600 Gm.	16½ fl. oz.

Mix them. Keep the product in well-stoppered bottles.

Diluted hypophosphorous acid, although directed to be made by diluting hypophosphorous acid (see above), may be made in various ways; the process of the National Formulary (see Part VI.), consists of decomposing potassium hypophosphite with tartaric acid. The trace of acid potassium tartrate left in the solution is insufficient to be considered objectionable when used medicinally, but the present official method is preferable.

Specific Gravity.—About 1.042 at 25° C. (77° F.).

Tests for Identity.—It should respond to the reactions and tests given under *Acidum Hypophosphorosum.*

Quantitative Test.—If 10 Gm. of Diluted Hypophosphorous Acid be diluted with distilled water to measure 100 Cc., then 65.5 Cc. of this solution should require 10 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent of absolute Hypophosphorous Acid), methyl-orange T.S. being used as indicator.

Uses.—This acid was introduced into the U. S. P. 1890 for the purpose of acting as a reducing agent when added to solutions of various iodides which are liable to be decomposed by the action of light and air, as in syrup of ferrous iodide, or to aid in dissolving hypophosphites in the official syrups; calcium hypophosphite frequently requiring such an addition.

CHAPTER XXXIV

PREPARATIONS OF THE HALOGENS

Chlorine, Bromine, and Iodine

Cl; 35.18. Br; 79.46. I; 125.90

FOUR elements, *chlorine, bromine, iodine,* and *fluorine,* are termed halogens (salt-producers). Fluorine is of so little interest in pharmacy that it will not be noticed; the other three are of great interest both to medicine and to pharmacy.

Chlorine Cl; 35.18

Chlorine is a greenish-yellow, gaseous body, having a very suffocating odor; its specific gravity is 2.45 (when liquefied 1.38). Its most useful and characteristic property is that of bleaching organic coloring principles; the presence of water is necessary to effect this object. Chlorine is one of the most reliable disinfectants; it is principally used in combination with lime as bleaching powder, the official name being Calx Chlorinata. Chlorine in its free state is used officially in Chlorine Water (Liquor Chlori Compositus).

Chlorine combines with hydrogen and the metals, but has very little attraction for oxygen; its principal hydrogen compound is hydrochloric acid, HCl (see Acidum Hydrochloricum). The compounds of chlorine with metals and bases are termed chlorides; they will be considered under the heads of their respective bases.

Chlorine combines indirectly with oxygen, and the compounds produced by the union of the oxyacid, chloric acid, $HClO_3$, with metals or bases are termed chlorates. Perchlorates are also known.

Tests for Chlorides and Chlorates

Chlorides in solution, or hydrochloric acid, may be recognized by the addition of a solution of silver nitrate; a curdy white precipitate is produced, which is soluble in ammonia water, but insoluble in nitric acid.

Chlorates are recognized by the evolution of oxygen when heated, and by the reaction of the residue corresponding with that of chlorides.

Chlorine, Bromine, and Iodine and their Official Preparations

Chlorine.—Made by the action of heat upon hydrochloric acid and manganese dioxide, or produced by the action of hydrochloric acid upon potassium chlorate.

Liquor Chlori Compositus.—An aqueous solution, containing 0.4 percent. of Chlorine with oxides of chlorine and potassium chloride.

Chlorine loosely combined

Calx Chlorinata.—Made by subjecting calcium hydroxide to the action of chlorine.

Liquor Sodæ Chlorinatæ.—Made by decomposing solution of chlorinated lime with monohydrated sodium carbonate.

Bromum (Bromine).—Made by decomposing crude magnesium bromide with chlorine.
Iodum (Iodine).—Made by decomposing crude sodium iodide with manganese dioxide and sulphuric acid and subliming.
Tinctura Iodi.—An alcoholic solution of iodine containing 7 Gm. of iodine and 5 Gm. of potassium iodide in 100 Cc.
Liquor Iodi Compositus.—A 5 percent. aqueous solution of iodine, made soluble by the addition of 10 percent. of potassium iodide.
Unguentum Iodi.—Four percent. iodine; 4 percent. potassium iodide; 12 percent. glycerin, with benzoinated lard.

Iodine loosely combined

Acidum Hydriodicum Dilutum.—Ten percent. absolute hydriodic acid.
Syrupus Acidi Hydriodici.—One percent. absolute hydriodic acid.

Unofficial Preparations of Chlorine, Bromine, and Iodine

Acidum Hypochlorosum, $HClO$ Hypochlorous Acid	Agitate chlorine water with precipitated mercuric oxide. Distil the liquid to remove mercuric chloride, and collect the distillate
Acidum Chloricum, $HClO_3$ Chloric Acid	Decompose barium chlorate with an equivalent amount of pure diluted sulphuric acid; pour off the clear solution of chloric acid, and evaporate carefully *in vacuo* over strong sulphuric acid
Acidum Perchloricum, $HClO_4$ Perchloric Acid	Distil pure dry potassium perchlorate with four times its weight of concentrated (previously boiled) sulphuric acid. Collect the yellow distillate
Bromi Chloridum Bromine Chloride	Pass chlorine gas over bromine
Acidum Bromicum Bromic Acid	Decompose barium bromate with an equivalent amount of diluted sulphuric acid, filter, and evaporate
Acidum Iodicum, HIO_3 Iodic Acid	Heat 1 part iodine with 10 parts nitric acid in a retort until the iodine is dissolved and fumes cease to be evolved. Evaporate the solution, and heat the residue to 200° F. until all trace of acid is removed. Collect the white powder
Acidum Periodicum, HIO_4 Periodic Acid	Add 1 part iodine to a solution of 7 parts sodium carbonate in 100 parts water, and pass chlorine into the heated liquid until a precipitate ceases to form. Dissolve this precipitate in pure nitric acid, then add silver nitrate, and dissolve the resulting precipitate in hot diluted nitric acid. Then concentrate to crystallize. Treat the crystals with water, filter, and evaporate
Amylum Iodatum Iodized Starch	Five parts iodine moistened with water and triturated with 90 parts starch. It has been asserted by Bondonneau, Payen, Fritzsche, and others that iodine forms with starch a definite compound, and the formulas $(C_6H_{10}O_5)_5I$ and $(C_6H_{10}O_5)_{10}I$ have been assigned to it. The existence of these compounds is regarded as doubtful, however, and the U. S. P. 1880 terms the mixture iodized starch Iodized starch is a convenient preparation for administering iodine internally, the principal advantage being that starch forms an admirable diluent and the iodine is freed from irritant properties. The dose is two to four drachms (8 to 16 Gm.)

LIQUOR CHLORI COMPOSITUS. U. S. Compound Solution of Chlorine, Chlorine Water

[To replace Aqua Chlori, Pharm. 1890]

An aqueous solution, containing, when freshly prepared, about 0.4 percent. of Chlorine [Cl = 35.18], with some oxides of chlorine and potassium chloride.

	Metric	Old form
* **Potassium Chlorate,** granulated	5 Gm.	73 grains
Hydrochloric Acid	18 Cc.	276 minims
Distilled Water, a sufficient quantity,		
To make about	1000 Cc.	2 pints

Add the Hydrochloric Acid, diluted with 20 Cc. [old form 5 fl. dr.] of Distilled Water, to the Potassium Chlorate contained in a flask of the capacity of about 2000 Cc. [old form 4 pints].

Insert in the flask a stopper perforated to admit a funnel of the capacity of about 100 Cc. [old form 3¼ fl. oz.] containing about 10 Gm. [old form 2½ dr.] of purified cotton well wetted with cold water; place the flask on a water-bath containing boiling water, for a period of from two to three minutes; when the flask is completely filled with a greenish-yellow gas, remove it from the bath and add cold Distilled Water through the cotton in the funnel, in two separate portions of 500 Cc. [old form 1 pint] each. After the addition of each separate portion of cold Distilled Water, stopper the flask securely, invert, and thoroughly agitate the contents.

This solution should be freshly made when wanted.

Chlorine water was directed to be prepared in the U. S. P. 1890 by heating 35 Cc. of hydrochloric acid with 10 Gm. of manganese dioxide and conducting the generated chlorine into 400 Cc. of distilled water until a saturated solution is produced. The reactions are shown below:

$$\underset{\text{Manganese Dioxide}}{MnO_2} + \underset{\text{Hydrochloric Acid}}{4HCl} = \underset{\text{Manganese Chloride}}{MnCl_2} + \underset{\text{Chlorine}}{Cl_2} + \underset{\text{Water}}{2H_2O}$$

The chlorine water must be kept secluded from the light, to prevent its partial conversion into hydrochloric acid through the decomposition of the water by the union of the chlorine with its hydrogen.

The little apparatus shown in Fig. 265 is well adapted for making small quantities of chlorine water rapidly. The process adopted by the U. S. P. (8th Rev.) is practical and efficient; the slight traces of potassium chloride and oxides of chlorine may be disregarded, for they do not interfere with medicinal and pharmaceutical uses.

Uses.—Compound solution of chlorine, or chlorine water, is antiseptic and stimulant; it is given in doses of from thirty to sixty minims (2 to 4 Cc.) diluted with water; it is used as a gargle in scarlet fever, diphtheria, and similar diseases. Chlorine in the gaseous state is largely used as a disinfectant. A convenient way of generating it is by the well-known *chlorine saucer disinfectant;* this is made by pouring half a fluidounce of equal measures of sulphuric acid and water upon two hundred grains of a finely ground mixture of equal parts of black manganese oxide and common salt, contained in a saucer. Chlorine is gradually evolved from this mixture for several days.

CALX CHLORINATA. U.S. Chlorinated Lime Chlorinated Calcium Oxide

[CALX CHLORATA, PHARM. 1890 CHLORIDE OF LIME]

A compound resulting from the action of chlorine upon calcium hydroxide, and containing not less than 30 percent. of available chlorine. It is often improperly called "Chloride of Lime." It should be kept in well-closed vessels, in a cool and dry place.

Preparation.—Chlorinated lime is made by exposing finely powdered calcium hydroxide, which is placed on trays in a suitable chamber, to the action of chlorine. The gas is absorbed by the lime, and a chemical compound is formed, which is represented by the formula $CaOCl_2$. Various views have been held by chemists as to its exact composition, but the weight of opinion is now in favor of considering it to be a *calcium chloro-hypochlorite*, and yielding, by decomposition with water, calcium hypochlorite and calcium chloride. The value of chlorinated lime, whether used for bleaching purposes or in medicine, depends upon the amount of chlorine which can be liberated; for, whatever view is accepted as to its composition, it is admitted that the chlorine is very loosely combined.

A very excellent method of preservation is now in vogue in which the dry chlorinated lime is hermetically sealed in metallic zinc boxes. When exposed to the air it soon becomes moist, on account of the hygroscopic character of the calcium chloride present.

Official Description.—A white, or grayish-white, granular powder, becoming moist and gradually decomposing on exposure to air.

Odor, Taste, and Reaction.—Exhaling the odor of hypochlorous acid; repulsive, saline taste. An aqueous solution first colors red litmus paper blue, and then bleaches it.

Solubility.—*Water.* Partially.
Alcohol. Partially.

Tests for Identity.—If Chlorinated Lime be dissolved in diluted acetic acid, an abundance of chlorine gas will be evolved, and only a trifling residue remain undissolved.

From this solution ammonium oxalate T.S. throws down a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid.

Quantitative Test.—Introduce into a stoppered weighing bottle between 3 and 4 Gm. of Chlorinated Lime and weigh accurately; triturate this thoroughly with 50 Cc. of water, transfer the mixture to a graduated vessel, together with the rinsings, and add sufficient water to make 1000 Cc. After thoroughly shaking, add to 100 Cc. of the mixture 1 Gm. of potassium iodide, 5 Cc. of diluted hydrochloric acid, and sufficient tenth-normal sodium thiosulphate V.S. for complete decolorization. Multiply the number of Cc. of tenth-normal sodium thiosulphate V.S. consumed, by 0.3518, and divide this product by one-tenth of the weight of the Chlorinated Lime taken; the quotient represents the percentage of available chlorine present.

Uses.—Chlorinated lime is used in the preparation of solution of chlorinated soda, but most largely as a disinfectant, through its power of arresting animal and vegetable putrefaction. It is rarely given internally, but is sometimes used as a stimulant and alterative, in doses of three to six grains (0.2 to 0.38 Gm.). Externally, it is used in solution as an application to ulcers, burns, etc.

LIQUOR SODÆ CHLORINATÆ. U.S. Solution of Chlorinated Soda

[Liquor Sodæ Chloratæ, Pharm. 1890 Labarraque's Solution]

An aqueous solution of several chlorine compounds of sodium, containing at least 2.4 percent., by weight, of available chlorine.

	Metric	Old form
* **Monohydrated Sodium Carbonate**	65 Gm.	9 oz. av. 47 gr.
Chlorinated Lime	90 Gm.	12 oz. av. 262 gr.
Water, a sufficient quantity,		
To make	1000 Gm.	8 pints

Triturate the Chlorinated Lime (which should contain not less than 30 percent. of available chlorine) with 200 Cc. [old form 25½ fl. oz.] of Water, gradually added, until a uniform mixture results. Allow the heavier particles to subside, and transfer the thinner, supernatant portion to a filter. Then triturate the residue again with 200 Cc. [old form 25½ fl. oz.] of Water, transfer the whole to the filter, and, when the liquid has drained off, wash the filter and contents with 100 Cc. [old form 13 fl. oz.] of Water. Dissolve the Monohydrated Sodium Carbonate in 300 Cc. [old form 38 fl. oz.] of hot Water, and add this solution to the previously obtained filtrate contained in a suitable vessel. Stir or shake the mixture thoroughly, and, if it should become gelatinous, warm the vessel very gently, until the precipitate subsides. Then transfer the mixture to a new filter, and, when no more liquid drains from it, wash the filter and contents with enough Water to make the product weigh 1000 Gm. [or measure, old form, 8 pints]. Keep the Solution in well-stoppered bottles, protected from light, and in a cool place.

Double decomposition results in the formation of insoluble calcium carbonate or precipitated chalk, while sodium hypochlorite and sodium chloride remain in solution.

$$\underset{\text{Chlorinated Lime}}{Ca(OCl)_2 + CaCl_2} + \underset{\text{Sodium Carbonate}}{2Na_2CO_3} = \underset{\text{Chlorinated Soda}}{2NaOCl + 2NaCl} + \underset{\text{Calcium Carbonate}}{2CaCO_3}$$

Official Description.—A clear, pale greenish liquid.

Odor, Taste, and Reaction.—Faint odor of chlorine, and a disagreeable alkaline taste. The solution at first colors red litmus paper blue, and then bleaches it.

Specific Gravity.—About 1.050 at 25° C. (77° F.).

Test for Identity.—The addition of hydrochloric acid to the Solution causes an evolution of chlorine and carbon dioxide.

Quantitative Test.—If 7 Gm. of the Solution be mixed with 50 Cc. of water, and 2 Gm. of potassium iodide and 10 Cc. of hydrochloric acid be added, not less than 48 Cc. of tenth-normal sodium thiosulphate V.S. should be required to discharge the final yellow color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. corresponding to 0.05 percent. of available chlorine).

Uses.—Solution of chlorinated soda is principally employed as a disinfectant or bleaching solution; it is frequently termed *Labarraque's Solution*, and is sometimes substituted for *Eau de Javelle* (*Javelle's water*), a French preparation made with potassium carbonate instead of sodium carbonate.

BROMUM. U.S. Bromine

Br = 79.36

It should contain not less than 97 percent. of pure Bromine, and be kept in protected glass-stoppered bottles, in a cool place.

Preparation.—This non-metallic element, which is in the form of a dark red, volatile liquid, is produced largely in the United States, in Ohio, West Virginia, and Pennsylvania. It is prepared from the brine obtained from salt-wells by the following process. The brine is concentrated to separate chlorides, sulphates, etc., by crystallization. The mother liquor, containing the bromine principally in the form of magnesium bromide, is decomposed by treating it with chlorine gas produced from manganese dioxide and hydrochloric acid.

The manner of conducting this process is peculiar. The original salt liquor, or brine, is pumped out of the ground and evaporated to about 15° B. in large iron pans, then allowed to settle, and is further evaporated to the point of crystallization in wooden tanks heated by steam pipes. These tanks, five in number, are placed at different elevations, one above the other. Each day the liquor is run off from No. 1, the highest, to No. 2, next day to No. 3, and so on until it reaches No. 5, the crystallized salt being removed from each tank after draining off the liquor. The brine which reaches No. 5 is *bittern*, and consists chiefly of calcium, magnesium, sodium, and aluminum chlorides, with varying percentages of sodium and calcium bromides.

The bittern marking 30° to 38° B. is evaporated to about 45° B. The liquor is then run into stone stills, materials for generation of chlorine added, and heat applied by means of steam until the bromine has all been vaporized. It is condensed and collected in cooled receivers.

$$\underset{\substack{\text{Magnesium}\\\text{Bromide}}}{MgBr_2} + \underset{\text{Chlorine}}{2Cl} = \underset{\substack{\text{Magnesium}\\\text{Chloride}}}{MgCl_2} + \underset{\text{Bromine}}{2Br}$$

On account of its very caustic and irritating properties, *great care* must be used in handling bromine. Its vapor is very corrosive and suffocating.

Chemically, there is a close analogy between bromine and chlorine. Its combination with hydrogen is hydrobromic acid, which is official (see page 470).

The salts, termed bromides, are used very largely in medicine. They will be considered under the heads of their respective bases. *Bromates*, formed, like chlorates, by combination with the corresponding oxyacid, bromic acid, $HBrO_3$, are rarely used.

Tests for Bromine and Bromides

1. If a solution of a bromide be treated with a solution of silver nitrate, a yellowish-white precipitate of silver bromide is produced, which is insoluble in nitric acid and but slightly soluble in ammonia water.

2. If chlorine water be added to a strong solution of a bromide, bromine is liberated. This may be dissolved by agitation with carbon disulphide, chloroform, or ether.

3. If concentrated sulphuric acid be added to a bromide (not in solution), reddish vapors of bromine are evolved.

Official Description.—Bromine is a heavy, dark brownish-red, mobile liquid evolving, even at ordinary temperatures, reddish fumes, highly irritating to the eyes and lungs.

Odor.—Peculiar suffocating odor, resembling that of chlorine.

Specific Gravity.—About 3.016 at 25° C. (77°F.)

Solubility.—*Water.* In 28 parts at 25° C. (77° F.).

Other solvents. Readily in alcohol and ether (with gradual decomposition of these liquids); also in carbon disulphide, and in chloroform, with a deep reddish-yellow color.

Tests of Identity.—Boiling point, about 63° C. (145.4° F.).

On exposure to air or to heat, it is completely volatilized without leaving any residue.

It destroys the color of solutions of litmus and indigo, and imparts a yellow color to solution of starch.

Impurities and Tests for Impurities.—*Organic bromine compounds.* If Bromine be added to an excess of potassium hydroxide T.S., it should combine to form a permanently clear liquid, without the separation of oily drops.

Iodine. If an aqueous solution of Bromine be shaken with a slight excess of reduced iron until it becomes nearly colorless, the filtered liquid, on the addition of a small amount of ferric chloride and of starch T.S., should not assume a blue color.

Uses.—Bromine is rarely used in its undiluted condition. When diluted with water in the proportion of forty minims in a pint, it forms a powerful wash. It is the important ingredient in *Bibron's antidote* to rattlesnake poison, which is made by dissolving three hundred grains of bromine in half a pint of diluted alcohol, placing four grains of potassium iodide and two grains of corrosive mercuric chloride in a mortar; adding sufficient of the solution to dissolve the salts, and mixing it with the rest of the solution. The *utmost care* should be exercised in handling bromine: the vapor not only attacks the eyes and nostrils, but renders the air irrespirable. It acts on metallic surfaces, and may ruin balances if permitted to remain in contact with them.

IODUM. U.S. Iodine

$I = 125.90$

It should contain not less than 99 percent. of pure Iodine, and be kept in glass-stoppered bottles, in a cool place.

Preparation.—Iodine is a non-metallic element widely distributed in nature. It was formerly exclusively obtained from *kelp*, the ashes of certain sea-weeds. In addition to this source, it is now made from the mother liquors obtained from the crystallization of sodium nitrate in South America. These contain the iodine in the form of sodium iodide and sodium iodate. The iodides are decomposed by chlorine, iodine being set free, while the iodine from the iodates is precipitated by treatment with acid sodium sulphite. The liquid obtained by lixiviating kelp contains the iodine as sodium iodide and potassium iodide. A concentrated solution of the impure iodide is treated with sulphuric acid, then distilled with manganese dioxide; the separated iodine condenses in a series of glass receivers.

$$\underset{\substack{\text{Sodium}\\\text{Iodide}}}{2NaI} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{2H_2SO_4} + \underset{\substack{\text{Manganese}\\\text{Dioxide}}}{MnO_2} = \underset{\text{Iodine}}{I_2} + \underset{\substack{\text{Manganese}\\\text{Sulphate}}}{MnSO_4} + \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{Na_2SO_4} + \underset{\text{Water}}{2H_2O}$$

Iodine of excellent quality is now readily obtained; the presence of a small quantity of water, however, is often noticed.

Tests for Iodine and Iodides

1. A dark blue color (fading upon the application of heat) is produced when iodine is brought in contact with starch mucilage.
2. An iodide is detected by first liberating the iodine by adding a little chlorine water and then using starch mucilage; or if carbon disulphide be added the iodine dissolves in it.
3. Silver nitrate produces with a solution of an iodide a yellowish-white precipitate of silver iodide, which is insoluble in nitric acid and but slightly soluble in ammonia water.
4. A yellow precipitate of lead iodide is produced by adding a solution of lead salt to a neutral solution of an iodide.
5. A red precipitate of mercuric iodide is produced by adding a solution of mercuric chloride to a neutral solution of an iodide.

Official Description.—Heavy, bluish-black, dry and friable, rhombic plates, having a metallic lustre.

Odor and Taste.—Distinctive odor; sharp, acrid taste.

Specific Gravity.—4.948 at 17° C. (62.6° F.).

Solubility.—*Water.* In about 5000 parts of water at 25° C. (77° F.).

Alcohol. In 10 parts of alcohol at 25° C. (77° F.).

Other solvents. Freely in ether, chloroform, or carbon disulphide; its solution in alcohol or in an aqueous solution of potassium iodide has a reddish color; its solution in chloroform or carbon disulphide has a violet color.

Tests for Identity.—Iodine imparts a deep brown, evanescent stain to the skin, and slowly destroys vegetable colors.

Soluble in about 5000 parts of water, and in 10 parts of alcohol at 25° C. (77° F.); freely soluble in ether, chloroform, or carbon disulphide; its solution in alcohol or in an aqueous solution of potassium iodide has a reddish color; its solution in chloroform or carbon disulphide has a violet color.

It volatilizes slowly at ordinary temperatures. When heated to about 114° C. (237.2° F.), it fuses, and is gradually dissipated in the form of a purple vapor, leaving no residue.

With starch T.S. a dark blue color is produced.

Impurities and Tests for Impurities.—*Moisture.* A solution of iodine in chloroform should be perfectly clear and limpid.

To determine the presence of cyanogen, chlorine, or bromine, proceed as follows:

Iodine cyanide. Triturate 0.5 Gm. of finely powdered Iodine with 20 Cc. of water, and filter the solution. To one-half of this solution, in a test-tube, carefully add tenth-normal sodium thiosulphate V.S., until the solution is just decolorized. Then add a few drops of ferrous sulphate T.S., and subsequently a little sodium hydroxide T.S., and heat the mixture gently. On now adding a slight excess of hydrochloric acid, the liquid should not assume a blue color.

Limit of chlorine or bromine. To the other half of the aqueous filtrate, in a test-tube, add a slight excess of silver nitrate T.S., shake the liquid actively, allow the precipitate to subside, and, having poured off the clear, supernatant liquid completely, shake the precipitate with a mixture of 1 Cc. of ammonia water and 9 Cc. of water, and filter. Upon the addition of a slight excess of nitric acid to the filtrate, not more than a slight opalescence should make its appearance.

Assay.—Place about 0.5 Gm. of Iodine in a tightly stoppered weighing bottle and weigh accurately; add 1 Gm. of potassium iodide and dissolve in 50 Cc. of water, then add tenth-normal sodium thiosulphate V.S. until the liquid is decolorized. The number of Cc. of tenth-normal sodium thiosulphate V.S. consumed, when multplied by 1.259, and divided by the weight of the Iodine taken, gives the percentage of pure Iodine present.

Iodine is closely related chemically to bromine and chlorine. Its combination with hydrogen (hydriodic acid) is official in the form of a diluted acid of 10 percent. strength and also as Syrupus Acidi Hydriodici, the syrup preserving it from decomposition. The iodides are largely used in medicine. The iodates, like the chlorates and bromates, are produced by combination with the oxyacids of iodine, iodic and periodic acids. They are of little interest pharmaceutically.

Uses.—Iodine is very largely used in medicine. It excites the action of the absorbent and glandular systems, and is employed both internally and externally.

TINCTURA IODI. U. S. Tincture of Iodine

An alcoholic solution containing 7 Gm. of Iodine and 5 Gm. of Potassium Iodide in 100 Cc. of Tincture. The addition of potassium iodide to the iodine solution was made in the 8th Revision of the U. S. Pharmacopœia, it being found by actual trial to prevent loss of iodine through gradual decomposition when the tincture was kept (see page 354).

If 5 Cc. of the Tincture be mixed with about 25 Cc. of Water and titrated with tenth-normal sodium thiosulphate V.S., about 27.25 Cc. of tenth-normal sodium thiosulphate V.S. should be required for complete decolorization (corresponding to about 6.86 Gm. of Iodine in 100 Cc.).

LIQUOR IODI COMPOSITUS. U. S. Compound Solution of Iodine

[Lugol's Solution]

An aqueous solution, which should contain not less than 5 percent. of iodine and 10 percent. of potassium iodide.

	Metric	Old form
***Iodine**	5 Gm.	½ oz. av.
Potassium Iodide	10 Gm.	1 oz. av.
Distilled Water, a sufficient quantity,		
To make	100 Gm.	8¾ fl. oz.

Dissolve the Iodine and Potassium Iodide in a sufficient quantity of Distilled Water to make the product weigh 100 Gm. [or measure, old form, 8¾ fl. oz.]. Keep the solution in glass-stoppered bottles.

In this Solution iodine is dissolved in water with the assistance of potassium iodide. Iodine dissolves sparingly in water, but freely in a solution of potassium iodide. In using this salt to render iodine more soluble in water, it is generally employed in a quantity twice the weight of the iodine. The Solution contains about 3.12 grains of iodine in the fluidrachm.

Quantitative Test.—For complete decolorization 6.3 Gm. of the Solution should require not less than 24.75 Cc. of tenth-normal sodium thiosulphate V.S. (each Cc. of the tenth-normal sodium thiosulphate V.S. corresponding to 0.2 percent. of Iodine).

Uses.—This Solution affords an efficient means of administering iodine internally. It is given in three minim (0.2 Cc.) doses, and, to prevent gastric irritation, it must be largely diluted.

UNGUENTUM IODI. U.S. Iodine Ointment

An ointment containing 4 percent. of Iodine, 4 percent. of Potassium Iodide, 12 percent. of Glycerin, and 80 percent. of Benzoinated Lard. (See Unguenta, Part V.)

ACIDUM HYDRIODICUM DILUTUM. U.S. Diluted Hydriodic Acid

This preparation was introduced into the U. S. Pharmacopœia (8th Revision), because the process adopted makes a stable preparation which is very convenient for diluting with syrup to make the official syrup of hydriodic acid (see page 290). It contains 10 percent. of absolute hydriodic acid.

SYRUPUS ACIDI HYDRIODICI. U.S. Syrup of Hydriodic Acid

This is a syrupy liquid containing 1 percent. of absolute hydriodic acid [HI; 126.9] and having the specific gravity 1.190 (see page 472). It is prepared officially by mixing 100 Gm. of Diluted Hydriodic Acid with 300 Gm. of Water and 600 Gm. of Syrup.

The object of this preparation is to furnish an agreeable mode of administering hydriodic acid, and also a liquid which will be reasonably stable. *Hydriodic acid*, HI, is easily decomposed in simple aqueous solution (unless protected by hypophosphorous acid as in the official process), free iodine being liberated, and if taken internally when in this condition, serious results might follow. Syrup of hydriodic acid was formerly made by passing hydrogen sulphide through an alcoholic solution of iodine (see U. S. P. 1880). The chemical reaction which takes place may be expressed as follows:

$$\underset{\text{Iodine}}{4I} + \underset{\substack{\text{Hydrogen}\\\text{Sulphide}}}{2H_2S} = \underset{\substack{\text{Hydriodic}\\\text{Acid}}}{4HI} + \underset{\text{Sulphur}}{2S}$$

Official Description.—A transparent, colorless, or not more than pale straw-colored liquid.

Odor and Taste.—Odorless, and having a sweet and acidulous taste.

Specific Gravity.—About 1.190 at 25° C. (77° F.).

Test for Identity.—The addition of silver nitrate T.S. to a small portion of the Syrup diluted with four volumes of water produces a pale yellow precipitate, nearly insoluble in ammonia water.

Impurity and Test.—*Limit of free iodine.* If a small portion of the Syrup be mixed with a little Starch T.S., and a few drops of chlorine water then added, the liquid will acquire a deep blue color. Not more than a faint bluish tint should be produced in the Syrup by starch T.S. alone.

Quantitative Test.—If 31.73 (31.725) Gm. of Syrup of Hydriodic Acid be diluted with distilled water to measure 50 Cc., and if to 10 Cc. of this solution about an equal volume of distilled water, 8 Cc. of tenth-normal silver nitrate V.S., and 5 Cc. of diluted nitric acid be added, followed by 3 Cc. of ferric ammonium sulphate T.S., then, after thoroughly shaking the mixture, not more than 3 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 0.2 percent. of absolute Hydriodic Acid).

Uses.—Syrup of hydriodic acid is used as an alterative. The dose is twenty to sixty minims (1.3 to 4 Cc.).

CHAPTER XXXV

SULPHUR AND PHOSPHORUS

S; 31.83. P; 30.77

THESE two elements furnish many important compounds to medicine. They present several analogies, both physically and chemically.

Sulphur S; 31.83

Sulphur is found uncombined in Sicily and in other parts of the world. In the form of sulphates and sulphides it is widely diffused. It is prepared for use by fusing it, allowing it to stand to permit the earthy impurities to settle, and then pouring it into cylindrical moulds. The sulphur in cylinders is termed *roll sulphur*.

Three forms of sulphur are official,—sublimed, washed, and precipitated sulphur.

Sulphur forms with hydrogen an offensive gas, which is known officially as hydrogen sulphide, H_2S. It is also termed *sulphuretted hydrogen* and *hydrosulphuric acid.* The formula for its preparation will be found under "Tests," in Part IV. It is used for proving the presence or absence of certain metallic salts, lead, bismuth, antimony, copper, mercury, zinc, etc., with which it produces characteristic precipitates. *Sulphides* are compounds of elements with sulphur. Some of the sulphides are analogous to acids, others to bases; and these different sulphides, by combining with one another, form compounds, which, from their analogy to salts, are called by Berzelius *sulpho-salts.* It forms with oxygen two oxides, *sulphurous* oxide, SO_2, and *sulphuric* oxide, SO_3. These oxides, by their union with water, form *sulphurous acid*, H_2SO_3, and *sulphuric acid*, H_2SO_4. These are considered in the chapter on inorganic acids. There is also known *hyposulphurous acid*, H_2SO_2, the corresponding oxide of which is not known, and *thiosulphuric acid* (frequently known as hyposulphurous acid), $H_2S_2O_3$, and a series of acids, $H_2S_2O_6$, $H_2S_3O_6$, $H_2S_4O_6$, and $H_2S_5O_6$, known as the *thionic series.* Sulphurous acid forms with bases salts which are termed *sulphites.* The salts similarly produced from sulphuric acid are termed *sulphates.* The sulphates are much more important salts. Pharmaceutically and medicinally, they have totally different properties. The official sulphites and sulphates will be considered under their respective bases.

Tests for Sulphites and Sulphurous Acid

1. Solution of barium chloride produces with sulphurous acid or a solution of a sulphite, a white precipitate of barium sulphite, which is soluble in hydrochloric acid.
2. If a solution of a sulphite or sulphurous acid be added to diluted sulphuric acid and zinc, hydrogen sulphide gas is liberated.
3. An acid solution of potassium permanganate is decolorized and deoxidized by sulphurous acid.

Tests for Sulphates and Sulphuric Acid

1. A solution of barium chloride produces a white insoluble precipitate of barium sulphate with sulphuric acid or a soluble sulphate.

2. A soluble salt of lead produces a white insoluble precipitate of lead sulphate with sulphuric acid or a soluble sulphate.

Sulphur and Phosphorus and their Official Preparations

Sulphur Sublimatum.—Made by subliming crude sulphur.
Sulphur Lotum.—Made by washing sublimed sulphur.
Sulphur Præcipitatum.—Made by precipitating a solution of calcium disulphide with HCl.
Sulphuris Iodidum.—Made by heating iodine with washed sulphur.
Unguentum Sulphuris.—Made by mixing 15 parts of washed sulphur with 85 parts of benzoinated lard.

Sulphur or Phosphorus loosely combined

Hydrogen Sulphide.—By acting on ferrous sulphide with diluted sulphuric acid. (See Tests.)
Carbonei Disulphidum.—By passing sulphur vapor over red-hot charcoal.
Phosphorus.—Made by deoxidizing phosphoric acid with carbon.
Pilulæ Phosphori.—Each pill contains $\frac{1}{100}$ of a grain of phosphorus.

Unofficial Compounds and Preparations of Sulphur and Phosphorus

Acidum Hyposulphurosum, H_2SO_2 Hyposulphurous Acid	Add metallic zinc to sulphurous acid contained in a closed vessel and separate the zinc sulphite
Acidum Metaphosphoricum, HPO_3 Metaphosphoric Acid	Evaporate a solution of phosphoric acid until the residue ceases to give off water
Acidum Phosphorosum, H_3PO_3 Phosphorous Acid	Expose phosphorus to moist air under a bell-jar, and collect the heavy white vapor which falls, in a vessel containing water
Acidum Pyrophosphorosum, $H_4P_2O_7$ Pyrophosphorous Acid	Precipitate sodium pyrophosphate with a solution of lead acetate, and decompose the well-washed lead pyrophosphate with hydrogen sulphide
Spiritus Phosphori Spirit of Phosphorus. U. S. P. 1890	Weigh 1.2 Gm. of phosphorus in a tared dish containing water, dry it quickly with the aid of blotting paper, and transfer it at once to a flask containing 1000 Cc. of absolute alcohol. Having connected the flask with an upright condenser, boil the liquid gently on a water-bath until the phosphorus is dissolved, cool, and add enough absolute alcohol to make 1000 Cc. Store in small dark-colored vials
Elixir Phosphori Elixir of Phosphorus. U. S. P. 1890	Add to 210 Cc. of spirit of phosphorus 2 Cc. oil of anise and 550 Cc. of glycerin. Repeatedly invert the bottle until they form a clear liquid, and then add enough aromatic elixir, in portions, gently agitating after each addition to make 1000 Cc. Keep in dark-colored, well-stoppered bottles in a cool place
Oleum Phosphoratum Phosphorated Oil. U. S. P. 1890	Heat 100 Gm. of expressed oil of almond, during 15 minutes, on a sand-bath, to 250° C. (482° F.), cool, filter, add 1 Gm. of phosphorus to 90 Gm. of filtered oil, contained in a stoppered bottle, and heat on a water-bath, with occasional agitation, until the phosphorus is dissolved. Lastly add enough ether to make the product weigh 100 Gm. and store in small glass-stoppered vials
Resina Phosphorata Phosphorated Rosin Phosphoretted Resin	Melt together, by the aid of a sand-bath, in a dry bottle having the nearly exact capacity of the ingredients, rosin free from moisture 96 parts and phosphorus 4 parts. Keep the whole at a temperature of 392° F. until the phosphorus is dissolved, cool, and keep in bottles protected from light

SULPHUR SUBLIMATUM. U.S. Sublimed Sulphur

S = 31.83

[FLOWERS OF SULPHUR]

It should contain not less than 99 percent. of pure Sulphur.

Preparation.—When vapors of sulphur are conducted into a chamber properly cooled, they are condensed in the form of a crystalline powder, which collects on the sides and bottom of the chamber. The yellowish powder is known as sublimed sulphur, or *flowers of sulphur*. *Ground roll sulphur* is sometimes sold as "*flour of sulphur*," it is not equal in quality to the official sublimed sulphur.

Official Description.—A fine yellow powder.
Odor, Taste, and Reaction.—Slight characteristic odor; faintly acid taste; acid reaction when agitated with water.
Solubility.—*Water.* Insoluble.
Alcohol and other solvents. Readily in carbon disulphide; slightly in absolute alcohol; more readily in petroleum benzin, benzene, oil of turpentine, and many other oils; also in ether, chloroform, and in boiling aqueous solutions of alkali hydroxides.
Tests for Identity.—At about 115° C. (239° F.) it fuses to a yellow, mobile fluid, which upon further heating, becomes dark and viscid, until a temperature above 300° C. (572° F.) is reached, when it becomes a thin liquid boiling at 448° C. (838.4° F.). In the air it burns to sulphur dioxide, characterized by its odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. held in the gas.
Quantitative Test.—The amount of residue left after volatilizing or burning a weighed portion of well-dried Sublimed Sulphur should not exceed 0.5 percent.

Uses.—Sublimed sulphur is given internally as a laxative and diaphoretic, in doses of from one to three drachms (4 to 12 Gm.). It is often combined with potassium bitartrate and administered to children mixed with honey or molasses. In diphtheritic croup it is sometimes used to remove the exudation by insufflation; externally, it is used as an ointment in scabies and other skin diseases.

SULPHUR LOTUM. U.S. Washed Sulphur

S = 31.83

Washed sulphur, when dried, should contain not less than 99.5 percent. of pure Sulphur.

	Metric	Old form
* **Sublimed Sulphur**	**100 Gm.**	16 oz. av.
Ammonia Water	**10 Cc.**	1½ fl. oz.
Water, a sufficient quantity		

Pass the Sublimed Sulphur through a No. 30 sieve, mix it thoroughly with 100 Cc. [old form 1 pint] of Water, add the Ammonia Water, and digest for three days, agitating occasionally. Then add 100 Cc. [old form 1 pint] of Water, transfer the mixture to a muslin strainer, and wash the Sulphur with Water until the washings cease to impart a blue color to red litmus paper. Then allow it to drain, press the residue strongly, dry it rapidly at a moderate heat, pass it through a No. 30 sieve, and keep it in well-stoppered bottles.

Sublimed Sulphur is frequently contaminated with small quantities of sulphuric acid and other impurities, and the object of the ammonia in the above process is to neutralize the acid, the ammonium sulphate being subsequently washed out.

Official Description.—A fine yellow powder.
Odor and Taste.—Without odor or taste.
Solubility.—*Water.* Insoluble.
Alcohol and other solvents. Readily in carbon disulphide; slightly in absolute alcohol; more readily in petroleum benzin, benzene, oil of turpentine, and many other oils; also in ether, chloroform, and in boiling aqueous solutions of alkali hydroxides.
Tests for Identity.—At about 115° C. (239° F.) it fuses to a yellow, mobile fluid, which upon further heating becomes dark and viscid, until a temperature above 300° C. (572° F.) is reached, when it becomes a thin liquid boiling at 448° C. (838.4° F.). If air be admitted, it burns to sulphur dioxide, which is identified by its characteristic odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. held in the gas.
Impurities and Tests for Impurities.—*Earthy and metallic impurities.* If 0.5 Gm. of Washed Sulphur be boiled with 10 Cc. of sodium hydroxide T.S., it should be dissolved, leaving no appreciable residue.

Arsenic. If 0.5 Gm. of Washed Sulphur be digested for several hours with 10 Cc. of ammonia water, the liquid filtered, and the clear filtrate evaporated to dryness on a water-bath, then, after adding 1 Cc. of nitric acid and again evaporating, the solution obtained by dissolving the residue in 10 Cc. of hydrochloric acid (8 percent.) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Acid and ammonia. If 5 Cc. of water be agitated with 2 Gm. of Washed Sulphur, the liquid should not change the color of blue or red litmus paper.

Quantitative Test.—The amount of residue left after volatilizing or igniting a weighed portion of dried Washed Sulphur should not exceed 0.2 percent.

Uses.—Washed sulphur is preferred to sublimed sulphur for internal administration ; the small quantity of sulphuric acid present in the latter sometimes produces griping. The dose is from one to three drachms (4 to 12 Gm.). It is used in the preparation of Compound Licorice Powder, Sulphur Iodide, and Sulphur Ointment. (See Pulveres and Unguenta.)

SULPHUR PRÆCIPITATUM. U.S. Precipitated Sulphur

S = 31.83

Precipitated Sulphur, when dried, should contain not less than 99.5 percent. of pure Sulphur.

	Metric	Old form
* **Sublimed Sulphur**	**100 Gm.**	16 oz. av.
Lime	**50 Gm.**	8 oz. av.
Hydrochloric Acid,		
Water, each, a sufficient quantity		

Slake the lime, and mix it uniformly with 500 Cc. [old form 5 pints] of Water. Add the Sublimed Sulphur, previously sifted, and, after thorough mixing, add 1000 Cc. [old form 10 pints] of Water, and boil the mixture in a porcelain or glass vessel during one hour, stirring or agitating very frequently, and replacing the Water lost by evaporation. Then cover the vessel, and permit the contents to cool and become clear by subsidence. Carefully draw off the clear solution, and filter the remainder. To the united liquids add gradually, and with constant stirring, Hydrochloric Acid, previously diluted with an equal volume of Water, until the liquid is nearly neutralized, still retaining, however, an alkaline reaction and a yellow color. Collect the precipitate on a strainer, and wash it, until the washings are tasteless and cease to give a precipitate upon the addition of ammonium oxalate test solution. Then dry the product rapidly, at a moderate heat, and keep it in well-stoppered bottles.

In the above process the lime and sulphur react so as to form calcium disulphide and calcium thiosulphate (hyposulphite) :

$$\underset{\substack{\text{Calcium}\\ \text{Oxide}}}{3CaO} + \underset{\text{Sulphur}}{6S} = \underset{\substack{\text{Calcium}\\ \text{Disulphide}}}{2CaS_2} + \underset{\substack{\text{Calcium}\\ \text{Thiosulphate}}}{CaS_2O_3}$$

On the addition of hydrochloric acid, the sulphur is precipitated :

$$\underset{\substack{\text{Calcium}\\ \text{Disulphide}}}{2CaS_2} + \underset{\substack{\text{Calcium}\\ \text{Thiosulphate}}}{CaS_2O_3} + \underset{\substack{\text{Hydrochloric}\\ \text{Acid}}}{6HCl} = \underset{\substack{\text{Calcium}\\ \text{Chloride}}}{3CaCl_2} + \underset{\text{Sulphur}}{6S} + \underset{\text{Water}}{3H_2O}$$

In some processes sulphuric acid is used instead of hydrochloric acid, and calcium sulphate is precipitated with the sulphur. This furnishes an inferior product, and is called *lac sulphuris,* or *milk of sulphur.*

Official Description.—A fine, amorphous powder, of a pale yellow color.

Odor and Taste.—Without odor or taste.

Solubility.—*Water.* Insoluble.

Alcohol. Very slightly in absolute alcohol.

Other solvents. Readily in carbon disulphide, petroleum benzin, benzene, oil of turpentine, and many other oils; also in ether, chloroform, and in boiling aqueous solutions of alkali hydroxides.

Tests for Identity.—At 115° C. (239° F.) Precipitated Sulphur melts, and at a higher temperature it volatilizes, or if air be admitted, burns to sulphur dioxide.

If 1 Gm. of Precipitated Sulphur be ignited, it should not leave a weighable residue.

Impurities and Tests for Impurities.—*Arsenic.* If 1 Gm. of Precipitated Sulphur be digested for several hours with 10 Cc. of Ammonia water and the liquid filtered, one-half of the clear filtrate should not leave a residue on evaporation; if the remainder be evaporated to dryness on a water-bath, then, after adding 1 Cc. of nitric acid and again evaporating, the solution obtained by dissolving the residue in 10 Cc. of hydrochloric acid (8 percent.) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Acid and alkali. If 5 Cc. of water be agitated with 2 Gm. of Precipitated Sulphur, the liquid should not change the color of blue or red litmus paper.

Uses.—Precipitated sulphur is much to be preferred to the other forms in liquid mixtures, as the particles are lighter and more easily suspended; the ointments made with it are smoother than those made with sublimed sulphur. The dose is from one to three drachms (4 to 12 Gm.).

SULPHURIS IODIDUM. U.S. Sulphur Iodide

	Metric	Old form
***Washed Sulphur**	**20 Gm.**	60 grains
Iodine	**80 Gm.**	240 grains

Mix the Sulphur and Iodine thoroughly by trituration; introduce the mixture into a flask, close the orifice loosely, and by means of a water-bath, gradually and with occasional agitation apply a heat not exceeding 60° C. (140°F.), until the ingredients combine and become of a uniformly dark color throughout. Then increase the heat to the boiling point of water, so as to fuse the mass. Should any Iodine have sublimed and condensed on the glass, incline the flask so as to combine the Iodine with the fused mass, and then pour the latter upon a porcelain plate or other suitable cold surface. When it is cold, break the product into pieces of suitable size, and keep them in a glass-stoppered bottle, in a cool place.

This compound represents one of the instances of the direct chemical union of two elements, heat being the only agent used to effect the combination; it is sometimes called *subiodide of sulphur*, or *iodine disulphide*, S_2I_2. There are some doubts, however, as to its being a definite chemical compound.

Official Description.—Brittle masses of a crystalline fracture having a grayish-black, metallic lustre.

Odor and Taste.—Odor of iodine; somewhat acrid taste.

Solubility.—Almost insoluble in water; soluble in about 60 parts of glycerin; very soluble in carbon disulphide. Alcohol, ether, and a solution of potassium iodide dissolve the iodine, leaving the sulphur. Continued boiling with water vaporizes all of the iodine, leaving about 20 percent. of sulphur as residue.

Tests for Identity.—On exposing Sulphur Iodide to the air, it gradually loses iodine. On heating it, some iodine sublimes at first; at a somewhat higher temperature a sublimate is formed, containing both iodine and sulphur; at a still higher temperature, the whole is volatilized, leaving only a trace of residue.

Quantitative Test.—If 0.5 Gm. of finely pulverized Sulphur Iodide, together with 1 Gm. of potassium iodide, be dissolved in 20 Cc. of water (the sulphur separating), not less than 28 Cc. of tenth-normal sodium thiosulphate V.S. should be required for complete decolorization of the mixture, using starch T.S. as indicator.

Uses.—Sulphur iodide is principally used externally in skin diseases in the form of an ointment.

CARBONEI DISULPHIDUM. U.S. Carbon Disulphide

$CS_2 = 75.57$

[CARBON BISULPHIDE]

Carbon Disulphide should be kept in partially filled, well-stoppered bottles, or in tin cans, in a cool place, remote from lights or fire.

This sulphide is prepared by the direct combination of carbon and sulphur at a moderate red heat. To effect this, charcoal is heated to redness in a vertical cylinder, while sulphur is admitted through a lateral tubulure near the bottom. As the sulphur melts and vaporizes, it combines with the carbon, and the carbon disulphide formed distils over through a series of condensing tubes, which, while they serve to collect the crude carbon disulphide, allow of the escape of the hydrogen sulphide formed at the same time.

It is purified by agitation with mercury and distillation in contact with white wax. It can by repeated rectification be entirely freed from its usual disgusting odor.

Official Description.—A clear, colorless, highly refractive liquid, very diffusive.
Odor and Taste.—Strong, characteristic but not fetid odor; sharp, aromatic taste.
Specific Gravity.—1.256 to 1.257 at 25° C. (77° F.).
Solubility.—*Water.* In 526 parts of water at 25° C. (77° F.).
Alcohol. Very soluble.
Other solvents. Very soluble in ether, chloroform, fixed and volatile oils.
Tests for Identity.—Carbon Disulphide vaporizes rapidly at the ordinary temperature, is highly inflammable, boils at 46° to 47° C. (114.8° to 116.6° F.), and when ignited, burns with a bluish-white flame, producing carbon dioxide and sulphur dioxide.
Impurities and Tests for Impurities.—*Sulphur dioxide.* It should not affect the color of blue litmus paper moistened with water.
Dissolved sulphur. A portion evaporated spontaneously in a glass vessel should leave no residue.
Hydrogen sulphide. Lead acetate T.S. agitated with it should not be blackened.

Uses.—Carbon disulphide is used principally as a solvent. It is the best solvent for rubber and similar bodies. It is poisonous when taken internally, and the continuous inhalation of its vapor is very injurious.

PHOSPHORUS. U.S. Phosphorus

$P = 30.77$

It should contain not less than 99.5 percent. of pure Phosphorus, and be carefully kept under water, in strong, well-closed vessels, in a secure and moderately cool place, protected from light.

Preparation.—Phosphorus is a non-metallic element prepared by heating acid calcium phosphate with charcoal. The acid calcium phosphate is obtained by treating calcium phosphate with sulphuric acid, calcium sulphate also being formed; the latter is afterwards separated.

$$\underset{\substack{\text{Calcium}\\\text{Phosphate}}}{Ca_3(PO_4)_2} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{2H_2SO_4} = \underset{\substack{\text{Acid Calcium}\\\text{Phosphate}}}{CaH_4(PO_4)_2} + \underset{\substack{\text{Calcium}\\\text{Sulphate}}}{2CaSO_4}$$

Of the allotropic forms of phosphorus, *red phosphorus*, or *amorphous phosphorus*, is the most important. It is obtained by allowing phosphorus to remain for several days in an atmosphere of carbon dioxide at a temperature varying from 215° C. (419° F.) to 250° C. (482° F.)

Red phosphorus is not luminous and not poisonous until it is heated to 280° C. (536° F.), when it is converted into ordinary phosphorus.

Phosphorus forms with oxygen two oxides,—*phosphorous*, P_2O_3, or *phosphorous trioxide*, and *phosphoric*, P_2O_5, or *phosphorous pentoxide*. Corresponding to the last of these are three acids, known as *orthophosphoric* (tribasic phosphoric), H_3PO_4, *pyrophosphoric*, $H_4P_2O_7$, and *metaphosphoric*, HPO_3. Orthophosphoric acid is formed by dissolving P_2O_5 in boiling water, or by the action of nitric acid upon phosphorus itself; pyrophosphoric acid, by the heating of the tribasic phosphoric acid to 213° C. (415.4° F.); and metaphosphoric acid, by the ignition of the tribasic variety, or by dissolving P_2O_5 in cold water. *Phosphorous acid*, H_3PO_3, cannot be formed directly from phosphorous trioxide. This is a dibasic acid, containing one hydrogen atom not replaceable by metal. *Hypophosphorous acid*, H_3PO_2, is not capable of being derived directly from hypophosphorous oxide. It is monobasic, containing two hydrogen atoms not replaceable by metal.

Tests for Phosphates and Phosphoric Acids

1. Solution of silver nitrate produces a yellow precipitate with a neutral solution of an orthophosphate, soluble both in nitric acid and in ammonia water. It produces a white precipitate with pyrophosphoric acid or metaphosphoric acid.
2. If albumin be added to metaphosphoric acid, or to a solution of a metaphosphate containing acetic acid, a white precipitate is produced. No precipitate occurs if it be added to pyrophosphoric acid or orthophosphoric acid.
3. Official test solution of magnesium (magnesia mixture, see Tests) produces with phosphoric acid or a solution of a phosphate a precipitate of ammonio-magnesium phosphate.
4. If solution of ammonium molybdate in diluted nitric acid be added in excess to phosphoric acid or to a solution of a phosphate in nitric acid, and heat applied, a yellow precipitate of ammonium phosphomolybdate will be produced.
5. If a solution of barium chloride be added to a neutral solution of a phosphate, a white precipitate of barium phosphate is produced, which is soluble in acids.

Tests for Hypophosphites

1. When heated, they evolve spontaneously inflammable hydrogen phosphide.
2. An acid solution of potassium permanganate is decolorized.
3. From solution of mercuric chloride, mercury is precipitated upon the addition of a solution of a hypophosphite.

Official Description.—Phosphorus is a translucent, nearly colorless solid, of a waxy lustre, having, at ordinary temperatures, about the consistence of beeswax. By long keeping the surface becomes white or red, and occasionally black. When exposed to the air, it emits white fumes, which are luminous in the dark, and have an odor somewhat resembling that of garlic; on longer exposure to air, it often takes fire spontaneously.

Odor, Taste, and Reaction.—Distinctive and disagreeable odor and taste (*but should not be tasted, except in very diluted solution*).

Specific Gravity.—1.830 at 10° C. (50° F.), and 1.820 at 25° C. (77° F.).

Solubility.—*Water.* Insoluble, or nearly so, imparting, however, its characteristic, disagreeable odor and taste.

Alcohol. In 350 parts of absolute alcohol at 15° C. (59° F.); in 240 parts of boiling absolute alcohol.

Other solvents. In 80 parts of absolute ether, in about 50 parts of any fatty oil, and in about 25 parts of chloroform; very soluble in carbon disulphide, yielding a solution which must be handled with the greatest care to prevent evaporation, which would be followed by instant ignition.

Test for Identity.—Melting point, 44° C. (111.2° F.).

Impurities and Tests for Impurities.—To test for *arsenic* and *sulphur* proceed as follows:

Arsenic. Add 1 Gm. of Phosphorus to 10 Cc. of nitric acid diluted with 10 Cc. of distilled water, in a flask having a capacity of 50 Cc., and digest the mixture at a gentle heat on a water-bath while passing a current of carbonic acid gas into the flask over the surface of the liquid until the Phosphorus is dissolved. Transfer the solution to a dish, and evaporate it until no more nitrous vapors are given off, and then dilute the solution to 100 Cc. with distilled water. One Cc. of this solution should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of sulphur. On adding barium chloride T.S. to the remainder of the liquid, not more than a slight opalescence should be produced.

Uses.—Phosphorus is administered internally, in doses of one one-hundredth of a grain (0.0006 Gm.), as a nervous stimulant. Its value in this connection depends upon its being administered in a free state. The oxide of phosphorus, phosphoric acid, does not have the same action; hence all pharmaceutical preparations of phosphorus must be protected from oxidation. (See Pilulæ Phosphori). In large doses Phosphorus is poisonous.

CHAPTER XXXVI

CARBON, BORON, AND SILICON

C; 11.91. B; 10.9. Si; 28.2

THESE three elements present some analogies, and, although the number of pharmaceutical preparations made from them is not great, they are of considerable interest.

Official Preparations and Compounds of Carbon, Boron, and Silicon

Carbo Animalis.—Prepared by burning bones out of contact with air.
Carbo Animalis Purificatus.—Made by purifying animal charcoal with HCl.
Carbo Ligni.—Made by burning wood out of contact with air.
Carbonei Disulphidum.—See preparations of sulphur.
Acidum Boricum.—Made by purifying the natural product.
Sodii Boras.—See preparations of soda.
Kaolinum.—Native aluminum silicate.
Talcum.—Native hydrous magnesium silicate.
Talcum Purificatum.—Purified native hydrous magnesium silicate.

Carbon C; 11.91

Carbon is a very widely diffused element. It is a constituent of all organic substances, and is found in nature in the form of the diamond, graphite, plumbago, coal, etc.

Two compounds with oxygen are known,—carbon dioxide, CO_2, and carbon monoxide, CO.

Carbon dioxide, CO_2, is a colorless, odorless gas, with a slightly acid taste, heavier than ordinary air. It is not combustible, and not a supporter of combustion; indeed, it is used extensively as a means of putting out flames, and is generated for that purpose in fire extinguishers and other contrivances of the same character. Some pharmacists have in their cellars a series of pipes fastened to the ceiling with several outlets; a flexible pipe is connected with a soda water tank or cylinder, and thus one may always have a complete fire extinguisher in the cellar; nothing more is necessary to put out a small fire than to turn on the stopcock and close all doors and windows. Water is capable of absorbing its own volume of carbon dioxide, but many times its volume under pressure. This solution was formerly official, under the name of *Aqua Acidi Carbonici*, or carbonic acid water, the well-known "*soda water.*"

Carbonic acid, H_2CO_3, is produced when carbon dioxide is brought into contact with water.

$$\underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Carbonic}\\\text{Acid}}}{H_2CO_3}$$

The salts known as carbonates are widely diffused in nature, and many chemical processes are based upon the decomposition of carbonates by strong acids. Carbonic acid, although present everywhere, is one of the weakest acids known.

Carbon monoxide, CO, is of little interest in pharmacy.

The compounds of carbon and hydrogen are very numerous, and of great importance. They are mostly obtained from organic substances, and will be considered under Part IV. With nitrogen, carbon forms cyanogen, the compound radical of hydrocyanic or prussic acid.

Tests for Carbonates

1. If decomposed by the addition of a strong acid, and the gas passed through lime water, insoluble calcium carbonate is formed.
2. The solutions of many of the salts of the metals, like iron, copper, lead, etc., are precipitated by the soluble carbonates.

CARBO ANIMALIS. U.S. Animal Charcoal

Charcoal prepared from bone.

Preparation.—Animal charcoal is made by subjecting bones to a red heat in close vessels.

Bone consists of animal matter with calcium phosphate and carbonate. In consequence of the decomposition of the animal matter involved by the destructive distillation, the nitrogen and hydrogen, united as ammonia, distil over, while the greater part of the carbon is left in the cylinder, intermingled with the calcium salts.

The charcoal is termed *bone-black* or *ivory-black*, and in manufacturing it the bones are boiled in water, to separate the fat, before being subjected to destructive distillation in the iron cylinders. These are connected with vessels which receive the ammoniacal liquor, called *bone-spirit*, together with a dark tarry liquid (*bone-oil*).

Official Description.—Dull black, granular fragments, or a dull black powder.

Odor and Taste.—Odorless, nearly tasteless.

Solubility.—*Water.* Insoluble.
Alcohol. Insoluble.

Tests for Identity and Quality.—When ignited, it leaves a grayish or yellowish-white ash, amounting to about 85 percent. of the original weight of the portion taken, which should have been previously dried at 120° to 125° C. (248° to 257° F.) to a constant weight.

The ash should be soluble in hydrochloric acid with the aid of heat, leaving not more than a trifling residue.

If 1 Gm. of Animal Charcoal be boiled for several minutes with a mixture of 3 Cc. of potassium hydroxide T.S. and 5 Cc. of water, the filtrate should be colorless or nearly so (evidence of *complete carbonization*).

Uses.—Animal charcoal is used to deprive substances of color (see Decoloration, page 219).

CARBO ANIMALIS PURIFICATUS. U.S. Purified Animal Charcoal

	Metric	Old form
* **Animal Charcoal,** in No. 60 powder	100 Gm.	16 oz. av.
Hydrochloric Acid	300 Gm.	40 fl. oz.
Boiling Water, a sufficient quantity		

Introduce the Animal Charcoal into a capacious vessel, add 200 Gm. [old form 26 fl. oz.] of Hydrochloric Acid, and 400 Cc. [old form 4 pints] of Boiling Water. By means of a sand-bath keep the mixture gently boiling during eight hours, adding water occasionally to maintain the original volume. Then add 500 Cc. [old form 5 pints] of Boiling Water, transfer the mixture to a muslin strainer, and, when the liquid has run off, return the Charcoal to the vessel. Add to it

100 Gm. [old form 14 fl. oz.] of Hydrochloric Acid and 200 Cc. [old form 26 fl. oz.] of Boiling Water, boil for two hours, again add 500 Cc. [old form 5 pints] of Boiling Water, transfer the whole to a plain filter, and when the liquid has passed through, wash the residue with Boiling Water until the washings produce only a faint cloudiness with silver nitrate T.S. Dry the powder in a drying oven, and immediately transfer it to well-stoppered vials.

Official Description.—A dull black powder.
Odor and Taste.—Odorless; tasteless.
Solubility.—*Water.* Insoluble.
Alcohol. Insoluble.
Other solvents. Insoluble.

Tests for Quality and Impurities.—*Limit of silicates and other fixed inorganic matter.* If 2 Gm. of the powder be ignited at a red heat with free access of air in a broad, shallow porcelain or platinum dish, it should not leave a residue weighing more than 0.08 Gm., or 4 percent. of the original weight.

If 1 Gm. of the powder be boiled with a mixture of 3 Cc. of potassium hydroxide T.S. and 5 Cc. of water during three minutes, the filtrate should be colorless (evidence of *complete carbonization*).

Uses.—Its uses are the same as those for animal charcoal; the object of purifying animal charcoal by treatment with hydrochloric acid is to separate the calcium phosphate and carbonate which are invariably present in the crude bone-black. In some decolorizing operations these impurities are harmless, but in many delicate chemical processes they may be dissolved or decomposed, and thus seriously contaminate the products which the charcoal is intended to purify.

CARBO LIGNI. U.S. Charcoal

Charcoal prepared from soft wood, and very finely powdered.

Preparation.—It is made by burning wood out of contact with air, either in iron cylinders or in stacks. In the former case, the volatile substances resulting from the destructive distillation are collected by condensation, and contribute valuable products to pharmacy (see Acidum Aceticum). In the latter, the charcoal is made in the neighborhood of a cheap wood supply. Billets of wood are piled in a conical form, and covered with earth and sod to prevent the free access of air, several holes being left at the bottom and one at the top of the pile in order to produce a draught to commence the combustion. The wood is kindled from the bottom, and soon after ignition the hole at the top is closed, and when the wood is all ignited the holes at the bottom are stopped. The result is that the volatile portions of the wood, hydrogen, oxygen, water, etc., are dissipated, carbon being left.

Official Description.—A black powder, free from gritty matter.
Odor and Taste.—Odorless; tasteless.
Test for Identity.—If 1 Gm. of Charcoal be boiled with a mixture of 3 Cc. of potassium hydroxide T.S. and 5 Cc. of water for several minutes, the filtrate should be colorless or nearly so (evidence of *complete carbonization*).

Uses.—Charcoal is used in medicine as an absorbent and disinfectant. It is given in the form of powder, in doses of one to two drachms (4 to 8 Gm.). Owing to its absorbent powers, it should never be kept exposed to the air, as it will become unfit for use if subjected to the atmosphere of a laboratory or pharmacy. Tin cans with tightly fitting covers are appropriate containers.

Boron B; 10.9

Boron, like carbon, exists in three allotropic conditions,—amorphous, crystallized, and graphitoidal. Boron combines with hydrogen and oxygen, and boric (or boracic) acid is produced, H_3BO_3, the principal salt of which is sodium borate, or borax.

Tests for Borates and Boric Acid

1. A colorless flame is tinged green by an alcoholic solution of boric acid.

2. A solution of a borate, slightly acidified by hydrochloric acid, turns the yellow color of turmeric paper brown, if the paper is allowed to dry.

Official Compounds and Preparations of Boron

Acidum Boricum Boric Acid	Found native, and made by decomposing sodium borate with HCl
Unguentum Acidi Borici Ointment of Boric Acid	Ten percent. of Boric Acid with petrolatum and paraffin
Glyceritum Boroglycerini Glycerite of Boroglycerin	A solution of boric acid in glycerin used as a preservative
Sodii Boras Sodium Borate Borax	Made by purifying native borax or from boric acid by treating a solution with sodium carbonate and crystallizing
Liquor Antisepticus Antiseptic Solution	An aqueous solution of boric acid containing volatile oils, benzoic acid, thymol and alcohol

Unofficial Compounds of Boron

Acidum Metaboricum, HBO_2 Metaboric Acid	By heating boric acid to 38° C. (100° F.)
Acidum Pyroboricum, $H_2B_4O_7$ Pyroboric Acid	By heating boric acid for a long time to 60° C. (140° F.)
Boron Trisulphidum, B_2S_3 Boron Trisulphide	By heating boron in the vapor of sulphur and collecting the resulting white mass

ACIDUM BORICUM. U.S. Boric Acid

$H_3BO_3 = 61.54$

[BORACIC ACID]

It should contain not less than 99.8 percent. of pure Boric Acid $[B(OH)_3]$.

Preparation.—The lagoons of the volcanic districts of Tuscany formerly furnished the greater part of the boric acid and borax of commerce. Borax is now found native in California and some of the other Western States, and boric acid is produced by decomposing borax with hydrochloric acid.

$$\underset{\text{Sodium Borate}}{Na_2B_4O_7.10H_2O} + \underset{\text{Hydrochloric Acid}}{2HCl} = \underset{\text{Sodium Chloride}}{2NaCl} + \underset{\text{Boric Acid}}{4H_3BO_3} + \underset{\text{Water}}{5H_2O}$$

Boric Acid is required in very fine powder for most medical uses.

Official Description.—Transparent, colorless scales, of a somewhat pearly lustre, or six-sided, triclinic crystals, or a light, white, very fine powder, slightly unctuous to the touch; permanent in the air.

Odor, Taste, and Reaction.—Odorless; faintly bitter taste; acid reaction.

Solubility.—*Water.* In 18 parts at 25° C. (77° F.); in 3 parts of boiling water. The addition of hydrochloric acid decreases its solubility.

Alcohol. In 15.3 parts at 25° C. (77° F.); in 4.3 parts of boiling alcohol.

Other solvents. In 4.6 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—When heated to 100° C. (212° F.), Boric Acid loses water, forming metaboric acid (HBO_2), which slowly volatilizes at that temperature.

Heated to 160° C. (320° F.), it fuses to a glassy mass of tetraboric (or pyroboric) acid ($H_2B_4O_7$); at a higher temperature the fused mass swells up, loses all of its water, and becomes boron trioxide (B_2O_3), which fuses into a transparent, hygroscopic, non-volatile mass.

Boric Acid readily volatilizes from a boiling aqueous solution.

Its solution in alcohol or glycerin, when ignited, burns with a flame enveloped with a green-colored mantle.

An aqueous solution of Boric Acid (1 in 50) colors blue litmus paper red, and yellow turmeric paper brownish-red after drying, even when the solution has been acidulated with hydrochloric acid; this brownish-red color is changed to bluish-black by ammonia water.

If 1 Gm. of Boric Acid be added to 10 Cc. of boiling alcohol in a test-tube, complete solution should result.

Impurities and Tests for Impurities.—*Limit of sulphates.* The aqueous solution of the Acid (1 in 20) should not at once become more than slightly cloudy after the addition of barium chloride T.S.; nor

Limit of chlorides. Immediately more than opalescent by the addition of silver nitrate T.S. with nitric acid;

Absence of calcium. It should not be precipitated by ammonium oxalate T.S.

Magnesium. Sodium phosphate T.S. and ammonia water, or

Heavy metals. Respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of the saturated aqueous solution should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of iron. In a solution of 1 Gm. of Boric Acid in a mixture of 1 Cc. of hydrochloric acid and 49 Cc. of water, 0.5 Cc. of potassium ferrocyanide T.S. should not at once produce a blue color.

Quantitative Test.—One Gm. of Boric Acid, when dissolved in 50 Cc. of distilled water, after the addition of 50 Cc. of glycerin, should require not less than 16.2 Cc. of normal sodium hydroxide V.S., for neutralization (corresponding to at least 99.8 percent. of Boric Acid), phenolphthalein T.S. being used as indicator.

Uses.—Boric acid is used in antiseptic surgery, and externally in the form of an ointment. It is added in small quantities to various liquids, to prevent fermentation. It is well adapted for such uses, as it communicates but little taste. It has not been proved to be innocuous, however, and therefore should be sparingly used. (See Boroglycerinum, Part VI. ; also Glyceritum Boroglycerini, page 307, and Unguentum Acidi Borici, Part V.)

LIQUOR ANTISEPTICUS. U.S. Antiseptic Solution

	Metric	Old form
***Boric Acid**	20.00 Gm.	300 grains
Benzoic Acid	1.00 Gm.	15 grains
Thymol	1.00 Gm.	15 grains
Eucalyptol	0.25 Cc.	4 minims
Oil of Peppermint	0.50 Cc.	8 minims
Oil of Gaultheria	0.25 Cc.	4 minims
Oil of Thyme	0.10 Cc.	1½ minims
Alcohol	250.00 Cc.	8 fl. oz.
Purified Talc	20.00 Gm.	300 grains
Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Dissolve the Boric Acid in 700 Cc. [old form 22½ fl. oz.] of Water, and the Benzoic Acid in 150 Cc. [old form 5 fl. oz.] of Alcohol, and pour the aqueous solution into the alcoholic solution. Then dissolve, in a mortar, the Thymol in the Eucalyptol and Oils of Peppermint, Gaultheria, and Thyme; thoroughly incorporate the Purified Talc, and add, with constant trituration, the solution first prepared. Allow the mixture to stand, with occasional agitation, during forty-eight hours, filter, add 100 Cc. [old form 3 fl. oz.] of Alcohol to the clear filtrate, and a sufficient quantity of Water to make the finished product measure 1000 Cc. [old form 2 pints].

Uses.—This solution was introduced into the U. S. P. (8th Rev.) to furnish to physicians a formula for an antiseptic solution which experience has shown to be useful and which will obviate the difficulty of the present lack of uniformity in the solutions now in use. It is sometimes given internally in the dose of one fluidrachm (4 Cc.).

Silicon Si; 28.2

Very few of the compounds of the non-metallic element silicon are used medicinally. Silicon, like carbon and boron, is obtained in three allotropic states,—amorphous, crystalline, and graphitoidal. In some of its combinations, notably in glass, earthenware, china, mortar, and cements of various kinds, it is of vast importance commercially. Silicon is found in nature combined with aluminum, magnesium, or calcium, in *pumice stone*, *meerschaum*, *asbestos*, *talcum*, *soapstone*, etc.; or as an anhydride (silica), in *sand*, *flint*, *agate*, *quartz*, etc.

Silica, SiO_2, may be obtained in a pure condition by treating a solution of sodium silicate with hydrochloric acid.

$$\underset{\substack{\text{Sodium}\\\text{Silicate}}}{Na_2SiO_3} + \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{2HCl} = \underset{\text{Silica}}{SiO_2} + \underset{\substack{\text{Sodium}\\\text{Chloride}}}{2NaCl} + \underset{\text{Water}}{H_2O}$$

Test for Silicates

Silicates are insoluble in most reagents. If the soluble sodium and potassium silicates, in aqueous solution, be neutralized with hydrochloric acid, and ammonia water be added in excess, a gelatinous precipitate of silicic hydroxide will separate.

Official Compounds of Silicon

Kaolinum, Kaolin. Aluminum Silicate, $H_2Al_2Si_2O_8 + H_2O$	Used in making cataplasm of kaolin
Talcum, Talc. Magnesium Silicate, Mg_2SiO_3	Used when powdered as an absorbent
Talcum Purificatum. Purified Talc	Used in making medicated waters

Unofficial Compounds of Silicon

Silicon Dioxide, SiO_2, Silica	
Quartz (crystalline) in form of:	Amethyst, a gem Smoky quartz, a gem Rose quartz, a gem Granite, building stone Gneiss, building stone Syenite, building stone Sand, used in the manufacture of pottery, glass, and for many other purposes Pumice stone, volcanic rock Obsidian, volcanic glass Agate, mortars for chemists' use Kieselguhr (diatomaceous earth) used in the making of dynamite as an absorbent
Glass	Green Glass made from sand, soda ash, sodium nitrate, lime Blue Glass made from sand, soda ash, sodium nitrate, lime, antimony, manganese, and cobalt Flint Glass made from sand, soda ash, sodium nitrate, lime, antimony, and manganese Opal Glass made from sand, soda ash, sodium nitrate, zinc, fluorspar, cryolite, China clay, antimony, and manganese Amber Glass made from sand, soda ash, lime, salt, and carbon Lead Glass made from sand, soda ash, potash, sodium nitrate, lead, antimony, and manganese

Unofficial Compounds of Silicon—*Continued*

Meerschaum. Magnesium Silicate, Mg_2SiO_8	Used in making tobacco-pipes
Asbestos. Magnesium Silicate	Used for resisting action of fire, or heat
Sodium Silicate Liquor Sodii Silicatis Solution of Sodium Silicate. U. S. P. 1890	Made by fusing one part of fine sand and two parts of dried sodium carbonate, mixed in powder, in an earthenware crucible, pouring out the fused mass on a stone slab to cool, powdering, dissolving the soluble matter in boiling water, filtering and concentrating so as to contain about 30 percent. of sodium silicate

KAOLINUM. U. S. Kaolin

A native aluminum silicate, consisting chiefly of the pure silicate [$H_2Al_2Si_2O_8 + H_2O = 257.12$], powdered and freed from gritty particles by elutriation.

Kaolin is an official substance introduced for the first time in the U. S. P. (8th Rev.). The name is derived from the Chinese word "kaoling," meaning "high ridge," the name of a hill in China; it is sometimes called *China clay*, or *porcelain clay*, and is a valuable commercial product. Besides aluminum silicate, it often contains small quantities of aluminum hydroxide, ferric oxide, magnesium oxide, and calcium carbonate. For pharmaceutical purposes it should be purified by treatment with hydrochloric acid if calcium carbonate be present, and afterwards with diluted sulphuric acid to remove the other impurities; the kaolin should be thoroughly washed with water to remove the chlorides and sulphates.

Official Description.—A soft, white or yellowish-white powder, or in lumps.

Taste and Reaction.—Earthy or clay-like taste. When moistened with water, Kaolin assumes a darker color and develops a marked clay-like odor.

Solubility.—*Water.* Insoluble.

Other solvents. Insoluble in cold dilute solutions of the acids and alkali hydroxides.

Tests for Identity.—If 1 Gm. of Kaolin be mixed with 10 Cc. of water and 5 Cc. of sulphuric acid in a porcelain dish, no effervescence should occur, and if the mixture be evaporated until the excess of water has been removed, and further heated until dense white fumes of sulphuric acid anhydride appear, then after cooling and adding 20 Cc. of water, boiling for a few minutes and filtering, there should remain on the filter a gray insoluble residue of *impure silica*.

If to one-half of the filtrate ammonia water be added, a gelatinous precipitate of *aluminum hydroxide*, insoluble in excess, should be obtained.

If to the remaining half of the filtrate, sodium hydroxide T.S. be added, it should yield a gelatinous precipitate which is almost or completely soluble in an excess of the reagent.

Impurities and Tests for Impurities.—*More than traces of iron.* If 2 Gm. of Kaolin be rubbed in a mortar with 10 Cc. of water, the mixture should not acquire more than a slight reddish tint on the addition of 0.5 Gm. of sodium salicylate.

If Kaolin be ignited at a red heat, it should leave not less than 85 percent. of non-volatile residue.

Uses.—Kaolin forms the solid basis for the cataplasm of kaolin (Cataplasma Kaolini), and when purified it may be used as an absorbent in making medicated waters.

CATAPLASMA KAOLINI. U. S. Cataplasm of Kaolin

	Metric	Old form
* **Kaolin**, in very fine powder	577.0 Gm.	9 oz. av. 100 gr.
Boric Acid, in very fine powder	45.0 Gm.	315 grains
Thymol	0.5 Gm.	4 grains
Methyl Salicylate	2.0 Gm.	14 grains
Oil of Peppermint	0.5 Gm.	4 grains
Glycerin	375.0 Gm.	6 oz. av.
To make about	1000 Gm.	16 oz. av.

Heat the Kaolin in a suitable vessel at 100° C. (212° F.), with occasional stirring, for one hour; mix it intimately with the Boric Acid, and then incorporate the mixture thoroughly with the Glycerin; finally add the Thymol, which has been dissolved in the Methyl Salicylate and the Oil of Peppermint, and make a homogeneous mass. It should be kept in an air-tight container.

Uses.—The large demand for an external application containing glycerin led to the introduction of this cataplasm in the U. S. P. (8th Rev.); it is used to allay inflammation in the treatment of pneumonia, boils, carbuncles, etc., and in dermatological practice.

TALCUM. U. S. Talc

A native hydrous magnesium silicate.

Talc, also called *French Chalk*, or *Soapstone*, is found in America and other parts of the world; an excellent quality is now obtained from North Carolina.

Official Description.—A white or grayish-white powder or grayish-green irregular masses of waxy lustre; when rubbed upon the skin it imparts a feeling like greasiness; permanent in the air.

Odor and Taste.—Inodorous and tasteless.

Specific Gravity.—2.2 to 2.8.

Solubility.—*Water.* Insoluble.

Other solvents. Insoluble in dilute solutions of the acids and alkali hydroxides.

Tests for Identity.—Mix 0.5 Gm. of Talc with about 2 Gm. each of anhydrous sodium and potassium carbonates, heat the mixture in a platinum crucible until fusion is complete, and treat the resulting fused mass with hot water; then neutralize the liquid with diluted sulphuric acid, and, after adding an additional 10 Cc. of the latter, evaporate the mixture until the white fumes of sulphuric anhydride are evolved, then add 20 Cc. of water, and, after boiling the mixture and filtering, an insoluble residue of *silica* should be left. If to the filtrate ammonia water and ammonium chloride T.S. be added, a white, gelatinous precipitate of *aluminum hydroxide* may be formed, while the filtrate from this, upon the addition of sodium phosphate T.S., should yield a white, crystalline precipitate (*magnesium salts*).

Impurities and Tests for Impurities.—If 1 Gm. of Talc be boiled with 25 Cc. of diluted hydrochloric acid for one-half hour, adding water from time to time to maintain approximately the original volume, and the liquid filtered, then the filtrate should yield, upon evaporating to dryness, igniting, and quickly weighing, not more than 0.05 Gm. of residue.

Uses.—Powdered talc when purified (Talcum Purificatum) is used pharmaceutically as an absorbent in making medicated water. It is used extensively when perfumed or medicated as a toilet powder under the name of *Talcum Powder*.

TALCUM PURIFICATUM. U.S. Purified Talc

	Metric	Old form
* **Talc**, in fine powder	**500 Gm.**	16 oz. av.
Hydrochloric Acid	**75 Cc.**	2½ fl. oz.
Water, a sufficient quantity		

Mix the powdered Talc with 2500 Cc. [old form 5 pints] of boiling Water, gradually add 50 Cc. [old form 1½ fl. oz.] of the Hydrochloric Acid, and boil the mixture during fifteen minutes, then allow it to stand for fifteen minutes. Decant, and reject the supernatant liquid containing the finer particles of Talc in suspension, and again boil the residue with 2500 Cc. [old form 5 pints] of Water, mixed with the remainder of the Hydrochloric Acid, and allow it to stand for fifteen minutes. Again decant, and reject the finer suspended particles, and wash the coarser residue with Water by repeated decantation, until a portion of the wash-water, after filtering and acidifying with nitric acid, fails to become opalescent upon the addition of silver nitrate test solution. Then transfer the magma to a close linen or muslin strainer, allow it to drain, and dry it at 110° C. (230° F.).

Talc, as found in commerce, contains the impurities usually associated with native mineral substances. When treated with hydrochloric acid and water, as in this official process, aluminum, iron, and magnesium salts are removed.

Impurities and Tests for Impurities.—Purified Talc, when subjected to ignition at red heat, should lose not more than 5 percent. of its weight.

Limit of soluble substances. If 10 Gm. of Purified Talc be boiled with 50 Cc. of distilled water for one-half hour, adding water from time to time to maintain approximately the original volume, it should yield a filtrate which is neutral to litmus paper, and one-half of this filtrate, when evaporated and dried at 110° C. (230° F.), should yield not more than 0.005 Gm. of residue.

Iron. The remaining half of the filtrate, after slightly acidulating with hydrochloric acid, should not yield a blue color upon the addition of potassium ferrocyanide T.S.

Uses.—Purified Talc is used in making medicated waters (see Aquæ, page 272, and Talcum, page 508).

CHAPTER XXXVII

THE ALKALIES AND THEIR COMPOUNDS

Potassium, Sodium, Lithium, and Ammonium

K; 38.86. Na; 22.88. Li; 6.98. NH_4; 17.93

THE alkalies are bodies having strongly marked physical and chemical properties: 1. They combine with acids to form salts. 2. They restore the color of reddened litmus paper, and change the colors of vegetable blues to green, and of vegetable yellows to brown. 3. Their taste is never sour, but it is characteristic, and caustic if the alkali is in concentrated solution. The salts formed by their combinations with acids possess acid, alkaline, or neutral reactions according to the relative strength and proportion of the component parts.

The metals known as alkali metals, which form compounds of pharmaceutical interest, are potassium, sodium, and lithium. They are all univalent, and of a white color resembling that of silver, and are so prone to oxidation that they must be kept constantly immersed in some hydrocarbon or body free from oxygen, like naphtha or petroleum. They are so soft that they can be easily cut with a penknife. They float upon water, and inflame spontaneously and immediately when brought in contact with it.

The alkali metals are often called light metals, on account of their low specific gravity when compared with the others.

Their carbonates are all soluble in water, and each metal forms but one chloride.

Their oxides are strongly basic, restoring the color of reddened litmus quickly. The oxides are also very soluble in water, forming caustic and powerfully alkaline hydroxides, which cannot be decomposed by heat.

Their sulphates, phosphates, nitrates, sulphides, chlorides, bromides, iodides, and nearly all their salts, are soluble in water, are almost without exception colorless, or of an opaque white color, and many of them, if heated to redness, fuse without decomposition.

The processes for obtaining the metals are very similar, and formerly consisted in exposing their carbonates, intimately mixed with finely powdered charcoal, in suitable iron vessels, to an intense heat; carbon monoxide is liberated, and the vapors of the metals are condensed in flattened receivers. They are also largely made by electrolysis by subjecting the alkali hydroxide to a strong electric current.

Ammonium is a compound radical, NH_4, but has so many analogies with the alkali metals that it is classed with them.

CHAPTER XXXVIII

THE POTASSIUM SALTS

THE salts of potassium are among the most important of any that are used in medicine. They are generally very soluble, and, with a few exceptions, are colorless or of an opaque white color. The sole source of the potassium salts was formerly wood ashes, but at present cheaper sources have been discovered. The wood ashes were lixiviated, the liquid containing the soluble salts evaporated to dryness, and the residue allowed to cool. This constituted the crude *potash* of commerce.

Potash is now made from the ashes from beet sugar residues, from *suint*, the residue obtained by evaporating the water used to scour the fleeces of sheep, and from an impure potassium chloride obtained from the Stassfurt mines in Germany, which is now the principal source of the potassium compounds.

The salts are converted into potassium sulphate, and this into carbonate by heating with coal and limestone. For the purpose of converting the sulphate into the carbonate, it is heated in a reverberatory furnace with the proper quantity of coal and limestone, with the coal in order to form potassium sulphide, and with the limestone to convert the sulphide into carbonate, the sulphur uniting with the calcium to form calcium sulphide. The mass, after cooling, is lixiviated with water, and this solution of impure potassium carbonate is filtered to separate the insoluble calcium sulphide, and subsequently treated with milk of lime, by which insoluble calcium carbonate is precipitated, and potassium hydroxide in solution remains. The liquid is then evaporated to dryness.

Tests for Potassium Salts

Potassium may be recognized in its combinations by the following tests :

1. The addition of platinic chloride with a little alcohol and a few drops of hydrochloric acid produces a yellow crystalline precipitate, $PtCl_4 2KCl$ (double platinum and potassium chloride).
2. With an excess of concentrated solution of tartaric acid, a white crystalline precipitate is slowly formed when a strong solution of a potassium salt is added with stirring. This is the well known acid potassium tartrate (cream of tartar).
3. A colorless flame is tinted violet by pure potassium salts.
4. Potassium salts are soluble in water, and not volatile at a red heat.

Official Potassium Salts and Preparations

Official Name	Preparation
With Inorganic Radicals	
Potassii Bicarbonas	By passing carbon dioxide into a solution of carbonate, evaporating and crystallizing
Bromidum	By treating solution of potassium hydroxide with bromine and charcoal
Carbonas	By purifying pearlash by dissolving it in water, filtering, evaporating, and granulating
Chloras	By reacting on potassium chloride with calcium hypochlorite and by electrolysis
Cyanidum	By fusing potassium ferrocyanide with potassium carbonate, separating the insoluble precipitate of metallic iron, and pouring the fused mass on a slab
Dichromas	By treating potassium chromate with sulphuric acid, evaporating and crystallizing
Ferrocyanidum	By heating nitrogenized substances with iron and potassium hydroxide
Hydroxidum	From the ashes of plants, etc., by lixiviating, concentrating the solutions, evaporating to dryness, purifying by treating a diluted solution with lime, evaporating, fusing, and casting into moulds
Hypophosphis	By precipitating calcium hypophosphite with potassium carbonate
Iodidum	By treating solution of potassium hydroxide with iodine, evaporating to dryness, and heating with charcoal
Nitras	By decomposition of sodium nitrate with potassium chloride
Permanganas	By heating together manganese dioxide, potassium chlorate, and potassium hydroxide
Sulphas	By purifying the residue from nitric acid manufacture, and from other sources.
Liquor Potassii Arsenitis	By boiling potassium bicarbonate with arsenic trioxide and adding a small quantity of compound tincture of lavender.
Potassii Hydroxidi	About 5 percent. solution of potassium hydroxide made by dissolving the hydroxide in water
Trochisci Potassii Chloratis	Each troche contains two and a half grains of potassium chlorate, with sugar, tragacanth, and sufficient water to form a mass
With Organic Radicals	
Potassii Acetas	By decomposing potassium bicarbonate with acetic acid, and evaporating the filtered solution, carefully avoiding contact with iron
Bitartras	By purifying argol, the sediment deposited in wine casks during fermentation
Citras	By decomposing potassium bicarbonate with citric acid, evaporating and granulating
Citras Effervescens	By mixing finely powdered potassium citrate, sodium bicarbonate, tartaric acid, and citric acid, heating the mixture until it becomes uniformly moist, granulating, and drying
et Sodii Tartras	By treating solution of potassium bitartrate with sodium carbonate
Liquor Potassii Citratis	8 parts of potassium bicarbonate with 6 parts of citric acid in 100 parts of water

Unofficial Potassium Salts and Preparations

Potassa cum Calce. U. S. P. 1890	By mixing equal parts of well dried potassium hydroxide and lime
Potassa Sulphurata. U. S. P. 1890	By melting potassium hydroxide and sulphur together in a crucible, pouring the liquid on a slab and cooling
Potassii Antimonias, $KSbO_3$ Potassium Antimoniate	Deflagrating 1 part metallic antimony with 4 parts potassium nitrate, and lixiviating with water
Potassii Bisulphas, $KHSO_4$ Potassium Bisulphate	Residue remaining in retort on preparing nitric acid from potassium nitrate and sulphuric acid
Potassii Bisulphis, $KHSO_3$ Potassium Bisulphite	Passing an excess of sulphurous acid gas into a concentrated solution of potassium carbonate
Potassii Borotartras Potassium Borotartrate	Dissolve by heat 4 parts potassium bitartrate, and 1 part boric acid in 10 parts water, and evaporate to dryness
Potassii Chloridum, KCl Potassium Chloride	Obtained as a by-product in many salts

Unofficial Potassium Salts and Preparations—*Continued*

Potassii Chromas, K_2CrO_4 Potassium Chromate	Add potassium carbonate to a hot solution of potassium dichromate until effervescence ceases
Potassii et Ammonii Tartras, $KNH_4C_4H_4O_6$ Potassium and Ammonium Tartrate	Diffuse 1 part potassium bitartrate in 3 parts boiling water; then add ammonium carbonate until effervescence ceases; filter and crystallize
Potassii et Sodii Borotartras Potassium and Sodium Borotartrate	Dissolve 2 parts sodium borate in 20 parts distilled water, and digest with 5 parts potassium bitartrate
Potassii Ferricyanidum, $K_6Fe_2Cy_{12}$ Potassium Ferricyanide	Pass chlorine gas into a cold solution of potassium ferrocyanide until it ceases to produce a blue precipitate with ferric chloride
Potassii Iodas, KIO_3 Potassium Iodate	Pass chlorine gas into cold water containing iodine in suspension until wholly dissolved; then add potassium chlorate and warm. Dose, 6 to 8 grains (0.3 to 0.5 Gm.)
Potassii Iodohydrargyras, $(2KI.HgI_2)3H_2O$ Potassium Iodohydrargyrate (Potassio-Mercuric Iodide)	Dissolve 3 parts mercuric iodide in a concentrated solution of potassium iodide containing 2 parts of the salt; when cool, yellow prisms will deposit from the mother liquor. Dose, one-twelfth of a grain (0.005 Gm.)
Potassii Nitris, KNO_2 Potassium Nitrite	Made by heating the nitrate to redness and separating undecomposed nitrate; by dissolving the fused mass in water the nitrate will crystallize out; the mother liquor is treated with diluted acetic acid and twice its volume of alcohol, to separate more nitrate. The nitrite may be obtained by evaporating the solution over sulphuric acid. Dose, 3 grains (0.2 Gm.)
Potassii Perchloras, $KClO_4$ Potassium Perchlorate	Heat potassium chlorate until it melts; keep at this temperature until gas ceases to be evolved, and a portion tested with strong HCl acquires only a faint yellow color. Purify
Potassii Platinocyanidum, $2KCN.Pt(CN)_2.3H_2O$ Potassium Platinocyanide	Mix concentrated solutions of 1 part exsiccated platinic chloride and 2 parts potassium cyanide; heat until the precipitate is redissolved
Potassii Pyrosulphis, $K_2(SO)_2O$ Potassium Pyrosulphite	Pass sulphurous acid gas into a warm, saturated solution of potassium carbonate; on cooling, it deposits crystals
Potassii Salicylas, $(KC_7H_5O_3)_2.H_2O$ Potassium Salicylate	Dissolve 7 parts potassium bicarbonate in water; then add gradually 10 parts salicylic acid, and evaporate
Potassii Silicas, K_2SiO_3 Soluble glass	Fuse 10 parts potassium carbonate, 15 parts fine sand, and 1 part charcoal
Potassii Sulphidum, K_2S Potassium Sulphide	Pass hydrogen sulphide gas into a solution of potassium hydroxide as long as it is absorbed, and add an equal bulk of potassium hydroxide solution; evaporate
Potassii Sulphis, $K_2SO_3 + 2H_2O$ Potassium Sulphite	Pass sulphurous acid gas through a solution of potassium carbonate
Potassii Sulphocarbonas, K_2CS_3 Potassium Sulphocarbonate	Mix a solution of potassium sulphide with carbon disulphide; on evaporation, orange-yellow crystals are deposited
Potassii Sulphocyanas, KSCN Potassium Sulphocyanate	Melt together 17 parts potassium carbonate, 32 parts sulphur, and 46 parts anhydrous potassium ferrocyanide, and heat to low redness. When cool, treat with boiling alcohol
Potassii Tartras Potassium Tartrate	By treating solution of potassium bitartrate with potassium carbonate
Mistura Potassii Citratis. U. S. P. 1880 Neutral Mixture	By neutralizing 100 parts of lemon juice with 10 parts of potassium bicarbonate

POTASSII HYDROXIDUM. U.S. Potassium Hydroxide

$KOH = 55.74$

[Potassa, Pharm. 1890 Caustic Potash, Potassium Hydrate]

It should contain not less than 85 percent. of pure anhydrous Potassium Hydroxide, and not more than 2 percent. of other inorganic substances, with the exception of water. It should be kept in well-stoppered bottles made of hard glass.

Preparation.—Potassium Hydroxide, called commercially caustic potash, is made by evaporating a solution of potassium hydroxide rapidly in a silver or clean iron vessel until a fluid of oily consistence remains, a drop of which, when removed on a warm glass rod, solidifies on cooling. The hot caustic is poured into cylindrical moulds, and while the sticks are still warm they are bottled quickly, to prevent deliquescence.

Pure caustic potassium hydroxide is sometimes prepared in the form of powder by stirring the fused mass rapidly with a silver spatula until a granulated powder is formed. This must be placed in warm dry bottles and quickly sealed hermetically.

Potassa by Alcohol and *Potassa by Barytes* are terms used to designate pure caustic Potassium Hydroxide made by purifying with alcohol and barium hydroxide, alcohol dissolving only the potassium hydroxide, while the sulphate is separated by treatment with baryta water, forming the insoluble barium sulphate.

Official Description.—Dry, white or nearly white flakes, fused masses, or in pencils, hard and brittle, showing a crystalline fracture. Exposed to the air it readily absorbs carbon dioxide and moisture, and deliquesces.

Odor, Taste, and Reaction.—Odorless, or having a faint odor of lye, and a very acrid and caustic taste. *Great caution is necessary in tasting and handling it,* as it rapidly destroys organic tissues; intensely alkaline reaction.

Solubility.—Water. In about 0.4 parts at 25° C. (77° F.); very soluble in boiling water.

Alcohol. In 2 parts of alcohol; very soluble in boiling alcohol.

Other solvents. Slightly soluble in ether.

Tests for Identity.—When heated to about 530° C. (986° F.), Potassium Hydroxide melts to a clear, oily liquid, and at a bright red heat is volatilized unchanged. When introduced into a non-luminous flame, it imparts to it a violet color.

The aqueous solution (1 in 20) should be perfectly clear and colorless.

A concentrated solution of Potassium Hydroxide, after acidulation with hydrochloric acid yields a bright yellow precipitate with platinic chloride T. S.

A concentrated, aqueous solution (1 in 10), when added to an excess of tartaric acid T. S. produces a white, crystalline precipitate, which redissolves when the Potassium Hydroxide is added in excess.

Impurities and Tests for Impurities.—*Heavy Metals.* An aqueous solution of Potassium Hydroxide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of Carbonate. On adding an excess of diluted sulphuric acid to 10 Cc. of an aqueous solution of Potassium Hydroxide (1 in 10), no distinct effervescence should occur.

Quantitative Test.—Introduce about 1 Gm. of Potassium Hydroxide into a stoppered weighing bottle and weigh accurately. Dissolve this in about 50 Cc. of water and titrate the solution with normal sulphuric acid V. S., using methyl-orange T. S. as indicator. Multiply the number of Cc. of the normal sulphuric acid V. S. consumed, by 5.574, and divide this product by the weight of the Potassium Hydroxide taken; the quotient, which must be not less than 85, represents the percentage of Potassium Hydroxide present.

Uses.—Potassium Hydroxide is used as a caustic, principally, however, in veterinary practice; the end of the stick may be inserted into a section of rubber tubing, or wrapped several times with tin foil, to avoid cauterizing the finger of the operator. When this form of potassium hydroxide is used for making official solution of potassium hydroxide, care should be taken to allow for the moisture contained in it; commercial caustic potash rarely contains less than 30 percent. of water.

LIQUOR POTASSII HYDROXIDI. U.S. Solution of Potassium Hydroxide

[Liquor Potassæ, Pharm. 1890 Solution of Potassa]

An aqueous solution, containing about 5 percent. of Potassium Hydroxide [KOH = 55.74].

	Metric	Old form
• **Potassium Hydroxide**	60 Gm.	1 oz. av. 20 gr.
Distilled Water	940 Gm.	15 fl. oz.
To make	1000 Gm.	1 pint

Dissolve the Potassium Hydroxide in the Distilled Water and add enough Distilled Water to weigh 1000 Gm. [or measure, old form, 1 pint].

The Potassium Hydroxide used in this process should be of the full strength and quality directed by the Pharmacopœia (85 percent.). Potassium Hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken ; the proper amount for the above formula being ascertained by dividing 5100 by the percentage of absolute Potassium Hydroxide contained therein.

Solution of Potassium Hydroxide should be kept in bottles made of green glass, and provided with glass stoppers coated with paraffin or petrolatum.

Solution of Potassium Hydroxide was formally made by decomposing 85 Gm. of potassium bicarbonate through the action of 40 Gm. of Lime slaked with 20 Cc. of water with heat. The mixture was made up to 1000 Gm. and the clear solution decanted. The direction to heat the solution of potassium bicarbonate until effervescence ceases was for the purpose of driving off as much of the carbonic acid as possible by the simplest method ; the remainder was disposed of through double decomposition, as shown by the equation

$$\begin{array}{ccccccc} K_2CO_3 & + & Ca(HO)_2 & = & 2KHO & + & CaCO_3 \\ \text{Potassium} & & \text{Calcium} & & \text{Potassium} & & \text{Calcium} \\ \text{Carbonate} & & \text{Hydroxide} & & \text{Hydroxide} & & \text{Carbonate} \end{array}$$

Preference was given to the bicarbonate as the source of the potassium, because the cheaper carbonates nearly always contain silicates and other impurities in sufficient quantities to render the product inferior.

In making this solution in this way the proportion of water is not a matter of indifference. The quantity used should be at least five times as great as that of the bicarbonate, and the lime must greatly exceed the amount indicated by theory.

Official Description.—A clear, colorless liquid.

Odor, Taste, and Reaction.—Odorless ; a very acrid and caustic taste ; strongly alkaline reaction.

Specific Gravity.—About 1.046 at 25° C. (77° F.).

Tests for Identity.—It should conform to the reactions and tests for an aqueous solution of potassium hydroxide given under *Potassii Hydroxidum.*

Quantitative Test.—To neutralize 28 (27.87) Gm. of Solution of Potassium Hydroxide should require about 25 Cc. of normal sulphuric acid V.S., methyl-orange T.S. being used as indicator (each Cc. of normal sulphuric acid V.S. indicating 0.2 percent. of absolute Potassium Hydroxide).

Uses.—Solution of potassium hydroxide is a valuable antacid when given in doses of fifteen minims (1 Cc.), diluted with milk. If a large quantity should be swallowed accidentally, the proper antidotes would be mild acid liquids, like vinegar or lemon juice, accompanied with bland oils.

POTASSII ACETAS. U.S. Potassium Acetate

$KC_2H_3O_2 = 97.44$

It should contain, when thoroughly dried, not less than 98 percent. of pure Potassium Acetate [$CH_3.COOK$], and should be kept in well-stoppered bottles.

Preparation.—This salt may be made by adding crystals of potassium bicarbonate to pure acetic acid until effervescence ceases, and, after acidulating slightly with a few drops of the acid, cautiously evaporating to dryness in a porcelain evaporating dish by means of a sand-bath. Great care is necessary to avoid contamination with iron, and it is not safe to use an enamelled iron dish.

$$\underset{\substack{\text{Potassium}\\\text{Bicarbonate}}}{KHCO_3} + \underset{\text{Acetic Acid}}{HC_2H_3O_2} = \underset{\substack{\text{Potassium}\\\text{Acetate}}}{KC_2H_3O_2} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O}$$

The manufacturer nearly always uses the carbonate in making potassium acetate, instead of the bicarbonate, because it is much cheaper. The product from the carbonate is apt to be impure, however, because of the silica, sulphate, chlorides, etc., always present in the ordinary carbonate.

Official Description.—A white powder, or in crystalline masses of a satin-like lustre. Very deliquescent on exposure to the air.

Odor, Taste, and Reaction.—Odorless; warming, saline taste; the aqueous solution (1 in 20) is alkaline to litmus paper, but does not affect phenolphthalein T.S.

Solubility.—*Water.* In 0.4 part at 25° C. (77° F.); much more soluble with increasing temperature.

Alcohol. In 2 parts at 25° C. (77° F.); much more soluble with increasing temperature.

Tests for Identity.—When heated to 292° C. (557.6° F.), the salt fuses. At a higher temperature it decomposes, blackens, and evolves vapors having an empyreumatic odor (an alliaceous odor would indicate the presence of *arsenic*), and finally, if ignited on platinum, it leaves a white residue, which should be completely soluble in water.

The addition of sodium bitartrate T.S. to the concentrated aqueous solution of the salt causes a white, crystalline precipitate.

If a few particles of the salt be added to a mixture of 1 Cc. of sulphuric acid and 1 Cc. of alcohol, acetic ether will be formed, recognizable by its odor.

The addition of a little ferric chloride T.S. to a solution of the salt produces a deep red color, and, upon boiling, a pale brown, flocculent precipitate of basic ferric acetate separates.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of an aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Quantitative Test.—If 1 Gm. of dry Potassium Acetate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 20.1 Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—Potassium acetate is a reliable diuretic when given in doses of twenty grains to one drachm (1.2 to 4 Gm.). In larger doses it acts as a cathartic.

POTASSII BICARBONAS. U.S. Potassium Bicarbonate

$KHCO_3 = 99.41$

It should contain not less than 99 percent. of pure Potassium Bicarbonate [CO(OH)(OK)], and should be kept in well-stoppered bottles.

Preparation.—This salt is made by passing carbon dioxide through a solution of potassium carbonate until it is fully saturated, then filtering the liquid, and evaporating at a temperature below 71° C. (160° F.) to prevent decomposition. The crystals formed should be well washed and dried.

$$\underset{\substack{\text{Potassium}\\\text{Carbonate}}}{K_2CO_3} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Potassium}\\\text{Bicarbonate}}}{2KHCO_3}$$

The cheapest way to make this salt is to suspend a dish containing a concentrated solution of potassium carbonate within the fermenting tuns of a brewery; the carbon dioxide produced during fermentation is thus utilized. The crude salt obtained on evaporation is called *salæratus*. When purified by crystallization, it constitutes the official bicarbonate.

Official Description.—Colorless, transparent, monoclinic prisms, or a colorless, granular powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless; saline and slightly alkaline taste. The concentrated aqueous solution is slightly alkaline to litmus paper, but neutral to phenolphthalein T.S.

Solubility.—*Water.* In about 3 parts at 25° C. (77° F.), and in 1.9 parts at 50° C. (122° F.). At a higher temperature the solution rapidly loses carbon dioxide, and after being boiled, contains only potassium carbonate.

Alcohol. Almost insoluble.

Tests for Identity.—The dry salt begins to lose carbon dioxide at 100° C. (212° F.), and this loss increases at a higher temperature, until, at a red heat, the salt has lost 30.96 percent. of its original weight, leaving a residue of carbonate.

Tartaric acid T.S., added in excess to the concentrated aqueous solution, produces a white, crystalline precipitate.

Impurities and Tests for Impurities.—*Limit of carbonate.* If 1 Gm. of the salt be dissolved without agitation in 20 Cc. of water at a temperature not above 15° C. (59° F.), and 0.2 Cc. of normal hydrochloric acid V.S. and 2 drops of phenolphthalein T.S. be added, a red tint should not appear immediately.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—To neutralize 1 Gm. of Potassium Bicarbonate not less than 19.9 Cc. of half-normal sulphuric acid V.S. should be required, methyl-orange T.S. being used as indicator.

Uses.—This salt is largely used as affording the purest available source of the potassium salts. The large quantity of carbonic acid which it yields on decomposition renders it useful in beverages and laxative draughts, such as solution of magnesium citrate. It is milder than the carbonate, and when administered internally it is more acceptable to the stomach. The dose is from fifteen to thirty grains (1 to 2 Gm.).

POTASSII BITARTRAS. U. S. Potassium Bitartrate

$KHC_4H_4O_6 = 186.78$

[CREAM OF TARTAR]

It should contain not less than 99 percent of pure Potassium Bitartrate [$C_2H_2(OH)_2(COOH)(COOK)$], and should be kept in well-stoppered bottles.

Preparation.—This well known salt is made by purifying *argol*, or *tartar*, a substance deposited in wine casks during the fermentation of the grape juice. (See Acid Saccharine Fruits, Part IV.)

Official Description.—Colorless or slightly opaque, rhombic crystals, or a white, somewhat gritty powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless; pleasant, acidulous taste; acid reaction.

Solubility.—*Water.* In about 200 parts at 25° C. (77° F.); in 16.7 parts of boiling water.

Alcohol. Very sparingly soluble.

Tests for Identity.—When a small portion of the salt is heated on platinum foil, it chars and emits inflammable vapors having the odor of burning sugar. At a higher temperature, with free access of air, the carbon of the black residue is oxidized, and a white, fused mass remains, which has an alkaline reaction and effervesces strongly with acids.

With sodium cobaltic nitrate T.S. the aqueous solution of the salt yields a copious yellow precipitate.

In the aqueous solution of the salt, rendered neutral by potassium hydroxide T.S., silver nitrate T.S. produces a white precipitate, which, on boiling, becomes black through the separation of metallic silver. If, before applying heat, just sufficient ammonia water be added to dissolve the white precipitate, and the solution boiled, a mirror will be deposited on the sides of the test-tube.

Impurities and Tests for Impurities.—*Starch, kaolin, calcium phosphate, and other insoluble matter.* A solution of 0.5 Gm. of the salt in 3 Cc. of ammonia water should leave no insoluble residue.

Heavy metals. The aqueous solution of the salt, slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Ammonia. The odor of *ammonia* should not be evolved on heating the salt with a slight excess of potassium hydroxide T.S.

Alum. If 1 Gm. of Potassium Bitartrate be well triturated with about 1 Gm. of potassium carbonate and 0.5 Gm. of potassium nitrate, and the mixture heated gradually to dull redness in a porcelain crucible, and if, upon cooling, the resulting mass be treated with a slight excess of diluted hydrochloric acid and filtered, the filtrate, upon being made slightly alkaline with potassium hydroxide T.S., should not yield a gelatinous precipitate soluble in excess of the reagent.

Phosphates. If a precipitate be produced which is insoluble, it should be collected and thoroughly washed with hot distilled water and dissolved in hot diluted nitric acid; the addition of an excess of ammonium molybdate T.S. to this solution should not produce a yellow precipitate.

Quantitative Test.—If 1 Gm. of Potassium Bitartrate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 10.6 Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator.

Calcium tartrate is always present in grape juice, and a trace is permitted by the official test in potassium bitartrate, but the total impurities must not be in greater proportion than 1 percent.

Uses.—This salt is the source of tartaric acid and some of the tartrates. It is one of the ingredients in compound powder of jalap, and is frequently used as a refrigerant and purgative in doses of one to four drachms (4 to 16 Gm.)

POTASSII BROMIDUM. U.S. Potassium Bromide

$KBr = 118.22$

It should contain not less than 97 percent. of pure Potassium Bromide, and should be kept in well-stoppered bottles.

Preparation.—Two methods are used in making this salt. In the one which was formerly official, ferrous bromide, made by acting on iron with bromine, is treated with potassium carbonate; ferrous carbonate is precipitated, and potassium bromide remains in solution. The latter is filtered and evaporated, that crystals may form.

$$\underset{\substack{\text{Ferrous}\\\text{Bromide}}}{FeBr_2} + \underset{\substack{\text{Potassium}\\\text{Carbonate}}}{K_2CO_3} = \underset{\substack{\text{Ferrous}\\\text{Carbonate}}}{FeCO_3} + \underset{\substack{\text{Potassium}\\\text{Bromide}}}{2KBr}$$

In the other method, bromine is added to solution of potassium hydroxide, producing potassium bromide and bromate. The solution is evaporated to dryness, mixed with charcoal, and heated to redness. The bromate is deoxidized and converted into bromide, carbon monoxide escaping.

$$\underset{\substack{\text{Potassium}\\\text{Bromate}}}{2KBrO_3} + \underset{\text{Carbon}}{3C_2} = \underset{\substack{\text{Potassium}\\\text{Bromide}}}{2KBr} + \underset{\substack{\text{Carbon}\\\text{Monoxide}}}{6CO}$$

The presence of chlorides in potassium bromide often to the extent of 3 percent. is due to the difficulty of obtaining the bromine which is used in making it, free from chlorine.

Formerly this salt was imported. It is now made in the United States upon a large scale, and is exported.

Official Description.—Colorless, or white, cubical crystals, or granular powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless; strongly saline taste; neutral or scarcely perceptible alkaline reaction.

Solubility.—*Water.* In about 1.5 parts at 25° C. (77° F.); in less than 1 part of boiling water.

Alcohol. In about 180 parts at 25° C. (77° F.); in 16 parts of boiling alcohol.

Other solvents. Soluble in glycerin.

Tests for Identity.—On heating the salt upon platinum foil it decrepitates; and at a temperature near 700° C. (1292° F.) it fuses without decomposing, and at a bright red heat volatilizes, communicating a violet color to the flame.

The addition of tartaric acid T.S., or of sodium bitartrate T.S., to a concentrated aqueous solution of the salt produces a white crystalline precipitate.

Silver nitrate T.S. produces a yellowish-white precipitate, insoluble in nitric acid and in a moderate excess of ammonia water.

Impurities and Tests for Impurities.—*Limit of alkali.* If 1 Gm. of Potassium Bromide be dissolved in 10 Cc. of water and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no color should be produced by the subsequent addition of a drop of phenolphthalein T.S., even after heating.

Bromate. If diluted sulphuric acid be dropped upon crushed crystals of the salt, and the mixture be shaken with 1 Cc. of chloroform, the latter should not assume a yellowish-brown color.

Iodides. If to 10 Cc. of the aqueous solution of the salt (1 in 20), 1 Cc. of chloroform be added, and if chlorine water, which has been diluted with an equal volume of water, be introduced cautiously drop by drop with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Barium. Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S.

Quantitative Test.—If 0.3 Gm. of the well-dried salt be dissolved in about 50 Cc. of water, and 2 or 3 drops of potassium chromate T.S. be added, it should require not less than 24.6 Cc. nor more than 25.85 Cc. of tenth-normal silver nitrate T.S to produce a permanent red color.

Uses.—Potassium bromide is largely used as a nervine, in doses of fifteen grains (1 Gm.), frequently repeated.

POTASSII CARBONAS. U.S. Potassium Carbonate

$K_2CO_3 = 137.27$

It should contain, when thoroughly dried, not less than 98 percent. of pure Potassium Carbonate [$CO(OK)_2$], and should be kept in well-stoppered bottles.

Preparation.—This salt, known commercially as *Sal Tartar*, is made by dissolving pearlash, or impure potassium carbonate, in an equal weight of cold water, allowing the mixture to stand a day or two, filtering the solution, pouring it into a bright iron dish, and evaporating over a gentle fire until it thickens, then removing it from the fire and stirring constantly with an iron spatula, so as to form a granular salt (see page 237).

A purer carbonate is produced by decomposing potassium bicarbonate by heating to redness, thus driving off water of crystallization and a portion of the carbon dioxide.

$$\underset{\text{Potassium Bicarbonate}}{2KHCO_3} = \underset{\text{Potassium Carbonate}}{K_2CO_3} + \underset{\text{Carbon Dioxide}}{CO_2} + \underset{\text{Water}}{H_2O}$$

Official Description.—A white, granular powder; very deliquescent.

Odor, Taste, and Reaction.—Odorless; strongly alkaline taste; strongly alkaline reaction.

Solubility.—*Water.* In 0.91 part at 25°C. (77°F.), and in about 0.65 part of boiling water.

Alcohol. Insoluble.

Tests for Identity.—When heated to 130° C. (266° F.), the salt loses all the water which it may have retained or absorbed; at a bright red heat it melts, and at a white heat it volatilizes, communicating to a non-luminous flame a pure violet color.

Its aqueous solution (1 in 20) effervesces with acids.

Its aqueous solution (1 in 10) yields with excess of tartaric acid T.S. a white crystalline precipitate.

Impurities and Tests for Impurities.—*Earthy Impurities.* No residue should be left on dissolving 1 Gm. of the salt in 20 Cc. of water.

Heavy Metals. An aqueous solution of Potassium Carbonate (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Nitrate. If 5 Cc. of the aqueous solution (1 in 20) be carefully mixed with an equal volume of concentrated sulphuric acid, and, after cooling, 3 Cc. of ferrous sulphate T.S. be poured upon it so as to form a separate layer, no brown color should appear at the line of contact.

Quantitative Test.—One Gm. of Potassium Carbonate, weighed after having been thoroughly dried at 130° C. (266° F.), and dissolved in about 50 Cc. of water, should require not less than 14.3 (14.28) Cc. of normal sulphuric acid V.S. for neutralization, methyl-orange T.S. being used as indicator.

Uses.—Potassium carbonate is an antacid, but it is less agreeable than the bicarbonate. The dose is fifteen grains (1 Gm.), largely diluted. In large doses it is an irritant caustic, the proper antidotes to administer being diluted vinegar, lemon juice, or weak acids.

POTASSII CHLORAS. U.S. Potassium Chlorate

$KClO_3 = 121.68$

It should contain not less than 99 per cent. of pure Potassium Chlorate [$ClO_2.OK$], and should be kept in well-stoppered bottles. *Great caution should be observed in handling it,* as dangerous explosions are liable to occur when it is heated or subjected to concussion or trituration with organic substances (cork, tannic acid, sugar, etc.), or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances.

Preparation.—Chlorate of Potash, as it is always termed commercially, was formerly made by passing chlorine gas into a solution of potassium hydroxide. This is a very wasteful process, as only one-fifth of the potassium hydroxide is obtained as chlorate, the rest passing into potassium chloride. It is now more economically prepared by boiling together solutions of potassium chloride and calcium hypochlorite, whereby potassium chlorate and calcium chloride are produced.

When a solution of calcium hypochlorite is boiled, it is decomposed, and calcium chlorate and calcium chloride are formed :

$$\underset{\text{Calcium Hypochlorite}}{3Ca(OCl)_2} = \underset{\text{Calcium Chloride}}{2CaCl_2} + \underset{\text{Calcium Chlorate}}{Ca(O_3Cl)_2}$$

When solution of calcium chlorate is heated in contact with potassium chloride, double decomposition takes place, as shown by the following equation :

$$\underset{\text{Calcium Chlorate}}{Ca(O_3Cl)_2} + \underset{\text{Potassium Chloride}}{2KCl} = \underset{\text{Potassium Chlorate}}{2KClO_3} + \underset{\text{Calcium Chloride}}{CaCl_2}$$

The potassium chlorate is easily separated from the calcium chloride, because it is much less soluble than the latter.

This salt is now made by electrolysis by placing opposite to each other in a solution of potassium chloride, anodes and cathodes, without being separated by a porous diaphragm. The electric current causes the formation of potassium hypochlorite in the solution, which by boiling is converted into potassium chlorate and potassium chloride.

Official Description.—Colorless, lustrous, monoclinic prisms or plates, or a white, granular powder. Permanent in the air.

Odor, Taste, and Reaction.—Odorless; cooling, characteristic taste; neutral reaction.

Solubility.—*Water.* In 16 parts at 25° C. (77° F.); in 1.7 parts of boiling water.

Alcohol. Slightly in diluted alcohol; insoluble in absolute alcohol.

Tests for Identity.—At 334° C. (633.2° F.) the salt fuses, and above 352° C. (665.6° F.) it is decomposed into oxygen and potassium perchlorate; above 400° C. (752° F.) all of its oxygen is liberated, and a white residue of potassium chloride remains, amounting to 60.8 percent. of the pure Chlorate employed. This residue is readily soluble in water, and the solution yields a white, curdy precipitate with silver nitrate T.S.

With excess of tartaric acid T.S., the solution (1 in 20) slowly yields a scant, white, crystalline precipitate; with platinic chloride T.S., a yellow crystalline precipitate is produced.

When heated with hydrochloric acid, the aqueous solution (1 in 20) assumes a greenish yellow color, and evolves chlorine.

Impurities and Tests for Impurities.—*Heavy Metals.* The aqueous solution of the salt (1 in 20) should not become discolored upon the addition of ammonium sulphide T.S.

Limit of nitrates and nitrites. If to 1 Gm. of Potassium Chlorate contained in a test-tube of about 40 Cc. capacity, 5 Cc. of water, 5 Cc. of potassium hydroxide T.S., and about 0.2 Gm. of aluminum wire be added, and if in the upper portion of the test-tube a pledget of purified cotton be inserted, and over the mouth there be placed a piece of moistened red litmus paper, then if the tube be heated upon a water-bath for fifteen minutes, no blue coloration of the paper will be discernible.

Potassium chlorate should not be triturated with readily oxidizable or combustible substances, if explosions are to be avoided.

Uses.—Potassium chlorate is used chemically as a source for obtaining oxygen, and medicinally is largely employed in diphtheria, sore throat, scarlet fever, etc., in doses of from four to twenty grains (0.25 to 1.2 Gm.)

POTASSII CITRAS. U.S. Potassium Citrate

$K_3C_6H_5O_7 + H_2O = 322.08$

It should contain not less than 99 percent. of pure Potassium Citrate [$C_3H_4(OH)(COOK)_3 + H_2O$], and should be kept in well-stoppered bottles.

Preparation.—This salt is made by adding potassium bicarbonate to a solution of citric acid until effervescence ceases, filtering the solution, evaporating to dryness, and granulating (see page 237).

$$\underset{\substack{\text{Potassium}\\\text{Bicarbonate}}}{3KHCO_3} + \underset{\text{Citric Acid}}{H_3C_6H_5O_7} = \underset{\substack{\text{Potassium}\\\text{Citrate}}}{K_3C_6H_5O_7} + \underset{\text{Water}}{3H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{3CO_2}$$

Manufacturers generally use the carbonate as the source of the potassium, as it is much cheaper than the bicarbonate. When carelessly made from the carbonate, silica may be present, which is to be suspected if the potassium citrate is not entirely soluble in water.

Official Description.—Transparent, prismatic crystals, or a white, granular powder. Deliquescent when exposed to the air.

Odor, Taste, and Reaction.—Odorless; cooling, saline taste; alkaline reaction with litmus paper, but does not affect phenolphthalein.

Solubility.—*Water.* In about 0.5 part at 25° C. (77° F.); very soluble in boiling water.

Alcohol. Sparingly soluble.

Tests for Identity.—When heated above 100° C. (212° F.), the salt begins to lose water; at 200° C. (392° F.) the water of crystallization (5.55 percent.) is completely lost. At 230° C. (446° F.) the salt begins to decompose, turns brown, and at a higher temperature carbonizes and emits inflammable gases which have a very pungent, acid odor. At a red heat a blackened mass of potassium carbonate and carbon is left, which has an alkaline reaction, and strongly effervesces with acids.

An aqueous solution of Potassium Citrate yields a white, crystalline precipitate with sodium bitartrate T.S.

On mixing 10 Cc. of the aqueous solution of the salt (1 in 20) with 10 Cc. of calcium chloride T.S., the liquid remains clear until it is boiled, when a white, granular precipitate is produced.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see U.S.P. Test No. 121, Chap. LXII).

Tartrate. A solution of 1 Gm. of Potassium Citrate in 1 Cc. of water, should not deposit any precipitate on the addition of 1 Cc. of acetic acid.

Quantitative Test.—If 1 Gm. of Potassium Citrate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 18.4 Cc. of half-normal hydrochloric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—Potassium citrate is principally employed in medicine as a diaphoretic, in doses of fifteen grains (1 Gm.). It is found in the official solution of potassium citrate.

POTASSII CITRAS EFFERVESCENS. U.S. Effervescent Potassium Citrate

	Metric	Old form
* **Potassium Citrate**	200 Gm.	4 oz. av.
Sodium Bicarbonate, dried and powdered	477 Gm.	9½ oz. av.
Tartaric Acid, dried and powdered	252 Gm.	5 oz. av.
Citric Acid, uneffloresced crystals	162 Gm.	3¼ oz. av.
To make about	1000 Gm.	20 oz. av.

Dry the Potassium Citrate on a water-bath, until it ceases to lose weight; after powdering the dried salt, mix it intimately with the powdered Citric Acid and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated between 93° and 104° C. (199.4° and 219.2° F.).

When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles.

Uses.—This forms an agreeable diaphoretic given in cold water in doses of thirty to sixty grains (2 to 4 Gm.).

LIQUOR POTASSII CITRATIS. U.S. Solution of Potassium Citrate

[NEUTRAL MIXTURE]

An aqueous liquid, containing in solution not less than 8 percent. of anhydrous Potassium Citrate [$C_3H_4(OH)(COOK)_3 = 304.2$], with small amounts of citric and carbonic acids.

	Metric	Old form
* **Potassium Bicarbonate**	8 Gm.	292 grains
Citric Acid	6 Gm.	219 grains
Distilled Water, a sufficient quantity,		
To make	100 Cc.	8 fl. oz.

Dissolve the Potassium Bicarbonate and Citric Acid, each, in 40 Cc. [old form 3 fl. oz.] of Distilled Water. Filter the solutions separately, and wash the filters with enough Distilled Water to obtain, in each case, 50 Cc. [old form 4 fl. oz.]. Finally, mix the two solutions, and, when effervescence has nearly ceased, transfer the liquid to a bottle. This preparation should be freshly made when wanted.

Official Description.—A clear, colorless liquid.

Odor, Taste, and Reaction.—Odorless; mildly saline taste; slightly acid reaction.

Tests for Identity.—It should conform to the reactions and tests for an aqueous solution of the salt given under *Potassii Citras.*

Quantitative Test.—If 10.14 Gm. of Solution of Potassium Citrate be evaporated to dryness and then thoroughly carbonized at a temperature not exceeding a low red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the filtrate should require, for complete neutralization, not less than 16 Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator (each Cc. of the half-normal sulphuric acid V.S. consumed representing 0.5 percent. of anhydrous Potassium Citrate).

For this preparation it will be found convenient in dispensing practice to keep the separate solutions of Citric Acid and Potassium Bicarbonate on hand ready to be mixed when the solution of potassium citrate is needed. The solutions keep moderately well. The solution contains about 9 percent. of potassium citrate, with some free Citric Acid and carbonic acid gas. It responds to the reactions and tests of potassium citrate (see Potassii Citras).

Neutral Mixture in some localities is always understood to mean a more agreeable preparation than this solution. It is made by nearly saturating lemon juice with Potassium Bicarbonate. It was official in the U. S. P. 1880 under the name of *Mistura Potassii Citratis* (see page 513).

Uses.—Solution of potassium citrate is refrigerant and diaphoretic, in doses of four fluidrachms (16 Cc.).

POTASSII CYANIDUM. U.S. Potassium Cyanide

$KCN = 64.70$

It should contain not less than 95 percent. of pure Potassium Cyanide, and should be kept in well-stoppered bottles.

Preparation.—A process for making this salt was formerly official. It was prepared by mixing intimately 8 parts of potassium ferrocyanide, and 3 parts of potassium carbonate, and dropping it in small portions into a red-hot iron crucible. When effervescence ceased, and the iron had precipitated, the clear, hot liquid was poured into a shallow dish to solidify.

The reaction between the potassium ferrocyanide and the potassium carbonate results in the production of potassium cyanide, potassium cyanate, iron, and carbon dioxide. The iron is precipitated out in the form of a fine powder, carbon dioxide escapes, and potassium cyanide, with a small proportion of cyanate, is produced.

$$\underset{\substack{\text{Potassium}\\\text{Ferrocyanide}}}{K_4Fe(CN)_6} + \underset{\substack{\text{Potassium}\\\text{Carbonate}}}{K_2CO_3} = \underset{\substack{\text{Potassium}\\\text{Cyanide}}}{5KCN} + \underset{\substack{\text{Potassium}\\\text{Cyanate}}}{KOCN} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Iron}}{Fe}$$

Potassium cyanide is found in commerce of several qualities. The cheapest grade is used for mining and metallurgical processes and in the arts. A granulated salt is used medicinally. It is sometimes cast into sticks, and in this form, of German manufacture, is of good quality. Chemically pure crystallized potassium cyanide is also in the market.

Official Description.—White, opaque, amorphous pieces, or a white, granular powder; deliquescent in the air and exhaling the odor of hydrocyanic acid.

Odor, Taste, and Reaction.—Odorless when perfectly dry. *Great caution should be used in tasting and handling this salt.* Its aqueous solution (1 in 20) has a strongly alkaline reaction upon red litmus paper, and emits the odor of hydrocyanic acid.

Solubility.—*Water.* In about 2 parts at 25° C. (77° F.); boiling water dissolves its own weight of the salt, but rapidly decomposes it.

Alcohol. Sparingly soluble.

Tests for Identity.—At a low red heat the salt fuses.

With an equal volume of sodium bitartrate T.S. the solution yields a white, crystalline precipitate.

With sodium cobaltic nitrite T.S. a copious yellow precipitate is produced.

A few drops of a solution of the salt (1 in 20) yields with silver nitrate T.S. a white precipitate, which is soluble in an excess of the solution of Potassium Cyanide, also in ammonia water, and in concentrated nitric acid.

If 5 Cc. of a solution of the salt (1 in 20) be shaken with a few drops of ferrous sulphate T.S. and of ferric chloride T.S., and a slight excess of hydrochloric acid then added, a blue precipitate (Prussian blue) will be produced.

Impurities and Tests for Impurities.—*Limit of carbonate.* The addition of diluted hydrochloric acid to the aqueous solution of the salt (1 in 20) should produce not more than a slight effervescence.

Ferrocyanide. After the diluted hydrochloric acid has been added in slight excess, a drop of ferric chloride T.S. should not produce a blue color.

Sulphocyanate. Nor should a red color be produced.

Quantitative Test.—If 1 Gm. of Potassium Cyanide be dissolved in sufficient distilled water to measure 100 Cc., then 64.7 Cc. of this solution mixed with 5 Cc. of ammonia water and 3 drops of potassium iodide T.S. should require not less than 47.5 Cc. of tenth-normal silver nitrate V.S. before the appearance of a permanent precipitate (each Cc. of the tenth-normal silver nitrate V.S. indicating 2 percent. of pure Potassium Cyanide).

Uses.—The action of this salt upon animals as a *poison* is the same as that of hydrocyanic acid. The dose is *one-fifth of a grain* (0.010 Gm.). It is more stable than the acid, and is preferably used as a substitute for it.

POTASSII DICHROMAS. U. S. Potassium Dichromate

$K_2Cr_2O_7 = 292.28$

[POTASSII BICHROMAS, PHARM. 1890 POTASSIUM BICHROMATE]

It should contain not less than 99 percent. of pure Potassium Dichromate [$Cr_2O_5(OK)_2$], and should be kept in well-stoppered bottles.

Preparation.—The source of this salt is *chrome iron ore*, which is first roasted, then powdered, mixed with potassium carbonate and lime, and the mixture heated strongly with access of air.

The mixture of iron and calcium oxide, calcium chromate, and potassium chromate is thrown into water, and potassium carbonate added to the solution which converts the calcium chromate into potassium chromate.

The solution of the latter is treated with an acid, usually sulphuric, but nitric acid would be preferable on some accounts, potassium nitrate being more readily separated from potassium dichromate than potassium sulphate. Sulphuric acid, however, is cheaper.

$$\underset{\substack{\text{Potassium}\\\text{Chromate}}}{2K_2CrO_4} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Potassium}\\\text{Dichromate}}}{K_2Cr_2O_7} + \underset{\substack{\text{Potassium}\\\text{Sulphate}}}{K_2SO_4} + \underset{\text{Water}}{H_2O}$$

This salt is considered to be a compound of potassium chromate with chromic anhydride, K_2CrO_4,CrO_3.

Official Description.—Large, orange-red, transparent, triclinic prisms, or four-sided tabular crystals; permanent in the air.

Odor, Taste, and Reaction.—Odorless; acidulous, metallic taste; acid reaction.

Solubility.—*Water.* In about 9 parts at 25° C. (77° F.); in 1.5 parts of boiling water.

Alcohol. Insoluble.

Tests for Identity.—The salt fuses below a red heat, without loss of weight, forming a dark brown liquid. At a white heat it evolves oxygen and leaves a residue of neutral potassium chromate and green chromic oxide.

On mixing 4 Cc. of an aqueous solution (1 in 20) with 0.5 Cc. of alcohol, and then adding 1 Cc. of sulphuric acid, the liquid should assume a green color and emit the odor of aldehyde.

Sodium cobaltic nitrite T.S. produces in an aqueous solution a copious yellow precipitate.

Uses.—This salt is used in the preparation of chromium trioxide and valeric acid, and for forming an official volumetric solution, the value of which in testing depends upon its yielding its oxygen to acid liquids (see Test Solutions). When given internally, in large doses, it is an irritant poison; the proper dose is one-fifth of a grain (0.010 Gm.); soap, magnesia, or chalk would be suitable antidotes.

POTASSII ET SODII TARTRAS. U.S. Potassium and Sodium Tartrate

$KNaC_4H_4O_6 + 4H_2O = 280.18$

[Rochelle Salt]

It should contain not less than 99 percent. of pure Potassium and Sodium Tartrate [$C_2H_2(OH)_2(COOK)(COONa) + 4H_2O$], and should be kept in well-stoppered bottles.

Preparation.—This salt is made by adding potassium bitartrate to a solution of sodium carbonate; the proportions are shown by a former official process, which is as follows:

Take of Carbonate of Sodium, 12 *troyounces;* Bitartrate of Potassium, in fine powder, 16 *troyounces;* Boiling Water, 5 *pints.* Dissolve the Carbonate of Sodium in the Water, and gradually add the Bitartrate of Potassium. Filter the solution, and evaporate until a pellicle begins to form; then set it aside to crystallize. Pour off the mother water, and dry the crystals on bibulous paper. Lastly, evaporate the mother water, that it may furnish more crystals.

It is advantageous to filter the solution after one-half of its volume has been evaporated and it has cooled and settled, in order to free it from the calcium tartrate which separates, otherwise the crystals will be contaminated.

The following equation shows the reaction:

$$\underset{\substack{\text{Potassium}\\\text{Bitartrate}}}{2KHC_4H_4O_6} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Potassium and}\\\text{Sodium Tartrate}}}{2KNaC_4H_4O_6} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

The chemical constitution of the tartrates will be fully explained under Acidum Tartaricum, but this opportunity will be embraced to note that tartaric acid is a dibasic acid; in its acid salts the remaining hydrogen can be replaced by a base, which in this case is sodium.

Official Description.—Colorless, transparent, rhombic prisms, or a white powder; slightly efflorescent in dry air.

Odor, Taste, and Reaction.—Odorless; cooling, saline taste. The aqueous solution is feebly alkaline to litmus paper, but does not affect phenolphthalein.

Solubility.—*Water.* In about 1.2 parts at 25° C. (77° F.), and in less than 1 part of boiling water.

Alcohol. Almost insoluble.

Tests for Identity.—When heated to 74° C. (165.2° F.), the salt fuses to a colorless liquid, which, at a higher temperature, froths, becomes brown, and gradually carbonizes, while inflammable vapors are emitted, having the odor of burning sugar. Finally, a black residue is left.

An aqueous solution of the salt (1 in 10) yields, with an equal volume of acetic acid, a white, crystalline precipitate.

With silver nitrate T.S. it produces a white precipitate, which becomes black on boiling.

Impurities and Tests for Impurities.—*Heavy Metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U.S. P. Test No. 121, Chap. LXII).

Ammonia. When heated with potassium hydroxide T.S., the solution should not evolve *ammonia.*

Quantitative Test.—If 1 Gm. of Potassium and Sodium Tartrate be thoroughly ignited at red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require, for complete neutralization, not less than 14.1 Cc. of half-normal hydrochloric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—Rochelle salt, as it is habitually termed, is an efficient purgative in the dose of one-quarter ounce to an ounce (8 to 32 Gm.). It is an important ingredient in the well known Seidlitz powders.

POTASSII FERROCYANIDUM. U.S. Potassium Ferrocyanide

$K_4Fe(CN)_6 + 3H_2O = 419.62$

It should contain not less than 99 percent. of pure Potassium Ferrocyanide, and should be kept in well-stoppered bottles.

Preparation.—When refuse animal substances which contain nitrogen are heated in an iron pot with crude pearlash, impure potassium cyanide is formed. If the fused mass is lixiviated and treated with freshly precipitated ferrous carbonate, potassium ferrocyanide is produced, according to the following reaction :

$$\underset{\text{Potassium Cyanide}}{6KCN} + \underset{\text{Ferrous Carbonate}}{FeCO_3} = \underset{\text{Potassium Ferrocyanide}}{K_4Fe(CN)_6} + \underset{\text{Potassium Carbonate}}{K_2CO_3}$$

This salt is important, because it is the source of all the cyanogen compounds used in medicine.

Official Description.—Large, soft, transparent, yellow, four-sided, monoclinic tabular crystals or prisms ; slightly efflorescent on exposure to the air.

Odor, Taste, and Reaction.—Odorless ; mild, saline taste ; neutral reaction.

Solubility.—*Water.* In about 4 parts at 25°C. (77°F.) ; in 2 parts of boiling water.

Alcohol.—Insoluble.

Tests for Identity.—When heated to 60° C. (140° F.), the salt begins to turn white from loss of water of crystallization, and when heated at 100° C. (212° F.), it is rendered anhydrous.

With sodium bitartrate T.S. the concentrated aqueous solution yields a white, crystalline precipitate.

The color of the precipitate produced by the addition of ferric chloride T.S. to the diluted aqueous solution of the salt is dark blue ; that produced by copper sulphate T.S. is reddish-brown ; lead acetate T.S. or silver nitrate T.S. causes a white precipitate.

Impurities and Tests for Impurities.—*Carbonate.* No effervescence should be caused by the addition of diluted sulphuric acid to a concentrated solution of the salt.

Ferricyanide. The precipitate produced by silver nitrate T.S. in the aqueous solution, acidulated with nitric acid, should be of a white color, without a tinge of red.

Uses.—This salt is rarely employed medicinally ; it is *not poisonous* if pure, but the absence of much acid in the stomach must be assured, as otherwise hydrocyanic acid in dangerous quantity might be liberated. Chemically, it is important as furnishing a reliable test for ferric salts.

POTASSII HYPOPHOSPHIS. U.S. Potassium Hypophosphite

$KPH_2O_2 = 103.39$

It should contain not less than 98 percent. of pure Potassium Hypophosphite [$PO.H_2OK$], and should be kept in well-stoppered bottles. Caution should be observed in dispensing Potassium Hypophosphite, as explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents.

Preparation.—When solutions of calcium hypophosphite and potassium carbonate are mixed, potassium hypophosphite and calcium carbonate are produced by double decomposition, thus :

$$\underset{\text{Calcium Hypophosphite}}{Ca2H_2PO_2} + \underset{\text{Potassium Carbonate}}{K_2CO_3} = \underset{\text{Potassium Hypophosphite}}{2KH_2PO_2} + \underset{\text{Calcium Carbonate}}{CaCO_3}$$

The calcium carbonate is removed by filtration, and the clear solution is evaporated until a pellicle forms, after which it is constantly stirred, with continuance of the heat, until the salt granulates. The heat employed in the evaporation should be kept considerably below 100° C. (212° F.), for fear of explosion. If the salt is required to be pure, it should be dissolved in the granulated state, in official alcohol, and the solution evaporated and then set aside to crystallize.

Official Description.—White, opaque, hexagonal plates, or crystalline masses, or a granular powder; very deliquescent.

Odor, Taste, and Reaction.—Odorless; pungent, saline taste; neutral or slightly alkaline reaction.

Solubility.—*Water.* In about 0.5 part at 25°C. (77°F.); in 0.3 part of boiling water.

Alcohol. In 7 parts at 25°C. (77°F.); in 3.6 parts of boiling alcohol.

Other solvents. Insoluble in ether.

Tests for Identity.—When heated in a dry test-tube, the salt at first loses moisture, and then evolves spontaneously inflammable hydrogen phosphide gas, which burns with a bright yellow flame.

The aqueous solution (1 in 20) yields, with sodium bitartrate T.S., a white crystalline precipitate.

One Gm. of the dried salt, dissolved in about 10 Cc. of water should not require more than 1.5 Cc. of tenth-normal hydrochloric acid V.S. for neutralization (methyl-orange T.S. being used as indicator).

The diluted aqueous solution, slightly acidulated with diluted sulphuric acid, yields, with silver nitrate T.S., a white precipitate, which rapidly turns brown or black, owing to the separation of metallic silver.

On gently heating an aqueous solution of Potassium Hypophosphite with copper sulphate T.S., a reddish-brown precipitate is formed.

When the aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is at first formed. On further addition of an excess of the Potassium Hypophosphite solution, the precipitate becomes gray from reduction to metallic mercury.

Impurities and Tests for Impurities.—*Carbonate.* An aqueous solution of the salt (1 in 20) should not effervesce upon the addition of an acid.

Heavy metals. An aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. If 5 Cc. of an aqueous solution of Potassium Hypophosphite (1 in 10) be measured into a beaker containing 3 Cc. of nitric acid diluted with about 10 Cc. of water, and the mixture be evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—The official use made of potassium hypophosphite is to form one of the ingredients of syrup and compound syrup of hypophosphites and the preparations into which they enter, and as an addition in the process for making diluted hydriodic acid. It may be given internally in the dose of eight grains (0.5 Gm.).

POTASSII IODIDUM. U.S. Potassium Iodide

$KI = 164.76$

It should contain not less than 99 percent. of pure Potassium Iodide, and should be kept in well-stoppered bottles.

Preparation.—An aqueous solution of potassium hydroxide is treated with iodine in slight excess. The result is the formation of two salts, potassium iodide and iodate.

$$\underset{\substack{\text{Potassium}\\\text{Hydroxide}}}{6KOH} + \underset{\text{Iodine}}{(I_2)_3} = \underset{\substack{\text{Potassium}\\\text{Iodide}}}{5KI} + \underset{\substack{\text{Potassium}\\\text{Iodate}}}{KIO_3} + \underset{\text{Water}}{3H_2O}$$

By evaporating the solution to dryness the mixed salts are obtained; and if the dry mass be exposed to a red heat, the iodate will be converted into potassium iodide, thus removing this impurity.

The mixed salts, toward the close of their evaporation to dryness, should be mixed with powdered charcoal, which facilitates the deoxidation of the iodate. This being accomplished by a dull red heat, the potassium iodide is dissolved out of the mass, and the solution is set aside to crystallize.

$$\underset{\substack{\text{Potassium}\\\text{Iodate}}}{KIO_3} + \underset{\text{Carbon}}{3C} = \underset{\substack{\text{Potassium}\\\text{Iodide}}}{KI} + \underset{\substack{\text{Carbon}\\\text{Monoxide}}}{3CO}$$

Potassium iodide is always crystallized from an alkaline solution if the manufacturer expects to avoid loss through the discoloration of the product from the separation of free iodine. The official test permits the presence of a small excess of alkali.

Official Description.—Colorless, transparent, translucent, or opaque white, cubical crystals, or a white, granular powder. Permanent in dry air, and but slightly deliquescent in moist air.

Odor, Taste, and Reaction.—Peculiar, faint, iodine-like odor; pungent, saline, afterwards bitter taste; neutral, or slightly alkaline reaction.

Solubility.—*Water.* In 0.7 part at 25° C. (77° F.); in 0.5 part of boiling water.

Alcohol. In about 12 parts at 25° C. (77° F.); in 6 parts of boiling alcohol.

Other solvents. In 2.5 parts of glycerin.

Tests for Identity.—When heated, the salt decrepitates. At a low red heat it fuses, and at a bright red heat it is volatilized without decomposition.

An aqueous solution of Potassium Iodide (1 in 20) yields a white, crystalline precipitate with sodium bitartrate T.S.

If to 5 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated, and impart to the solution a light reddish-brown color. On agitating the mixture with a few drops of chloroform, the latter will acquire a violet color.

Impurities and Tests for Impurities.—*Limit of alkali.* If 1 Gm. of the salt be dissolved in 10 Cc. of water, and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no color should be produced by the subsequent addition of a drop of phenolphthalein T.S., even after heating.

Less soluble salts. No residue should be left when 1 Gm. of the salt is dissolved in 2 Cc. of diluted alcohol of specific gravity 0.928.

Limit of iodate. If to 0.5 Gm. of the salt, dissolved in 10 Cc. of distilled water, which has previously been boiled and cooled in a small flask, 2 drops of diluted sulphuric acid (free from sulphurous and nitrous acids) be added, no distinct yellow color should appear within half a minute.

Heavy metals. An aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of nitrates and nitrites. If to 1 Gm. of Potassium Iodide contained in a test-tube of about 40 Cc. capacity, 5 Cc. of water, 5 Cc. of potassium hydroxide T.S., and about 0.2 Gm. of aluminum wire be added, and if, in the upper portion of the test-tube, a pledget of purified cotton be inserted, and over the mouth there be placed a piece of moistened red litmus paper, then, if the tube be heated upon a water-bath for fifteen minutes, no blue coloration of the paper should be discernible.

Barium. Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S.

Cyanide. If 5 Cc. of the aqueous solution be gently heated with one drop of ferrous sulphate T.S. and 0.5 Cc. of potassium hydroxide T.S., no blue color should appear after acidulating the mixture with hydrochloric acid.

Limit of chlorides and bromides and absence of thiosulphate. If 0.2 Gm. of Potassium Iodide be dissolved in 2 Cc. of ammonia water (10 percent.), and 13 Cc. of tenth-normal silver nitrate V.S. be added, then, after thoroughly agitating and filtering, the filtrate, upon acidifying with nitric acid, should not become more than slightly turbid nor should any darkening appear within ten minutes.

Quantitative Test.—If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of distilled water, and about 3 drops of potassium chromate T.S. be added, it should require not more than 30.8 Cc. nor less than 30 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color (corresponding to at least 99 percent. of pure Potassium Iodide).

Uses.—This is the most valuable medicinal compound of iodine, if the extent to which it is employed is a criterion. It is used as an alterative in eight-grain doses (0.5 Gm.); as an antisyphilitic, four drachms (16 Gm.), largely diluted, may be given.

POTASSII NITRAS. U.S. Potassium Nitrate

$KNO_3 = 100.43$

[NITRE]

It should contain not less than 99 percent. of pure Potassium Nitrate [$NO_2.OK$], and should be kept in well-stoppered bottles.

Preparation.—*Nitre*, or *Saltpetre*, is sometimes a natural product; usually, however, it is produced artificially in what are known as nitre beds, which are made up of earth and wood ashes, with animal and vegetable refuse; these are protected from rain by sheds. In time the ammonia, produced by the decomposition of the organic matter in the mixture, is oxidized, nitric acid is formed, which unites with the potassium hydroxide in the wood ashes, and potassium nitrate is gradually formed; this is separated by lixiviation, filtration, evaporation, and crystallization. It is generally imported from Europe or India in a crude state and refined in this country.

Official Description.—Colorless, transparent, six-sided, rhombic prisms, or a white crystalline powder; slightly hygroscopic in moist air.
Odor, Taste, and Reaction.—Odorless; cooling, saline, and pungent taste; neutral reaction.
Solubility.—*Water.* In 3.6 parts at 25° C. (77° F.); in 0.4 part of boiling water.
Alcohol. Very sparingly.
Tests for Identity.—When heated to 353° C. (667.4° F.) the salt melts. At a higher temperature it is decomposed, giving off oxygen at first, and then some of its nitrogen, leaving a residue of potassium nitrate, nitrite, and oxide. When thrown upon red-hot coals, the salt deflagrates.

With sodium bitartrate T.S. the aqueous solution (1 in 20) yields a white, crystalline precipitate.

If 5 Cc. of an aqueous solution (1 in 20) be agitated with an equal volume of sulphuric acid, and the liquid be cooled and a crystal of ferrous sulphate be placed in the liquid, a dark brown color should appear around the crystal.

If a drop of diphenylamine T.S. be mixed with 5 Cc. of an aqueous solution, and sulphuric acid be slowly added so as to form a separate layer, a deep blue color will appear at the line of contact.

Impurities and Tests for Impurities.—*Heavy metals.* An aqueous solution of Potassium Nitrate (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test (see U. S. P. Test No. 121, Chap. LXII).

Iodide. If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and if chlorine water be introduced, drop by drop, with agitation, the chloroform should not acquire a violet tint.

Chlorate and perchlorate. No yellow color should appear when 0.1 Gm. of the dry salt is sprinkled upon 1 Cc. of pure concentrated sulphuric acid.

Uses.—Potassium nitrate is diuretic and diaphoretic in doses of ten to twenty grains (0.6 to 1.2 Gm.). In concentrated solution it is antiseptic. It is most largely used in making gunpowder.

POTASSII PERMANGANAS. U.S. Potassium Permanganate

$KMnO_4 = 156.98$

It should contain not less than 99 percent. of pure Potassium Permanganate [$MnO_3.OK$], and should be kept in glass-stoppered bottles, protected from light.

Potassium Permanganate, when in concentrated solution or in the dry condition, should not be brought in contact with organic or other readily oxidizable substances.

Preparation.—This salt is made by boiling a solution of potassium manganate with water.

$$\underset{\text{Potassium Manganate}}{3K_2MnO_4} + \underset{\text{Water}}{3H_2O} = \underset{\text{Potassium Permanganate}}{K_2Mn_2O_8} + \underset{\text{Manganese Peroxide}}{MnO_3H_2} + \underset{\text{Potassium Hydroxide}}{4KHO}$$

Potassium manganate is made by heating manganese dioxide with potassium hydroxide with or without the aid of an oxidizing agent like potassium chlorate; the potassium hydroxide liberated by the reaction requires neutralization with an acid if all the permanganate is to be obtained, because the latter, in the presence of an excess of alkali remains in the condition of manganate.

It may also be made by the electrolysis of the manganate, the products being permanganate, potassium hydroxide and hydrogen.

Official Description.—Slender, monoclinic prisms, of a dark purple color, almost opaque by transmitted, and of a blue, metallic lustre by reflected, light; permanent in the air.

Odor, Taste, and Reaction.—Odorless; taste at first sweet, but afterwards disagreeable and astringent. Neutral reaction in aqueous solution.

Solubility.—*Water.* In about 15 parts at 25° C. (77° F.); in 3 parts of boiling water.
Alcohol. Decomposed.

Tests for Identity.—When heated, the salt decrepitates, and at 240° C. (464° F.) it decomposes, yielding oxygen, potassium manganate, and manganese dioxide.

The aqueous solution of the salt is of a deep violet-red color when concentrated, and of a rose color when much diluted, and the rose color is discharged by hydrogen sulphide, ferrous sulphate, oxalic acid, alcohol, hydrogen dioxide, and many other readily oxidizable substances, especially if the solution be first rendered acid by sulphuric acid.

Impurities and Tests for Impurities.—If 0.5 Gm. of Potassium Permanganate be boiled with 20 Cc. of water and 4 Cc. of alcohol until it is completely decomposed, and the liquid then filtered, the clear, colorless filtrate may be used for the following tests:

Limit of sulphate. If to 5 Cc. of the filtrate, acidulated with nitric acid, barium chloride T.S. be added, not more than a very slight turbidity should be produced.

Chloride. In another portion of 5 Cc., acidulated with nitric acid, silver nitrate T.S. should produce no precipitate or cloudiness.

Nitrate. If to another portion of 5 Cc. of the filtrate 1 drop of diphenylamine T.S. be added, and then 1 Cc. of sulphuric acid introduced, so as to form a layer beneath, no blue color should appear at the line of contact.

Quantitative Test.—If 0.1 Gm. of Potassium Permanganate be dissolved in 100 Cc. of distilled water, to which 1 Cc. of sulphuric acid and 35 Cc. of tenth-normal oxalic acid V.S. have been previously added, then the addition of not more than 3.5 Cc. of tenth-normal potassium permanganate V.S. should be required to impart a permanent pink tint.

Uses.—Potassium permanganate is one of the most powerful oxidizing agents known, and it is for this reason that the official cautionary note near the head of this article is properly appended. It is owing to the facility with which it parts with oxygen, when in contact with organic matter, that it is useful as a disinfectant; hence when used externally its application by means of lint, towels, etc., should be avoided, because its energy would be spent upon these instead of upon the part of the body intended to be affected by it. Chemically, it is used as a volumetric test and oxidizer, for which it is admirably adapted on account of the distinctness of its color reactions, although the difficulty of keeping the solution from partial decomposition through the action of light and air is a serious annoyance and interferes with the accuracy of the estimation. The dose is one grain (0.065 Gm.). It has been used successfully as an antidote to morphine poisoning and against snake bite. In the latter case a strong solution should be injected into the part which has been bitten.

POTASSII SULPHAS. U.S. Potassium Sulphate

$K_2SO_4 = 173.07$

It should contain not less than 99 percent. of pure Potassium Sulphate [$SO_2(OK)_2$].

Preparation.—Potassium sulphate is obtained as a by-product in many chemical processes, although since the introduction of sodium nitrate as the source of the nitrates it is not produced very largely. It is also obtained from *kainite*, the mineral found in the Stassfurt salt-beds, which is a double potassium and magnesium sulphate. It can be made by decomposing potassium nitrate with sulphuric acid.

$$\underset{\text{Potassium Nitrate}}{2KNO_3} + \underset{\text{Sulphuric Acid}}{H_2SO_4} = \underset{\text{Potassium Sulphate}}{K_2SO_4} + \underset{\text{Nitric Acid}}{2HNO_3}$$

Official Description.—Hard, colorless, transparent, six-sided, rhombic prisms terminated by pyramids, or a white powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless; somewhat bitter, saline taste; neutral reaction in aqueous solution.

Solubility.—*Water.* In about 9 parts at 25° C. (77° F.); in 4 parts of boiling water.

Alcohol. Insoluble.

Tests for Identity.—When heated, the crystals decrepitate. At a bright red heat they fuse, and at a white heat the salt suffers partial decomposition.

The aqueous solution is neutral to litmus paper.

The saturated aqueous solution of the salt yields a white, crystalline precipitate with excess of sodium bitartrate T.S.

An aqueous solution of the salt (1 in 20) yields with barium chloride T.S. a heavy white precipitate, insoluble in hydrochloric acid.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of Potassium Sulphate (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—The principal use for potassium sulphate in pharmacy has been to act as a diluent in powdering ipecac and opium in the so-called Dover's powder. It is well adapted for this purpose, for, on account of the hardness of the crystals, the ingredients are thoroughly blended during the time required to produce a fine powder.

CHAPTER XXXIX

THE SODIUM SALTS

THE sodium salts are generally more frequently used than those having potassium for their base, because they are relatively cheaper, and are often more soluble. The metal *Sodium* is a soft, malleable, ductile solid, which must be protected from the oxygen of the air by being constantly immersed in petroleum or naphtha. It is now largely and cheaply made by electrolysis.

Tests for Sodium Salts

Sodium may be recognized in its salts by the following reactions :

1. The intensely yellow color produced when even a trace of a sodium compound is introduced into a colorless flame.

2. A reliable and practical precipitant is yet to be discovered for the sodium salts, because the compounds are generally very soluble. Neutral solutions may be precipitated by potassium metantimoniate : this reaction, however, has but a limited application.

3. Sodium salts are generally colorless, and not volatile below a red heat.

Official Sodium Salts and Preparations

Official Name	Preparation
With Inorganic Radicals	
Sodii Arsenas	By heating together arsenic trioxide, sodium nitrate, and sodium carbonate
Arsenas Exsiccatus	By drying sodium arsenate until it ceases to lose weight
Bicarbonas	By exposing sodium carbonate to the action of carbon dioxide
Bisulphis	By saturating a solution of sodium carbonate with sulphurous acid
Boras	By purifying the native salt
Bromidum	By treating ferrous bromide with sodium carbonate
Carbonas Monohydratus	By crystallizing with agitation a concentrated solution of sodium carbonate at 35° C. (95° F.)
Chloras	By double decomposition between sodium bitartrate and potassium chlorate
Chloridum	By evaporating sea-water and purifying
Hydroxidum	By boiling solution of sodium carbonate with calcium hydroxide and evaporating
Hypophosphis	By double decomposition between calcium hypophosphite and sodium carbonate
Iodidum	By treating ferrous iodide with sodium carbonate
Nitras	By purifying the native salt
Nitris	By decomposing sodium nitrate by heating in contact with starch, lead, or other reducing substances
Phosphas	By treating acid calcium phosphate with sodium carbonate
Phosphas Effervescens	Prepared by mixing finely powdered exsiccated sodium phosphate, sodium bicarbonate, tartaric acid, and citric acid, heating until the whole becomes uniformly moist, granulating, and drying
Phosphas Exsiccatus	Made by drying the phosphate until it ceases to lose weight
Pyrophosphas	By heating sodium phosphate to redness, dissolving and crystallizing
Sulphas	By treating common salt with sulphuric acid
Sulphis	By decomposing sodium carbonate with sulphurous acid
Thiosulphas	By decomposing calcium thiosulphate with sodium sulphate

Official Sodium Salts and Preparations—*Continued*

Official Name	Preparation
Liquor Sodæ Chlorinatæ	Double decomposition between chlorinated lime and monohydrated sodium carbonate
Sodii Arsenatis	1 percent. solution of exsiccated sodium arsenate
Sodii Hydroxidi	By dissolving sodium hydroxide in water
Sodii Phosphatis Compositus, Compound Solution of Sodium Phosphate	Made by dissolving sodium phosphate, sodium nitrate, and citric acid in distilled water. 1 Cc. contains 1 Gm. of sodium phosphate
Trochisci Sodii Bicarbonatis	Each contains three grains of sodium bicarbonate
With Organic Radicals	
Sodii Acetas	By decomposing sodium carbonate with acetic acid
Benzoas	By decomposing sodium carbonate with benzoic acid
Citras	By saturating a solution of sodium carbonate with citric acid
Phenolsulphonas	By double decomposition between barium phenolsulphonate and sodium carbonate
Salicylas	By decomposing sodium carbonate with salicylic acid
Mistura Rhei et Sodæ	Contains sodium bicarbonate

Unofficial Sodium Salts and Preparations

Sodii Phenolas, NaC_6H_5O Sodium Phenolate	Add metallic sodium to phenol, and allow it to crystallize
Sodii-Citro-Tartras Effervescens Effervescent Sodium Citro-tartrate	17 parts sodium bicarbonate; 8 parts tartaric acid; 6 parts citric acid. Mix, and place in a dish heated to about 200° F. Stir constantly until a granular salt is obtained. Lastly, sift it
Sodii et Ammonii Phosphas $NH_4NaHPO_4+4H_2O$ Sodium and Ammonium Phosphate	Dissolve 5 parts crystallized sodium phosphate and 2 parts ammonium phosphate in 20 parts hot water; then add ammonia water until the liquid is alkaline, and crystallize
Sodii et Argenti Thiosulphas $2Na_2S_2O_3+Ag_2S_2O_3$ Sodium and Silver thiosulphate	Dissolve freshly precipitated silver oxide in a solution of sodium thiosulphate, evaporate and crystallize
Sodii Ethylas, C_2H_5NaO Sodium Ethylate	Caustic. Used in alcoholic solution; also applied externally mixed with olive oil
Sodii Ethylsulphas, $C_2H_5NaSO_4+H_2O$ Sodium Ethylsulphate, Sodium Sulphovinate	Cathartic
Sodii Nitro-Prussidum $Na_2Fe(CN)_5NO+2H_2O$ Sodium Nitro-Prusside	Digest 1 part potassium ferrocyanide with 2 parts nitric acid and 2 parts water until it ceases to produce a blue precipitate with iron salts. When cool, neutralize the mother liquor with sodium carbonate, then collect the red crystals
Sodii et Platini Chloridum $2NaCl.PtCl_4+6H_2O$ Sodium and Platinum Chloride	Dissolve 3 parts platinic chloride and 5 parts sodium chloride in water, and evaporate to dryness, stirring continually
Sodii Silicas, Na_2SiO_3 Sodium Silicate	Mix 1 part silica and 2 parts dried sodium carbonate; fuse in an earthenware crucible, and pour the mass on a slab. Dissolve in water, filter, concentrate, and crystallize
Sodii Silicofluoridum, Na_2SiF_6 Sodium Silico-Fluoride	Antiseptic. A mild caustic
Sodii Stannas, Na_2SnO_3 Sodium Stannate	Fuse tin ore with caustic soda and sodium nitrate
Sodii Sulphobenzoas, $C_6H_4(NaSO_3)COONa$ Sodium Sulphobenzoate	Non-poisonous antiseptic
Sodii Tartras, $Na_2C_4H_4O_6+2H_2O$ Sodium Tartrate	Dissolve 6 parts tartaric acid and 7½ parts sodium bicarbonate, each separately, in water. Mix solutions, filter, concentrate, and crystallize
Sodii Valeras, $NaC_5H_9O_2$ Sodium Valerate	Saturate valeric acid with sodium carbonate

SODII HYDROXIDUM. U.S. Sodium Hydroxide

$NaOH = 39.76$

[SODA, PHARM. 1890 CAUSTIC SODA, SODA, SODIUM HYDRATE]

It should contain not less than 90 percent. of pure anhydrous Sodium Hydroxide, and not more than two percent. of other inorganic substances, with the exception of water. It should be kept in well-stoppered bottles made of hard glass.

Preparation.—Owing to the improvements in the manufacture of metallic sodium and the cheapening of the product, sodium hydroxide can be found in commerce which has been made by oxidizing the metal by bringing it in contact with water and evaporating the pure solution of sodium hydroxide. When the pure hydroxide is not needed, the white caustic sodium hydroxide, in sticks, made by evaporating a solution of sodium hydroxide (see Liquor Sodii Hydroxidi) and casting the fused residue into moulds, is used. (See Potassii Hydroxidum, page 513.)

Official Description.—Dry, white or nearly white flakes, powder, fused masses, or translucent or opaque, white pencils. Exposed to the air it rapidly deliquesces, absorbs carbon dioxide, and becomes covered with a dry coating of carbonate.

Odor, Taste, and Reaction.—Odorless; caustic taste. *Great caution is necessary in tasting and handling it*, as it rapidly destroys organic tissues. Alkaline reaction.

Solubility.—*Water.* In about 1 part at 25° C. (77° F.); in 0.8 part of boiling water.
Alcohol. Very soluble.

Tests for Identity.—When heated to about 525° C. (977° F.), Sodium Hydroxide melts to a clear, oily liquid, and at a bright red heat it is slowly volatilized unchanged. When introduced into a non-luminous flame, it imparts to it an intense yellow color.

Impurities and Tests for Impurities.—*Organic matter and insoluble impurities.* The aqueous solution (1 in 20) should be perfectly clear and colorless, and

Limit of potassium. After being acidulated with acetic acid, it should yield no precipitate on the addition of an excess of tartaric acid T. S.

Heavy metals. The aqueous solution of Sodium Hydroxide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of carbonate. On adding a slight excess of diluted sulphuric acid to 10 Cc. of an aqueous solution of Sodium Hydroxide (1 in 10), no distinct effervescence should occur.

Limit of silicate, etc. If 0.7 Gm. of Sodium Hydroxide be dissolved in 1.5 Cc. of water, and the solution added to 10 Cc. of alcohol, not more than a slight, white precipitate should occur within ten minutes.

Quantitative Test.—Introduce about 1 Gm. of Sodium Hydroxide into a stoppered weighing bottle, and weigh accurately. Dissolve this in about 50 Cc. of water, and titrate the solution with normal sulphuric acid V. S., using methyl-orange T. S. as indicator. Multiply the number of Cc. of the normal sulphuric acid V. S. consumed, by 3.976, and divide this product by the weight of the Sodium Hydroxide taken; the quotient represents the percentage of Sodium Hydroxide present.

Uses.—*Caustic Soda*, as sodium hydroxide is termed commercially, is sometimes preferred to the analogous potassium salt, in the belief that it is milder and less deliquescent. It is used pharmaceutically in making solution of sodium hydroxide.

LIQUOR SODII HYDROXIDI. U.S. Solution of Sodium Hydroxide

[Liquor Sodæ, Pharm. 1890 Solution of Soda]

An aqueous solution, containing about 5 percent. of Sodium Hydroxide [NaOH = 39.76].

	Metric	Old form
* **Sodium Hydroxide**	56 Gm.	1 oz. av.
Distilled Water	944 Gm.	15 fl. oz.
To make	1000 Gm.	1 pint

Dissolve the Sodium Hydroxide in the Distilled Water, and add Distilled Water to weigh 1000 Gm. [or to measure, old form, 1 pint].

The Sodium Hydroxide used in this process should be of the full strength and quality directed by the Pharmacopœia (90 percent.). Sodium Hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5040 by the percentage of absolute Sodium Hydroxide contained therein.

Solution of Sodium Hydroxide should be kept in bottles made of green glass, and provided with glass stoppers coated with paraffin or petrolatum.

This solution was directed to be made in the U. S. P. 1890 by a method similar to that for preparing the solution of potassium hydroxide (see page 514).

The sodium hydroxide is obtained in this process by decomposing the carbonate by heating it in contact with an aqueous mixture of calcium hydroxide; calcium carbonate is formed, and sodium hydroxide remains in solution.

$$\underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} + \underset{\substack{\text{Calcium}\\\text{Hydroxide}}}{Ca(HO)_2} = \underset{\substack{\text{Sodium}\\\text{Hydroxide}}}{2NaHO} + \underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3}$$

Official Description.—A clear, colorless liquid.

Odor, Taste, and Reaction.—Odorless; very acrid and caustic taste; strongly alkaline reaction.

Specific Gravity.—About 1.056 at 25° C. (77° F.).

Tests for Identity.—It should conform to the reactions and tests for an aqueous solution of sodium hydroxide given under *Sodii Hydroxidum.*

Quantitative Test.—To neutralize 20 (19.9) Gm. of Solution of Sodium Hydroxide there should be required about 25 Cc. of normal sulphuric acid V. S., methyl-orange T. S. being used as indicator (each Cc. of normal sulphuric acid V. S. indicating 0.2 percent. of absolute Sodium Hydroxide).

Uses.—Solution of sodium hydroxide is an antacid, and is used for the same purposes and in the same dose as solution of potassium hydroxide (see page 514).

SODII ACETAS. U.S. Sodium Acetate

$NaC_2H_3O_2 + 3H_2O = 135.10$

It should contain in an uneffloresced condition not less than 99.5 percent. of pure Sodium Acetate [$CH_3.COONa + 3H_2O$], and should be kept in well-stoppered bottles.

Preparation.—This salt is obtained on the large scale in the process for making acetic acid. For medicinal purposes it may be made conveniently by saturating acetic acid with sodium carbonate, filtering the solution, concentrating it, and obtaining the salt in crystals.

$$\underset{\substack{\text{Acetic}\\\text{Acid}}}{2HC_2H_3O_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\\text{Acetate}}}{2NaC_2H_3O_2} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

It is sometimes granulated, and in this form it is more convenient for dispensing purposes than the usual large crystals.

Official Description.—Colorless, transparent, monoclinic prisms, or a granular, crystalline powder; efflorescent in warm, dry air.

Odor, Taste, and Reaction.—Odorless; cooling, saline taste. An aqueous solution (1 in 20) should be alkaline to red litmus paper, but should not affect phenolphthalein.

Solubility.—*Water.* In about 1 part at 25° C. (77° F.); in all proportions in boiling water. *Alcohol.* In 23 parts at 25° C. (77° F.); in all proportions in boiling alcohol.

Tests for Identity.—When heated to 60° C. (140° F.), the salt begins to liquefy. At 123° C. (253.4° F.) it becomes dry and anhydrous; at 315° C. (599° F.) it is decomposed, with evolution of inflammable, empyreumatic vapors, leaving a black residue of sodium carbonate and carbon, which imparts to a non-luminous flame an intense yellow color, gives an alkaline reaction with litmus paper, and effervesces with acids.

If a few particles of the salt be added to a mixture of 1 Cc. of sulphuric acid and 1 Cc. of alcohol, and heated to boiling, acetic ether will be formed, recognizable by its odor.

On the addition of a few drops of ferric chloride T.S., the aqueous solution (1 in 20) assumes a deep red color, and, when boiled, yields a brown, flocculent precipitate of basic ferric acetate.

Impurities and Tests for Impurities.—*Limit of potassium.* A saturated aqueous solution should not be rendered turbid by the addition of sodium bitartrate T.S.

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If 1 Gm. of Sodium Acetate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 14.7 (14.74) Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—Sodium acetate is often preferred to potassium acetate as a diuretic. It is not deliquescent like the latter, and is said to be as efficient, although milder in its action. The dose is from fifteen to sixty grains (1 to 4 Gm.).

SODII ARSENAS. U. S. Sodium Arsenate

$Na_2HAsO_4 + 7H_2O = 309.84$

It should contain in an uneffloresced condition not less than 98 percent. of pure Di-sodium-ortho-arsenate [$AsO(OH)(ONa)_2 + 7H_2O$], and should be kept in well-stoppered bottles.

Preparation.—A process for this salt was formerly official; it is as follows:

Take of Arsenious Acid (or Arsenic Trioxide), in fine powder, 960 *grains;* Nitrate of Sodium, in fine powder, 816 *grains;* Dried Carbonate of Sodium, in fine powder, 528 *grains;* Distilled Water, boiling hot, *half a pint.* Having mixed the powders thoroughly, put the mixture into a large clay crucible, and cover it with the lid. Expose it to a full red heat until effervescence has ceased and complete fusion has taken place. Pour the fused salt on a porcelain slab, and as soon as it has solidified, and while it is still warm, put it into the hot water, and stir until it is dissolved. Filter the solution, and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering paper, keep them in a well-stoppered bottle.

The rationale of this process is that when arsenic trioxide, sodium nitrate, and sodium carbonate are fused together, sodium pyroarsenate is formed, while nitrous anhydride and carbon dioxide escape as gases.

$$\underset{\substack{\text{Arsenic}\\\text{Trioxide}}}{As_2O_3} + \underset{\substack{\text{Sodium}\\\text{Nitrate}}}{2NaNO_3} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\\text{Pyroarsenate}}}{Na_4As_2O_7} + \underset{\substack{\text{Nitrous}\\\text{Anhydride}}}{N_2O_3} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

Sodium pyroarsenate is converted into the orthoarsenate (the official salt) by dissolving the former in water, filtering the solution, and crystallizing.

$$\underset{\substack{\text{Sodium}\\\text{Pyroarsenate}}}{Na_4As_2O_7} + \underset{\text{Water}}{15H_2O} = \underset{\substack{\text{Sodium}\\\text{Orthoarsenate}}}{2(Na_2HAsO_4, 7H_2O)}$$

Official Description.—Colorless, transparent, monoclinic prisms; efflorescent in dry air, and somewhat deliquescent in moist air.

Odor and Taste.—Odorless; mild, alkaline taste. *Caution should be used in tasting this salt, as it is very poisonous.*

Solubility.—*Water.* In 1.2 parts at 25° C. (77° F.), and very soluble in boiling water.
Alcohol. Very sparingly soluble in cold, but nearly insoluble in boiling alcohol.
Tests for Identity.—When gently heated, the salt loses 5 molecules of water (28.8 percent.), and is converted into a white powder. At 148° C. (298.4° F.) it loses all of its water of crystallization, at a higher temperature the salt fuses, and at a red heat it is converted into pyroarsenate.
Sodium Arsenate should respond to the tests of identity and purity prescribed under *Sodii Arsenas Exsiccatus.*

Uses.—The only advantage in using this salt in preference to arsenic trioxide is that the practitioner is more apt to get it of uniform quality; their properties are identical. The dose is from one-twelfth to one-third of a grain (0.005 to 0.02 Gm.).

SODII ARSENAS EXSICCATUS. U.S. Exsiccated Sodium Arsenate

$Na_2HAsO_4 = 184.68$

It should contain not less than 98 percent. of pure anhydrous Di-sodium-ortho-arsenate $[AsO(OH)(ONa)_2]$.

Sodium Arsenate Crystals, a sufficient quantity

Break the crystals into small fragments, and allow them to effloresce at a temperature between 40° and 50° C. (104° and 122° F.) until they are completely disintegrated; then gradually increase the temperature to 150° C. (302° F.), and continue the drying until the product ceases to lose weight. Reduce it to a fine powder, and transfer it to dry, well-stoppered bottles.

Official Description.—An amorphous, white powder; permanent in dry air.
Odor and Taste.—Odorless; mildly alkaline taste. *It should be tasted with great caution, as the salt is very poisonous.*
Solubility.—*Water.* In 3 parts at 25° C. (77° F.), and very soluble in boiling water.
Alcohol. Very sparingly in cold, but nearly insoluble in boiling alcohol.
Tests for Identity.—When heated to 150° C. (302° F.), the salt should not lose weight; at red heat it is converted into pyroarsenate. It imparts an intense yellow color to a non-luminous flame.
The aqueous solution of the salt (1 in 20) yields a white precipitate with barium chloride T.S., or with calcium chloride T.S., and a dark red precipitate with silver nitrate T.S., all of which precipitates are soluble in nitric acid.
If 0.5 Cc. of an aqueous solution (1 in 20) be mixed with 2 Cc. of hydrochloric acid, and a drop of this mixture be placed upon a bright piece of copper-foil, then, upon applying a gentle heat, a dark steel-gray film will be deposited upon the copper.
Impurities and Tests for Impurities.—*Arsenite.* If to 2 Cc. of an aqueous solution (1 in 20), 5 Cc. of tenth-normal silver nitrate V.S. be added, and the precipitate redissolved by a slight excess of ammonia water, no black precipitate of reduced silver should appear on boiling.
Lead, copper, iron, etc. If to 5 Cc. of an aqueous solution (1 in 100), 1 Cc. of ammonium sulphide T.S. be added, no dark coloration should appear.

Uses.—Exsiccated Sodium Arsenate is used in making the official solution (see Liquor Sodii Arsenatis). The advantage in using it in preference to sodium arsenate is that greater definiteness is secured; the latter salt as found in commerce is more or less effloresced, and the solution if made from it would be variable in its arsenical strength. Sixty parts of exsiccated arsenate represent 100 parts of the official crystallized salt.

SODII BENZOAS. U.S. Sodium Benzoate

$NaC_7H_5O_2 = 143.01$

It should contain not less than 99 percent. of pure Sodium Benzoate $[C_6H_5.COONa]$, and should be kept in well-stoppered bottles.

Preparation.—Benzoic acid is added to a hot concentrated solution of pure sodium carbonate until effervescence ceases. The solution is evaporated, cooled, and allowed to crystallize, or, preferably, evaporated to dryness and granulated.

$$\underset{\text{Benzoic Acid}}{2HC_7H_5O_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\\text{Benzoate}}}{2NaC_7H_5O_2} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O}$$

The yield of granulated salt is about one and one-third times the quantity of benzoic acid used.

Official Description.—A white, amorphous, granular or crystalline powder; permanent in the air.

Odor, Taste, and Reaction. Odorless; sweetish, astringent taste; neutral or slightly alkaline in aqueous solution.

Solubility.—*Water.* In 1.6 parts at 25° C. (77° F.); in 1.3 parts of boiling water.
Alcohol. In 43 parts at 25° C. (77° F.); in 12 parts of boiling alcohol.

Tests for Identity.—When heated, the salt melts, emits vapors having the odor of benzoic acid, then chars, and finally leaves a residue of sodium carbonate and carbon. To a non-luminous flame it imparts an intense yellow color.

If a few drops of ferric chloride T.S. be added to an aqueous solution of the salt, a salmon-colored precipitate will be deposited.

If 5 Cc. of diluted sulphuric acid be added to a solution of 1 Gm. of the salt in 10 Cc. of water, a white precipitate of benzoic acid will be produced, which, after being thoroughly washed, should conform to the tests of purity given under *Acidum Benzoicum.*

Impurities and Tests for Impurities.—*Heavy metals.* If an aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If 1 Gm. of dry Sodium Benzoate be thoroughly ignited at red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 13.85 Cc. of half-normal hydrochloric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—Sodium benzoate has been prescribed as a remedy in phthisis, diphtheria, and similar complaints, in fifteen-grain doses (1 Gm.). It is employed also in rheumatism.

SODII BICARBONAS. U.S. Sodium Bicarbonate

$NaHCO_3 = 83.43$

It should contain not less than 99 percent. of pure Sodium Bicarbonate [CO(OH)(ONa), and should be kept in well-closed vessels, in a cool place.

All the processes for making this important salt of sodium, with one exception, consist in the addition of carbon dioxide to sodium carbonate. This operation cannot be carried on profitably upon the small scale; hence it is most advantageous for the pharmacist to buy commercial sodium bicarbonate and purify it for dispensing purposes (see page 539). Sodium carbonate contains ten molecules of water of crystallization; sodium bicarbonate contains none, hence provision must be made for the escape of this water, which is thrown out of combination during the process of carbonating. The crystallized sodium carbonate is placed upon false bottoms in chambers arranged so that the water can escape as it is liberated.

$$\underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Sodium}\\\text{Bicarbonate}}}{2HNaCO_3}$$

Sodium bicarbonate is more largely prepared by the ammonia-soda process, or *Solvay's*, as it is usually called. In this, carbon dioxide is passed into a solution of common salt in ammonia water, double decomposition ensues, sodium bicarbonate is precipitated, and ammonium chloride, being very soluble, remains in solution.

$$\underset{\text{Sodium Chloride}}{NaCl} + \underset{\text{Ammonia}}{NH_3} + \underset{\text{Carbon Dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} = \underset{\text{Sodium Bicarbonate}}{HNaCO_3} + \underset{\text{Ammonium Chloride}}{NH_4Cl}$$

Sodium bicarbonate is still found in the market containing small quantities of impurities and having a disagreeable alkaline taste, and it should be purified.

This purification amounts to nothing more than washing the salt with distilled water. The common impurities, sodium carbonate, chloride, and sulphate, and ammonium salts, are much more soluble than the bicarbonate, and they are easily dissolved out, without any serious loss of the bicarbonate. Diluted alcohol is sometimes substituted for water for washing out the carbonate. (See official test for limit of carbonate.)

Official Description.—A white, opaque powder; permanent in dry air, but slowly decomposed in moist air.

Odor, Taste, and Reaction.—Odorless; cooling, mildly alkaline taste. The solution, when freshly prepared with cold distilled water, without shaking, gives a slightly alkaline reaction with litmus paper. The alkalinity increases by standing, agitation, or increase of temperature.

Solubility.—*Water.* In 12 parts at 15° C. (59° F.); above this temperature the solution gradually loses carbon dioxide, and at boiling heat the salt is entirely converted into normal carbonate.

Alcohol. Insoluble.

Tests for Identity.—When heated, the salt is decomposed into normal carbonate, water, and carbon dioxide, and finally, at 100° C. (212° F.), loses about 36.5 percent. of its weight. At a bright red heat it melts. To a non-luminous flame it imparts an intense yellow color.

With acids the solution effervesces strongly.

If Sodium Bicarbonate be heated in a test-tube, no odor of ammonia should be evolved.

If 1 Gm. of the salt be dissolved in 19 Cc. of water, it should yield a perfectly clear and colorless solution, leaving no residue.

Impurities and Tests for Impurities.—*Limit of carbonate.* If 1 Gm. of the salt be dissolved without agitation in 20 Cc. of water, at a temperature not exceeding 15° C. (59° F.), and 0.2 Cc. of normal hydrochloric acid and 2 drops of phenolphthalein T.S. be added, a red tint should not appear immediately.

Sulphocyanate. If 5 Cc. of an aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the liquid should not be colored red by a drop of ferric chloride T.S.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—Two Gm. of Sodium Bicarbonate should require for complete neutralization not less than 23.7 (23.74) Cc. of normal sulphuric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—If *official* sodium bicarbonate were universally used, the preparations into which the commercial article now enters would be largely deprived of the disagreeable, bitter taste which is caused by the presence of carbonate. Sodium bicarbonate is largely used as a safe antacid, in doses of ten to fifteen grains (0.6 to 1 Gm.). It is preferably administered in carbonic acid water, and the draught is popularly known as "extra soda." The misnomer is caused by the erroneous use of the term "soda water."

SODII BISULPHIS. U.S. Sodium Bisulphite

$NaHSO_3 = 103.35$

It should contain not less than 90 percent. of pure Sodium Bisulphite, and should be kept in a cool place, in small, completely filled, well-stoppered bottles.

Preparation.—The acid sodium sulphite is used in solution in the arts, but, owing to its unstable character, it is inferior to the normal sulphite. It is prepared by passing sulphurous acid gas into a solution of sodium carbonate until saturation takes place and all the carbon dioxide is expelled; the liquid is then evaporated, and the crystals which form on cooling are washed and dried.

$$\underset{\substack{\text{Sodium}\\ \text{Carbonate}}}{Na_2CO_3} + \underset{\substack{\text{Sulphurous}\\ \text{Acid}}}{2H_2SO_3} = \underset{\substack{\text{Sodium}\\ \text{Bisulphite}}}{2NaHSO_3} + \underset{\substack{\text{Carbon}\\ \text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O}$$

It is converted by exposure to the air into sulphate and carbonate. It is largely manufactured for use in the arts as an *antichlor*, to neutralize the effects of the chlorine used in bleaching fabrics.

Official Description.—Opaque, prismatic crystals, or a granular powder; exposed to the air it loses sulphur dioxide, and is gradually oxidized to sulphate.

Odor, Taste, and Reaction.—Exhaling an odor of sulphur dioxide, and having a disagreeable, sulphurous taste; acid reaction in aqueous solution.

Solubility.—*Water.* In 3.5 parts at 25° C. (77° F.); in about 2 parts of boiling water.

Alcohol. In 70 parts at 25° C. (77° F.); in 49 parts of boiling alcohol.

Tests for Identity.—When strongly heated, the salt decrepitates, emits vapors of sulphur and of sulphur dioxide, and leaves a residue of sodium sulphate. To a non-luminous flame it imparts an intense yellow color.

On the addition of hydrochloric or sulphuric acid, an aqueous solution of the salt evolves sulphur dioxide, which is recognized by its odor, and by its blackening a strip of paper dipped into mercurous nitrate T.S. and held over the escaping gas.

Impurities and Tests for Impurities.—*Thiosulphate.* If 1 Gm. of Sodium Bisulphite be dissolved in 10 Cc. of diluted nitric acid, and the solution heated sufficiently to expel the gases, the liquid should not become turbid.

Heavy metals. If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid, and heated sufficiently to expel the sulphur dioxide, the remaining solution, after being restored to its original volume, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If to 50 Cc. of tenth-normal iodine V.S., measured from a burette into a glass-stoppered vial (of about 100 Cc. capacity), 0.25 Gm. of finely powdered crystals of Sodium Bisulphite be added, the solution allowed to stand for about an hour, and shaken at frequent intervals, then the addition of not more than 6.45 Cc. of tenth-normal sodium thiosulphate V.S. should be required to decolorize the solution.

Uses.—Sodium bisulphite is used as an antiseptic and antiferment, in doses of five to ten grains (0.3 to 0.6 Gm.). The sulphite, however, is usually preferred. Its solution is also used in volumetric analysis.

SODII BORAS. U.S. Sodium Borate

$Na_2B_4O_7 + 10H_2O = 379.32$

It should contain in the uneffloresced condition not less than 99 percent. of pure sodium tetraborate, and should be kept in well-stoppered bottles.

Preparation.—This salt is found in immense quantities in California as a crystalline deposit at Clear Lake and near Death Valley. It is probable that this will continue to be the principal source of borax for many years to come. The process of purification consists simply in picking the large and perfect crystals out, washing them, and lixiviating the earth, which is strongly impregnated with borax, evaporating the solution, and crystallizing. It is sometimes called *biborate of sodium.* It is also found as *calcium borate*, or "cotton balls," in the borax mines of California, and sodium borate is obtained by double decomposition by treating the solution of calcium borate with sodium carbonate. Borax is found native in Thibet, Persia, and other localities. It is sometimes called *tincal.* Crude boric acid, obtained from

Tuscany, is fused with dried sodium carbonate, and a hot solution of the residue is crystallized in order to produce borax.

Official Description.—Colorless, transparent, monoclinic prisms, or a white powder; slightly efflorescent in warm, dry air.

Odor, Taste, and Reaction.—Inodorous; sweetish, alkaline taste. An aqueous solution (1 in 20) colors red litmus paper blue, and yellow turmeric paper reddish-brown. After being acidulated with hydrochloric acid, the solution colors blue litmus paper red; yellow turmeric paper remains unchanged at first, but on drying, becomes brownish-red, and this color is temporarily changed to bluish-black by moistening with ammonia water.

Solubility.—*Water.* In 17 parts at 25° C. (77° F.); in 0.5 part of boiling water.

Alcohol. Insoluble.

Other solvents. In 1 part of glycerin at 80° C. (176° F.).

Tests for Identity.—When heated, the salt at first loses part of its water of crystallization, then melts, and, when further heated, swells up and forms a white, porous mass.

At a red heat it loses all of its water of crystallization (47 percent.), and fuses to a colorless glass. To a non-luminous flame it imparts an intense yellow color.

If a drop of the solution of Sodium Borate in glycerin be held in a non-luminous flame, a transient bright green color will appear.

If a slight excess of diluted sulphuric acid be added to a hot, saturated, aqueous solution of the salt, shining, scaly crystals of boric acid will separate on cooling, which, when dissolved in alcohol and the liquid ignited, impart a green color to the flame.

With 21 Cc. of water, 1 Gm. of Sodium Borate should yield a perfectly clear and colorless solution, leaving no residue.

Impurities and Tests for Impurities.—*Carbonate or bicarbonate.* The aqueous solution (1 in 20) should not effervesce with acids.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Phosphate. The aqueous solution (1 in 20) should not be rendered turbid by magnesia mixture.

Nitrate. If 1 Gm. of the salt be dissolved in 20 Cc. of diluted sulphuric acid by the aid of heat, and 3 drops of indigo T.S. be added, the blue color should not be discharged after heating for ten minutes on a water-bath.

Uses.—Borax, as it is almost universally called, is antacid and diuretic. It enters into many mouth washes, and is frequently applied in the form of powder to ulcers in the mouth, for which purpose it is admirably adapted, being mildly alkaline and not very soluble. It is used enormously in the household as an ingredient in soaps, cleansers, etc. Pharmaceutically, it is frequently used in small quantity to whiten ointments, particularly the ointment of rose water. It is used for this purpose by dissolving it in water, and incorporating the solution. The dose is eight grains (0.5 Gm.).

SODII BROMIDUM. U. S. Sodium Bromide

$NaBr = 102.24$

It should contain, when dried, not less than 97 percent. of pure Sodium Bromide, and should be kept in well-stoppered bottles.

Preparation.—The process most used in making this salt is by decomposing ferrous bromide by treating it with sodium carbonate. The ferrous bromide is made by acting on iron wire with bromine in the presence of water, and, after filtering the solution, adding solution of sodium carbonate. The reaction may be thus expressed:

$$\underset{\text{Ferrous Bromide}}{FeBr_2} + \underset{\text{Sodium Carbonate}}{Na_2CO_3} = \underset{\text{Sodium Bromide}}{2NaBr} + \underset{\text{Ferrous Carbonate}}{FeCO_3}$$

Sodium bromide may also be made by first producing ammonium bromide by treating a solution of ammonia with bromine (see Ammonii Bromidum), and then by double decomposition with sodium carbonate, forming sodium bromide and ammonium carbonate. The solution, by careful evaporation and granulation, may be made to yield sodium bromide, while ammonium carbonate, being composed of volatile compounds, is dissipated by the amount of heat used to granulate the sodium salt.

Official Description.—Colorless or white, cubical crystals, or a white, granular powder. It absorbs moisture from the air without deliquescing.

Odor, Taste, and Reaction.—Odorless; saline, slightly bitter taste. The aqueous solution (1 in 20) is neutral or has a faintly alkaline reaction.

Solubility.—*Water.* In about 1.7 parts at 25° C. (77° F.); in 0.8 part of boiling water. *Alcohol.* In 12.5 parts at 25° C. (77° F.); in 11 parts of boiling alcohol.

Tests for Identity.—When heated to a bright red heat, the salt melts, and, at a somewhat higher temperature, slowly volatilizes without decomposition. To a non-luminous flame it imparts an intense yellow color.

Silver Nitrate T.S. added to a concentrated aqueous solution produces a yellowish-white precipitate, insoluble in nitric acid and in a moderate excess of ammonia water.

Impurities and Tests for Impurities.—*Limit of alkali.* If 1 Gm. of the salt be dissolved in 10 Cc. of water and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no color should be produced by the subsequent addition of a drop of phenolphthalein, T.S., even after boiling.

Iodide. If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and then chlorine water which has been diluted with an equal volume of water be cautiously introduced, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint.

Heavy metals. The aqueous solution of Sodium Bromide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Bromate. If diluted sulphuric acid be dropped upon some of the powdered salt, no yellow color should appear at once.

Barium. Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S.

Quantitative Test.—If 0.3 Gm. of the well-dried salt be dissolved in about 50 Cc. of water, and 2 or 3 drops of potassium chromate T.S. be added, it should require not less than 28.5 nor more than 30 Cc. of tenth-normal silver nitrate V. S. to produce a permanent red color.

Uses.—Sodium bromide is used for the same purposes as potassium bromide. It is probably inferior to the latter as a nervous sedative, although frequently combined with it. The dose is fifteen to sixty grains (1 to 4 Gm.).

SODII CARBONAS MONOHYDRATUS. U.S. Monohydrated Sodium Carbonate

$Na_2CO_3 + H_2O = 123.19$

It should contain not less than 85 percent. of pure anhydrous Sodium Carbonate [$CO.(ONa)_2$], corresponding to not less than 99.5 percent. of the crystallized monohydrated salt.

Preparation.—Impure sodium carbonate, or soda-ash, is consumed in enormous quantities in the arts, and cheap methods of production have been long sought for. The process elaborated by Leblanc, a French apothecary, in 1784, has been most largely used, and it possesses an historic interest because of the public endorsements which it received from the French government in 1794. It is remarkable that this process has been successfully worked, without material modifications, *for a century*, and has supplied the world with cheap soap and cheap glass. It also furnishes a striking illustration of the unrequited labors of inventors and benefactors, from the fact that Leblanc died a pauper in a French asylum. Although the process has been superseded by other methods, it is worthy of study, and is as follows:

sodium carbonate is made from common salt by two steps, first, by converting the salt by sulphuric acid into sodium sulphate, and, secondly, by decomposing the sulphate by calcium carbonate and charcoal at a high temperature, so as to yield sodium carbonate. The chemical reactions are as follows:

$$\underset{\substack{\text{Sodium}\\\text{Chloride}}}{2NaCl} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{Na_2SO_4} + \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{2HCl}$$

$$\underset{\substack{\text{Sodium}\\\text{Sulphate}}}{Na_2SO_4} + \underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3} + \underset{\text{Carbon}}{C_4} = \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} + \underset{\substack{\text{Calcium}\\\text{Sulphide}}}{CaS} + \underset{\substack{\text{Carbon}\\\text{Monoxide}}}{4CO}$$

The sulphate, first dried, is mixed with its own weight of ground limestone, and half its weight of small coal, ground and sifted, and the whole is heated in a reverberatory furnace, where it fuses and forms a black mass. The coal, at the temperature employed, converts the sodium sulphate into sodium sulphide. This reacts with the limestone, so as to form calcium sulphide and sodium carbonate. The black mass is next digested in warm water, which takes up the alkali and other soluble matters, and leaves the insoluble impurities, called *soda waste,* largely utilized in the manufacture of sodium thiosulphate. The solution is evaporated to dryness, and the mass obtained is calcined with one-fourth of its weight of sawdust, to convert the alkali fully into carbonate, by means of the carbonic acid resulting from the combustion of the sawdust. The product is redissolved in water, and the solution evaporated to dryness. This soda-ash contains about 50 percent. of sodium carbonate.

Solvay's process for making sodium bicarbonate is given on page 538; the bicarbonate is easily converted into carbonate by heating, and the carbon dioxide is utilized in another part of the process.

The cryolite process is used largely in the United States. Cryolite, $Al_2F_6 + 6NaF$, consists mainly of a double fluoride of aluminum and sodium, containing, in 100 parts, 13 of aluminum, 34 of sodium, and 53 of fluorine. Sodium carbonate is obtained by heating cryolite with chalk, whereby calcium fluoride is formed, while the sodium and aluminum combine to form sodium aluminate, a weak salt, which is dissolved out by lixiviation. The soda is converted into carbonate by passing carbon dioxide under pressure through the solution; and the alumina, separated from the soda, becomes insoluble, and is deposited.

$$\underset{\text{Cryolite}}{Al_2F_6 + 6NaF} + \underset{\substack{\text{Calcium}\\\text{Carbonate}}}{6CaCO_3} = \underset{\substack{\text{Sodium}\\\text{Aluminate}}}{Al_2O_3.3Na_2O} + \underset{\substack{\text{Calcium}\\\text{Fluoride}}}{6CaF_2} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{6CO_2}$$

Monohydrated sodium carbonate was introduced into the U. S. P. (8th Rev.), because it is free from the excess of water of crystallization found in *sal soda* or ordinary sodium carbonate (63 percent.); it is practically impossible to prevent efflorescence in this salt, and in making preparations inconvenience arises from the necessity of calculating the varying quantities of water present. The monohydrated carbonate is made by crystallizing a concentrated solution of sodium carbonate at a temperature above 35° C. (95° F.), and stirring the liquid so as to produce small crystals, washing, and purifying. It contains about 15 percent. of water of crystallization and may replace the *exsiccated sodium carbonate* of former pharmacopœias.

Official Description.—A white, crystalline, granular powder. When exposed to the air, under ordinary conditions, it absorbs only a slight percentage of moisture; exposed to warm, dry air at or above 50° C. (122°F.) it effloresces, and at 100° C. (212° F.) it loses its water of crystallization (14.52 percent.).

Odor, Taste, and Reaction.—Odorless; strongly alkaline taste; alkaline reaction in aqueous solution.

Solubility.—*Water.* In 2.9 parts at 25° C. (77° F.); in 1.8 parts of boiling water.
Alcohol. Insoluble.
Other solvents. Insoluble in ether; soluble in 8 parts of glycerin.

Test for Identity.—The aqueous solution effervesces strongly with acids. To a non-luminous flame the solution imparts an intense yellow color.

Impurity and Test.—*Heavy metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If 1 Gm. of Monohydrated Sodium Carbonate, or 0.855 Gm. of the anhydrous salt, be dissolved in 10 Cc. of distilled water, it should require not less than 32.3 Cc. of half-normal sulphuric acid V.S. for neutralization, 3 drops of methyl-orange T.S. being used as indicator.

Uses.—Monohydrated sodium carbonate is one of the most useful of the alkaline salts; it is the source of most of the sodium salts made by the pharmacist. It is rarely given internally. The dose is from two to ten grains (0.13 to 0.6 Gm.).

SODII CHLORAS. U. S. Sodium Chlorate

$NaClO_3 = 105.70$

It should contain not less than 99 percent. of pure Sodium Chlorate [$ClO_2.ONa$].

Preparation.—This salt is usually prepared by Wittstein's process, which consists in first preparing acid sodium tartrate by adding a strong solution containing nine and a half parts of tartaric acid to a hot aqueous solution of nine parts of sodium carbonate. The hot solution is mixed with one in which eight parts of potassium chlorate have been dissolved. Acid potassium tartrate separates, while sodium chlorate remains in solution. The filtered solution is evaporated and crystallized. If desired of absolute purity, it may be recrystallized from an alcoholic solution.

$$\underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} + \underset{\substack{\text{Tartaric}\\\text{Acid}}}{2H_2C_4H_4O_6} = \underset{\substack{\text{Acid Sodium}\\\text{Tartrate}}}{2NaHC_4H_4O_6} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O}$$

$$\underset{\substack{\text{Acid Sodium}\\\text{Tartrate}}}{NaHC_4H_4O_6} + \underset{\substack{\text{Potassium}\\\text{Chlorate}}}{KClO_3} = \underset{\substack{\text{Sodium}\\\text{Chlorate}}}{NaClO_3} + \underset{\substack{\text{Acid Potassium}\\\text{Tartrate}}}{KHC_4H_4O_6}$$

Owing to the facility with which this salt parts with its oxygen, the following official cautionary direction should be borne in mind:

"This salt should be kept in well-stoppered bottles, and *great caution should be observed* in handling it, as dangerous explosions are liable to occur when it is heated, or subjected to concussion or trituration with organic substances (cork, tannic acid, sugar, etc.), or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances."

Official Description.—Colorless, transparent crystals (principally cubes with tetrahedral facets), or a crystalline powder; permanent in dry air.

Odor, Taste, and Reaction.—Odorless; cooling, saline taste; neutral reaction.

Solubility.—*Water.* In about 1 part at 25° C. (77° F.); in 0.5 part of boiling water.
Alcohol. In about 100 parts at 25° C. (77° F.), and in about 40 parts of boiling alcohol.
Other solvents. Soluble in about 5 parts of glycerin.

Tests for Identity.—When heated, the salt melts, then gives off oxygen (about 45 percent. of its weight), and finally leaves a residue of sodium chloride, readily soluble in water, and yielding, with silver nitrate T.S., a white, curdy precipitate, insoluble in nitric acid. To a non-luminous flame it imparts an intense yellow color.

When a crystal of the salt is dropped into hydrochloric acid, the liquid assumes a deep greenish-yellow color, and emits the odor of chlorine.

Impurities and Tests for Impurities.—*Limit of potassium.* A saturated, aqueous solution should not be rendered turbid by sodium bitartrate T.S.

Lead, copper, etc. The aqueous solution of the salt (1 in 20), upon the addition of 1 Cc. of ammonium sulphide T.S., should not develop a dark coloration.

Uses.—This salt has an advantage over potassium chlorate in point of solubility, thus permitting the use of stronger solutions. The dose is from four to twenty grains (0.25 to 1.2 Gm.).

SODII CHLORIDUM. U.S. Sodium Chloride

$NaCl = 58.06$

It should contain when dried not less than 99 percent. of pure Sodium Chloride.

Preparation.—Common salt is universally distributed over the world, and may be mined, as rock salt, or obtained by evaporating sea-water, and afterwards purifying. If perfectly free from contaminating salts it will not become moist upon exposure to air.

Official Description.—Colorless, transparent, cubical crystals, or a white, crystalline powder; permanent in dry air.

Odor, Taste, and Reaction.—Odorless; purely saline taste; neutral reaction.

Solubility.—*Water.* In 2.8 parts at 25° C. (77° F.); in 2.5 parts of boiling water.
Alcohol. Almost insoluble.

Tests for Identity.—When heated, the salt decrepitates. At a red heat it fuses, and at a white heat it is slowly volatilized and partly decomposed. To a non-luminous flame it imparts an intense yellow color.

With silver nitrate T.S. the solution yields a white, curdy precipitate, insoluble in nitric acid, and readily soluble in ammonia water.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of Sodium Chloride (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Bromide and iodide. If 2 Gm. of the finely powdered salt be digested for some hours with 25 Cc. of warm alcohol, and, after cooling, the undissolved salt be removed by filtration, the filtrate evaporated to dryness, and the residue dissolved in 5 Cc. of water, and if 1 Cc. of chloroform be added, and chlorine water which has been diluted with twice its volume of water, cautiously introduced, drop by drop, with constant agitation, the chloroform should not acquire a violet, yellow, or orange color.

Quantitative Test.—If 1 Gm. of well-dried Sodium Chloride be dissolved in sufficient distilled water to measure 100 Cc., and 10 Cc. of the solution be mixed with a few drops of potassium chromate T.S., it should require not less than 17 (17.05) Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color.

Uses.—Sodium chloride is largely used as a condiment and an antiseptic. It undoubtedly serves a useful purpose in the animal economy, as many animals possess an instinctive craving for it. Salt baths are tonic, and valuable aids in many diseases. Common salt is used as a styptic in hemorrhage.

SODII CITRAS. U.S. Sodium Citrate

$2Na_3C_6H_5O_7 + 11H_2O = 709.20$

It should contain not less than 97 percent. of pure Sodium Citrate [$2C_3H_4(OH)(COONa)_3 + 11H_2O$], and should be kept in well-stoppered bottles.

Preparation.—This salt is usually prepared by adding sodium carbonate to a solution of citric acid until effervescence ceases, evaporating and granulating the product.

Official Description.—A white, granular powder; slowly effloresces on exposure to dry air.
Odor, Taste, and Reaction.—Odorless; cooling, saline taste; slightly alkaline reaction.
Solubility.—*Water.* In 1.1 parts at 25° C. (77° F.); in 0.4 part of boiling water.
Alcohol. Slightly soluble.

Tests for Identity.—When heated to about 150° C. (302° F.) the salt loses all of its water of crystallization; on ignition at a red heat it decomposes and a mixture of sodium carbonate and carbon is left, which has an alkaline reaction and strongly effervesces with acids. To a non-luminous flame the salt imparts an intense yellow color.

The addition of 2 Cc. of calcium chloride T.S. to 10 Cc. of the aqueous solution of the salt (1 in 20) yields a clear solution, which, upon boiling, deposits a white granular precipitate.

Impurities and Tests for Impurities.—*Carbonate.* The aqueous solution (1 in 20) should not be colored red by a drop of phenolphthalein T.S., nor effervesce on the addition of an acid.

Heavy metals. The aqueous solution of the salt (1 in 20) slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If 1 Gm. of Sodium Citrate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 16.4 (16.41) Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—Sodium citrate is preferred to potassium citrate by some practitioners, and it is used in the process for making compound syrup of hypophosphites. The dose is four to fifteen grains (0.25 to 1 Gm.).

SODII HYPOPHOSPHIS. U.S. Sodium Hypophosphite

$$NaPH_2O_2 + H_2O = 105.29$$

It should contain not less than 98 percent. of pure Sodium Hypophosphite [$PO.H_2ONa + H_2O$], and should be kept in well-stoppered bottles; caution should be observed in dispensing Sodium Hypophosphite, as explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents.

Preparation.—This salt is prepared by mixing a solution of six ounces of calcium hypophosphite in four pints of water with a solution of ten ounces of sodium carbonate in one and a half pints of water.

$$\underset{\substack{\text{Calcium}\\\text{Hypophosphite}}}{Ca2H_2PO_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\\text{Hypophosphite}}}{2Na_2HPO_2} + \underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3}$$

Double decomposition takes place, with the formation of calcium carbonate and sodium hypophosphite, of which the latter is held in solution, and the former precipitated. After filtration to separate the calcium carbonate, the solution is evaporated to a pellicle, and then stirred constantly until the salt granulates, the heat being continued. If required quite pure, the granulated salt is dissolved in official alcohol, and the liquid, having been evaporated to a syrupy consistence, is set aside to crystallize.

Sometimes the sodium hypophosphite explodes with violence during the evaporation of its solution; this was ascribed to the fact that the solution was overheated; but the same accident has occurred when the heat was applied by means of a water-bath. Evaporation, therefore, should be performed below 100° C. (212° F.).

$$\underset{\substack{\text{Sodium}\\\text{Hypophosphite}}}{5NaH_2PO_2} = \underset{\substack{\text{Sodium}\\\text{Pyrophosphate}}}{Na_4P_2O_7} + \underset{\substack{\text{Sodium}\\\text{Metaphosphate}}}{NaPO_3} + \underset{\substack{\text{Hydrogen}\\\text{Phosphide}}}{2PH_3} + \underset{\text{Hydrogen}}{2H_2}$$

The gases evolved by heat are hydrogen and hydrogen phosphide. The latter is well known to be spontaneously inflammable.

The acid present in this salt is *hypophosphorous acid.* It consists of one atom of phosphorus, two atoms of oxygen, and three atoms of hydrogen, only one of the latter being replaceable by a metal.

This acid is a powerful deoxidizer, and as it reduces mercury and silver from their combinations, it should not be prescribed with either.

Official Description.—Small, colorless, transparent, rectangular plates of a pearly lustre, or a white, granular powder. Very deliquescent on exposure to moist air.

Odor, Taste, and Reaction.—Odorless; bitterish-sweet, saline taste; neutral or slightly alkaline reaction.

Solubility.—*Water.* In about 1 part at 25° C. (77° F.); in 0.12 part of boiling water.

Alcohol. In about 25 parts at 25° C. (77° F.); in 1 part of boiling alcohol; slightly soluble in absolute alcohol.

Other solvents. Insoluble in ether.

Tests for Identity.—When heated in a test-tube, the salt at first loses its water of crystallization, and at about 200° C. (392° F.) it is decomposed, evolving hydrogen and hydrogen phosphide which burns spontaneously with a bright yellow flame. Finally, there is left a residue of sodium pyrophosphate and metaphosphate, sometimes mingled with a little red phosphorus. To a non-luminous flame the salt imparts an intense yellow color.

One Gm. of the dried salt, dissolved in about 10 Cc. of water, should not require more than 1.5 Cc. of tenth-normal hydrochloric acid V.S. for neutralization (methyl-orange T.S. being used as indicator).

The diluted aqueous solution, slightly acidulated with diluted sulphuric acid, yields, with silver nitrate T.S., a white precipitate, which rapidly turns brown or black, owing to the separation of metallic silver.

With copper sulphate T.S., on gentle heating, a reddish-brown precipitate is formed.

When the aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed. On further addition of the hypophosphite solution in excess, the precipitate becomes gray from reduction to metallic mercury.

Impurities and Tests for Impurities.—*Caustic alkali and carbonate.* The aqueous solution (1 in 20) should not be colored red by the addition of a drop of phenolphthalein T.S., nor effervesce on the addition of an acid.

Heavy metals. The aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. If 5 Cc. of the aqueous solution of the salt (1 in 10) be measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water and evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—Sodium hypophosphite is used in phthisis and other wasting diseases, and in cases of defective nerve nutrition; pharmaceutically it is an ingredient in the various official and unofficial preparations of the hypophosphites; the dose is fifteen grains (1 Gm.).

SODII IODIDUM. U.S. Sodium Iodide

$NaI = 148.78$

It should contain not less than 98 percent. of pure Sodium Iodide, and should be kept in well-stoppered bottles.

Preparation.—This iodide may be prepared by double decomposition between solutions of ferrous iodide and sodium carbonate, or by treating a solution of sodium hydroxide with iodine, exactly as in the preparation of potassium iodide. The former process is preferable if working on a small scale.

$$\underset{\substack{\text{Ferrous}\\ \text{Iodide}}}{FeI_2} + \underset{\substack{\text{Sodium}\\ \text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\ \text{Iodide}}}{2NaI} + \underset{\substack{\text{Ferrous}\\ \text{Carbonate}}}{FeCO_3}$$

By boiling the solution containing the ferrous carbonate the latter is rendered less bulky, and it can be easily separated by filtration.

Official Description.—Colorless, cubical crystals, or a white, crystalline powder. In moist air it deliquesces and frequently decomposes, the salt assuming a brown tint.

Odor, Taste, and Reaction.—Odorless; saline, and slightly bitter taste; slightly alkaline reaction.

Solubility.—*Water.* In about 0.5 part at 25° C. (77° F.); in 0.33 part of boiling water.

Alcohol. In about 3 parts at 25° C. (77° F.); in 1.4 parts of boiling alcohol.

Tests for Identity.—If to 5 Cc. of the aqueous solution (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated and impart to the solution a light reddish-brown color. On agitating this mixture with a few drops of chloroform, the latter will acquire a violet color.

When strongly heated, the salt melts, and at a bright red heat it is slowly volatilized and partly decomposed. To a non-luminous flame it imparts an intense yellow color.

Impurities and Tests for Impurities.—*Limit of alkali.* If 1 Gm. of the salt be dissolved in water, and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no red color should be produced by the addition of a drop of phenolphthalein T.S., even after heating.

Limit of potassium. A solution of 1 Gm. of the salt in 1 Cc. of water should yield no precipitate with 1 Cc. of sodium bitartrate T.S.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Free iodine. If 0.5 Gm. of the salt be dissolved in 10 Cc. of distilled water, which has been previously boiled and cooled in a small flask, the solution should not have a distinct yellow tint.

Limit of iodate. Nor should the solution acquire a yellow color within half a minute after the addition of 2 drops of diluted sulphuric acid (which should be free from sulphurous acid or nitrous acid).

Barium. Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S.

Cyanide. If 5 Cc. of the aqueous solution be gently heated with 1 drop of ferrous sulphate T.S., 1 drop of ferric chloride T.S., and 0.5 Cc. of potassium hydroxide T.S., no blue color should appear after acidulating the mixture with hydrochloric acid.

Limit of nitrates and nitrites. If to 1 Gm. of Sodium Iodide, contained in a test-tube of about 40 Cc. capacity, 5 Cc. of water, 5 Cc. of potassium hydroxide T.S., and about 0.2 Gm. of aluminum wire be added, and if in the upper portion of the test-tube a pledget of purified cotton be inserted, and over the mouth there be placed a piece of moistened red litmus paper, then if the tube be heated upon a water-bath for fifteen minutes, no blue coloration of the paper should be discernible.

Limit of chlorides and bromides, and absence of thiosulphate. If 0.2 Gm. of Sodium Iodide be dissolved in 2 Cc. of ammonia water, and 15 Cc. of tenth-normal silver nitrate V.S. be added, then after thoroughly agitating and filtering, the filtrate, upon supersaturating with nitric acid, should not become more than slightly turbid, nor should any darkening appear within ten minutes.

Quantitative Test.—If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of distilled water, and about 5 drops of potassium chromate T.S. be added, it should require not more than 34.6 Cc., nor less than 33 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color (corresponding to at least 98 percent. of pure Sodium Iodide).

Uses.—Medicinally, this salt is preferred to potassium iodide by some practitioners, although apparently without good reason. The dose is from five to fifteen grains (0.3 to 1 Gm.).

SODII NITRAS. U.S. Sodium Nitrate

$NaNO_3 = 84.45$

It should contain not less than 99 percent. of pure Sodium Nitrate [$NO_2.ONa$], and should be kept in well-stoppered bottles.

Preparation.—Sodium nitrate, called also *cubic nitre*, and *Chili saltpetre*, is a native salt found in Chili and Peru, purified by crystallization from its aqueous solution. It is the cheapest source for obtaining nitrates, as explained elsewhere (see Acidum Nitricum).

Official Description.—Colorless, transparent, rhombohedral crystals; hygroscopic in moist air.

Odor, Taste, and Reaction.—Odorless; cooling, saline, and slightly bitter taste; neutral reaction.

Solubility.—*Water.* In about 1.1 parts at 25° C. (77° F.); in 0.6 part of boiling water.

Alcohol. In about 100 parts at 25° C. (77° F.); in 40 parts of boiling alcohol.

Tests for Identity.—When heated to 312° C. (593.6° F.), the salt melts without decomposition. At a higher temperature it evolves oxygen, and is reduced to nitrite. When

Sodium Nitrate is heated with charcoal, the mixture deflagrates. To a non-luminous flame it imparts an intense yellow color.

If the aqueous solution be mixed in a test-tube with a drop of diphenylamine T.S., and sulphuric acid be carefully poured in, so as to form a separate layer, a deep blue color will appear at the line of contact.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Iodide. If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and then chlorine water which has been diluted with an equal volume of water be introduced, drop by drop, with agitation, the chloroform should remain free from any violet tint.

Uses.—Sodium nitrate is used in a number of diseases, such as epilepsy, angina pectoris, dysentery, etc., but without marked effects. The dose is fifteen to twenty grains (1 to 1.2 Gm.).

SODII NITRIS. U.S. Sodium Nitrite

$NaNO_2 = 68.57$

It should contain not less than 90 percent. of pure Sodium Nitrite [NO.ONa], and should be kept in well-stoppered bottles.

Preparation.—Sodium nitrite has been made official solely on account of its use in preparing spirit of nitrous ether. It is made by heating sodium nitrate in contact with starch, or preferably by adding strips of sheet lead to sodium nitrate heated to the fusing point for several hours, lead oxide being formed at the same time. After cooling, the fused sodium nitrite is lixiviated with water, purified, and recrystallized.

Official Description.—White or nearly white, opaque, fused masses, or pencils, or colorless, transparent, hexagonal crystals.

Odor, Taste, and Reaction.—Odorless; mild, saline taste. An aqueous solution should be colorless, and give a slightly alkaline reaction with red litmus paper.

Solubility.—*Water.* In about 1.4 parts at 25° C. (77° F.), and very soluble in boiling water.

Alcohol. Slightly soluble.

Tests for Identity.—When exposed to the air, the salt deliquesces and is gradually oxidized to sodium nitrate, and becomes unfit for use.

When heated, the salt melts, and at a red heat it is decomposed, yielding oxygen, nitrogen, nitrogen dioxide, and sodium oxide. To a non-luminous flame it imparts an intense yellow color.

If the aqueous solution of the salt be mixed with some potassium iodide T.S, and a few drops of an acid added, iodine will be liberated, and nitrogen dioxide gas will escape with effervescence.

Impurities and Tests for Impurities.—*Heavy metals.* If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid, and heated sufficiently to expel the gases, the resulting solution after restoring it to its original volume should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If to 30 Cc. of tenth-normal potassium permanganate V.S., diluted with about 150 Cc. of distilled water, 5 Cc. of sulphuric acid and 10 Cc. of a solution of 1 Gm. of Sodium Nitrite in sufficient distilled water to make 100 Cc. be successively added, the liquid brought to a temperature of 40° C. (104° F.) and allowed to stand for five minutes, not more than 3.75 Cc. of tenth-normal oxalic acid V.S. should be required to decolorize the solution (each Cc. of tenth-normal potassium permanganate consumed corresponding to 0.0034285 Gm. of pure Sodium Nitrite).

Uses.—This salt is used in making spirit of nitrous ether.

SODII PHENOLSULPHONAS. U.S. Sodium Phenolsulphonate

$NaC_6H_5O_4S + 2H_2O = 230.45$

[Sodii Sulphocarbolas, Pharm. 1890 Sodium Sulphocarbolate]

It should contain not less than 99 percent. of Pure Sodium Paraphenolsulphonate [$C_6H_4(OH)SO_3Na$ 1 : 4 + $2H_2O$], and should be kept in well-stoppered bottles.

Preparation.—Sodium phenolsulphonate may be made by mixing equal parts of pure phenol and strong sulphuric acid, whereby *phenolsulphonic acid*, $C_6H_5HSO_4$, is produced. The mixed liquids must be subjected to a temperature of 55° C. (131° F.) for several days, to convert this into *paraphenolsulphonic acid*, and then twenty parts of water should be added. Two parts of barium carbonate are mixed with the liquid, a little at a time, carefully graduating the quantity until effervescence ceases. The liquid is now allowed to stand, to permit the precipitation of the barium sulphate, and of any carbonate which may be present, and the liquid filtered. The solution of *barium paraphenolsulphonate* is decomposed by adding sodium carbonate until precipitation ceases, when the liquid is filtered from the barium carbonate, and the sodium paraphenolsulphonate may be obtained by evaporating the filtrate and crystallizing.

$$\underset{\text{Phenol}}{C_6H_5HO} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Phenolsulphonic}\\\text{Acid}}}{HC_6H_5SO_4} + \underset{\text{Water}}{H_2O}$$

Official Description.—Colorless, transparent, rhombic prisms; somewhat efflorescent in dry air.
Odor, Taste, and Reaction.—Odorless; cooling, saline, bitter taste; neutral reaction.
Solubility.—*Water.* In 4.8 parts at 25° C. (77° F.); in 0.7 part of boiling water.
Alcohol. In about 130 parts at 25° C. (77° F.); in 10 parts of boiling alcohol.
Tests for Identity.—When heated a little above 100° C. (212° F.), the salt loses all of its water of crystallization (15.5 percent.), and becomes white. At a higher temperature it chars, emits inflammable vapors having the odor of phenol, and finally leaves a residue of sodium sulphate amounting to 30.6 percent. of the original weight. To a non-luminous flame it imparts an intense yellow color.

A diluted solution of the salt (1 in 100) is rendered pale violet by ferric chloride T.S., but remains clear; barium chloride T.S. leaves the solution clear, but if a portion of the salt be ignited, and the residue dissolved in water, the same reagent will produce in the solution a copious, white precipitate.

Impurity and Test.—*Heavy metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Uses.—This salt is used as an antiferment, in doses of four to twenty grains (0.25 to 1.3 Gm.). It is also used in injections.

SODII PHOSPHAS. U.S. Sodium Phosphate

$Na_2HPO_4 + 12H_2O = 355.61$

It should contain, in an uneffloresced condition, not less than 99 percent. of pure Di-sodium-ortho-phosphate [$PO.(OH)(ONa)_2 + 12H_2O$], and should be kept in well-stoppered bottles, in a cool place.

Preparation.—The part of bones which is incombustible is obtained by burning them to whiteness, and consists of neutral calcium phosphate, called *bone-phosphate*, or *bone-ash*, associated with some calcium carbonate. When this is mixed with sulphuric acid, the calcium carbonate is entirely decomposed, giving rise to effervescence. The calcium phosphate undergoes partial decomposition; the greater part of the lime, being liberated, precipitates as calcium sulphate, while the phosphoric acid combines with the undecomposed portion of the phosphate, and remains in solution as an acid calcium phosphate, holding dissolved a small portion of calcium sulphate.

$$\underset{\substack{\text{Calcium}\\\text{Phosphate}}}{Ca_32PO_4} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{2H_2SO_4} = \underset{\substack{\text{Acid Calcium}\\\text{Phosphate}}}{CaH_42PO_4} + \underset{\substack{\text{Calcium}\\\text{Sulphate}}}{2CaSO_4}$$

In order to separate the acid phosphate from the precipitated mass of calcium sulphate, boiling water is added to the mixture, the whole is strained, and the sulphate washed as long as acid phosphate is removed, which is known by the water which passes through having an acid reaction. The different liquids which have passed the strainer, consisting of the solution of acid calcium phosphate, are mixed and allowed to stand; by cooling a portion of calcium sulphate is deposited, which is removed by decantation. The bulk of the liquid is now reduced by evaporation, and, in consequence of the diminution of the water, a fresh portion of calcium sulphate is deposited, which is separated by subsidence and decantation as before. The acid calcium phosphate solution, being heated, is now saturated by means of a hot solution of sodium carbonate. The carbonic acid is liberated with effervescence, and the alkali, combining with the excess of acid of the acid phosphate, produces sodium phosphate, while the acid calcium phosphate, by the loss of its excess of acid, becomes the neutral phosphate and precipitates.

$$\underset{\substack{\text{Acid Calcium}\\\text{Phosphate}}}{CaH_42PO_4} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Calcium}\\\text{Phosphate}}}{CaHPO_4} + \underset{\substack{\text{Sodium}\\\text{Phosphate}}}{Na_2HPO_4} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

The calcium phosphate is separated by filtration; and the filtered liquid, which is a solution of sodium phosphate, is evaporated so as to crystallize.

Official Description.—Large, colorless, monoclinic prisms, or a granular, crystalline salt. The crystals effloresce in the air, and gradually lose 5 molecules of their water of crystallization (25.1 percent.).

Odor, Taste, and Reaction.—Odorless; cooling, saline taste. An aqueous solution is slightly alkaline to red litmus and phenolphthalein paper.

Solubility.—*Water.* In about 5.5 parts at 25° C. (77° F.).

Alcohol. Insoluble.

Tests for Identity.—When heated to about 40° C. (104° F.), the salt fuses, yielding a colorless liquid. At 100° C. (212° F.) it loses all its water of crystallization (60.3 percent.), and at a red heat it is converted into sodium pyrophosphate. It imparts to a non-luminous flame an intense yellow color.

An aqueous solution of the salt (1 in 20) yields a white, crystalline precipitate with magnesia mixture T.S.

With silver nitrate T.S. an aqueous solution yields a yellow precipitate, soluble in ammonia water and in nitric acid.

If 0.5 Cc. of the aqueous solution (1 in 20) be mixed with 1 Cc. of ammonium molybdate T.S., the mixture will at once assume a yellow color, and after being gently heated a few minutes will yield a yellow precipitate.

Impurities and Tests for Impurities.—*Limit of calcium, aluminum, etc.* Not more than a slight turbidity should appear on dissolving 1 Gm. of the salt in 20 Cc. of water.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Carbonate. No effervescence should occur on the addition of hydrochloric or nitric acid to a solution of the salt.

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (See U. S. P. Test No. 17, Chap. LXII).

Uses.—Sodium phosphate is principally used as a cathartic; it should be free from arsenic, and when purified it may be given in doses of half an ounce to one ounce (15.5 to 31.1 Gm.).

SODII PHOSPHAS EFFERVESCENS. U.S. Effervescent Sodium Phosphate

	Metric	Old form
* **Exsiccated Sodium Phosphate,** in fine powder	200 Gm.	4 oz. av.
Sodium Bicarbonate, dried and powdered	477 Gm.	9½ oz. av.
Tartaric Acid, dried and powdered	252 Gm.	5 oz. av.
Citric Acid, uneffloresced crystals	162 Gm.	3¼ oz. av.
To make	1000 Gm.	20 oz. av.

Powder the Citric Acid and mix it intimately with the Exsiccated Sodium Phosphate and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate.

Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.). When the mixture has acquired a moist consistence, by the aid of careful manipulation with a wooden spatula, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles.

Uses.—Effervescent Sodium Phosphate furnishes a pleasant means of administering sodium phosphate. Dose, two drachms (8 Gm.).

SODII PHOSPHAS EXSICCATUS. U.S. Exsiccated Sodium Phosphate

It should contain not less than 99 percent. of pure anhydrous Sodium Phosphate [$PO.(OH)(ONa)_2$], and should be kept in well-stoppered bottles.

Sodium Phosphate, a convenient quantity

Allow the crystals to effloresce for several days in warm air, at a temperature of from 25° to 30° C. (77° to 86° F.), then continue the drying in an oven; raise the temperature very gradually until 100° C. (212° F.) has been reached, and maintain this temperature until the salt ceases to lose weight. Powder and sift the residue, and preserve it in well-stoppered bottles.

A white powder which absorbs moisture readily, and which, after allowance is made for the loss of 60.3 percent. of water of crystallization, conforms to the reactions and tests given under *Sodii Phosphas.*

Uses.—This salt is used in making effervescent sodium phosphate. It may be given in fifteen grain (1 Gm.) doses.

LIQUOR SODII PHOSPHATIS COMPOSITUS. U.S. Compound Solution of Sodium Phosphate

	Metric	Old form
* **Sodium Phosphate,** uneffloresced crystals	1000 Gm.	33 oz. av. 167 gr.
Sodium Nitrate	40 Gm.	1 oz. av. 147 gr.
Citric Acid	130 Gm.	4 oz. av. 149 gr.
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

Triturate the Sodium Phosphate and Sodium Nitrate, in a mortar, with the Citric Acid, until completely liquefied, then add sufficient Distilled Water to make the product measure 1000 Cc. [old form 2 pints]. Filter the liquid. Keep the solution in well-stoppered bottles in a moderately warm place.

Tests for Identity.—If to 1 Cc. of the Solution, diluted with an equal volume of water, a slight excess of ammonia water, followed by 1 Cc. of magnesia mixture T. S., be added, a white crystalline precipitate will be obtained.

If 1 Cc. of the Solution, diluted with 5 Cc. of water, be mixed with an equal volume of sulphuric acid, and to the cooled mixture a crystal of ferrous sulphate be added, a dark brown zone will appear around the crystal.

If 5 Cc. of the Solution be neutralized with ammonia water, an excess of calcium chloride T.S. added, and the mixture filtered, the filtrate, upon boiling, should deposit a white precipitate.

Uses.—This solution, which represents the salt in the proportion of 1 Gm. in 1 Cc., was made official in the U. S. P. (8th Rev.) to furnish a convenient form for the exhibition of sodium phosphate, which, while soluble in water, is not rapidly dissolved; sodium nitrate and citric acid are added to prevent the solution from crystallizing; nevertheless, in cold weather the solution should be kept in a moderately warm place. The dose is two fluidrachms (8 Cc.).

SODII PYROPHOSPHAS. U.S. Sodium Pyrophosphate

$Na_4P_2O_7 + 10H_2O = 443.02$

It should contain, in an uneffloresced condition, not less than 99 percent. of pure Sodium Pyrophosphate [$(PO)_2O.(ONa)_4 + 10H_2O$], and should be kept in well-stoppered bottles.

Preparation.—Sodium pyrophosphate, as its name indicates, is prepared by heating sodium phosphate in a suitable vessel to redness. When sodium phosphate is subjected to a temperature of 44° C. (111.2° F.), it melts in its water of crystallization; if the heat be increased to 100° C. (212° F.), all the water is dispelled, and but 40 percent. of the original weight remains; at 390° C. (572° F.) it is converted into the tetrabasic phosphate or pyrophosphate. By dissolving this residue in water, filtering, and crystallizing, the salt may be obtained.

Official Description.—Colorless, transparent, monoclinic prisms, or a crystalline powder; slightly efflorescent in warm air.

Odor, Taste, and Reaction.—Odorless; cooling, saline, and feebly alkaline taste. Its aqueous solution is feebly alkaline to red litmus paper and to phenolphthalein paper.

Solubility.—*Water.* In about 11.5 parts at 25° C. (77° F.), and in 1.1 parts of boiling water. *Alcohol.* Insoluble.

Tests for Identity.—When heated to 100° C. (212° F.), the salt loses its water of crystallization (40.35 percent.) without previous fusion. At a higher temperature it fuses, forming a transparent liquid, which, on cooling, solidifies to a crystalline mass. To a non-luminous flame it imparts an intense yellow color.

An aqueous solution of the salt (1 in 20) yields with magnesia mixture a white precipitate; with silver nitrate T.S. it yields a white precipitate (distinction from *orthophosphate*).

With an excess of ammonium molybdate T.S. no precipitate is formed within fifteen or twenty minutes, even when a gentle heat is applied (distinction from *orthophosphate*).

Impurities and Tests for Impurities.—*Carbonate.* An aqueous solution of the salt (1 in 20) yields with silver nitrate T.S. a white precipitate which is soluble in ammonia water and also in nitric acid without effervescence.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—This salt is used principally in preparing ferric pyrophosphate. It may be given in doses of from ten to thirty grains (0.6 to 2 Gm).

SODII SALICYLAS. U.S. Sodium Salicylate

$NaC_7H_5O_3 = 158.89$

It should contain not less than 99.5 percent. of pure Sodium Salicylate [$C_6H_4(OH)COONa$], and should be kept in well-stoppered bottles, protected from heat and light.

Preparation.—Sodium salicylate is prepared by mixing one hundred parts of pure salicylic acid with sufficient distilled water to form a paste, and then with one hundred and four parts of pure crystallized sodium carbonate (uneffloresced) in a glass or porcelain vessel; carbon dioxide will be evolved, and sodium salicylate will remain in solution.

$$\underset{\text{Salicylic Acid}}{2HC_7H_5O_3} + \underset{\substack{\text{Sodium}\\ \text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\ \text{Salicylate}}}{2NaC_7H_5O_3} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\ \text{Dioxide}}}{CO_2}$$

The liquid may be strained through thoroughly washed muslin if necessary, and heated in a porcelain dish until the carbon dioxide is expelled.

It should not be filtered through ordinary paper, on account of the impurities generally present in paper; the slightest contact with iron will discolor the product, and for this reason the commercial sodium carbonate is unfitted for use in making this salt.

If alkaline to litmus paper, enough salicylic acid must be added to be slightly in excess, and the solution should be evaporated at a low heat to dryness. If the acid is not in excess, the salt will not be white, but gray or lead-colored; and if heated too much, the odor of phenol will be noticed.

Official Description.—White, microcrystalline powder or scales, or an amorphous, colorless powder, or having not more than a faint pink tinge.

Odor, Taste, and Reaction.—Odorless; sweetish, saline taste. An aqueous solution when freshly made should be colorless, and should slightly redden blue litmus paper.

Solubility.—*Water.* In 0.8 part at 25° C. (77° F.); very soluble in boiling water.

Alcohol. In 5.5 parts at 25° C. (77° F.); very soluble in boiling alcohol.

Other solvents. Soluble in glycerin.

Tests for Identity.—When heated, the salt is decomposed, giving off inflammable vapors and an odor of phenol, and finally leaves a residue of sodium carbonate. To a non-luminous flame it imparts an intense yellow color.

Ferric chloride T.S., added to an excess of a concentrated solution of the salt, produces a violet precipitate; but when added to a dilute solution (1 in 100), it produces a deep violet-blue color.

If copper sulphate T.S. be added to the aqueous solution (1 in 20), a green color is produced.

On adding to about 0.2 Gm. of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and then, cautiously, drop by drop, about 1 Cc. of methyl alcohol, and heating the mixture to boiling, methyl salicylate will be evolved, recognizable by its odor.

Diluted hydrochloric or sulphuric acid produces in a concentrated aqueous solution of the salt a voluminous, white precipitate, which, after being separated by filtration, and washed, should conform to the reactions and tests given under *Acidum Salicylicum.*

Impurities and Tests for Impurities.—*Sulphites.* If to an aqueous solution of the salt (1 in 20), 3 drops of iodine T.S. and a slight excess of hydrochloric acid be added, the filtrate from this mixture should not yield a precipitate upon the addition of barium chloride T.S.

Heavy metals. If the aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No 121, Chap. LXII).

Quantitative Test.—If 1 Gm. of dry Sodium Salicylate be thoroughly ignited at a red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 12.5 (12.52) Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator.

Uses.—This salt is administered in rheumatic and neuralgic affections, in doses of fifteen to thirty grains (1 to 2 Gm.).

SODII SULPHAS. U.S. Sodium Sulphate

$Na_2SO_4 + 10H_2O = 319.91$

[GLAUBER'S SALT]

It should contain, in an uneffloresced condition, not less than 99 percent. of pure Sodium Sulphate [$SO_2(ONa)_2 + 10H_2O$], and should be kept in well-closed vessels, in a cool place.

Preparation.—This salt is largely obtained as a by-product in the manufacture of soda-ash, hydrochloric and nitric acids, ammonium chloride, etc.

Official Description.—Large, colorless, transparent, monoclinic prisms, or granular crystals. Effloresces rapidly in the air, and finally loses all of its water of crystallization.

Odor, Taste, and Reaction.—Odorless; bitter, saline taste; neutral reaction.

Solubility.—*Water.* In 2.8 parts at 15° C. (59° F.), in 0.25 part at 34° C. (93.2° F.), and in 0.47 part at 100° C. (212° F.).

Alcohol. Insoluble.

Other solvents. Soluble in glycerin.

Tests for Identity.—When heated to 33° C. (91.4° F.), the salt fuses, and, on continuing the heat to 100° C. (212° F.), it loses all of its water of crystallization (55.9 percent.). At a red heat the anhydrous salt fuses without decomposition. To a non-luminous flame it imparts an intense yellow color.

An aqueous solution of Sodium Sulphate (1 in 20) yields, with barium chloride T.S., a white precipitate insoluble in hydrochloric acid.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Care must be employed, in using the formulas requiring this salt, to see that it is not effloresced, as such a salt may have lost half of its water of crystallization, and be therefore one-third stronger than it should be.

Uses.—This well known sulphate is largely used in veterinary practice. As a purgative it is not so well suited for administration to human beings, the magnesium sulphate being preferred. It may be given to adults in doses of half an ounce to one ounce (16 to 32 Gm.).

SODII SULPHIS. U. S. Sodium Sulphite

$$Na_2SO_3 + 7H_2O = 250.39$$

It should contain, in the uneffloresced and air-dried condition, not less than 94 percent. of pure Sodium Sulphite, and should be kept in well-stoppered bottles, in a cool place.

Preparation.—A very satisfactory mode of making this sulphite is by dissolving a convenient weight of sodium carbonate in a small quantity of water, then passing sulphurous acid gas through the solution until it is completely saturated and acid sodium sulphite is formed. The addition of an equal weight of sodium carbonate forms a solution of the neutral sulphite, which is to be evaporated and crystallized.

$$\underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} + \underset{\substack{\text{Sulphur}\\\text{Dioxide}}}{SO_2} = \underset{\substack{\text{Sodium}\\\text{Sulphite}}}{Na_2SO_3} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

The sodium sulphite which is most frequently used now is the *granulated sodium sulphite:* this is prepared by evaporating a solution of the sulphite to dryness in the usual manner. As thus prepared, it is much more stable than the crystallized salt; it should be remembered, however, that it is of nearly twice the strength of the latter, and the quantity used should be proportionately lessened. Theoretically, the quantity of water present in the crystals is exactly half their weight.

Official Description.—Colorless, transparent, monoclinic prisms. Exposed to the air, the salt effloresces, and is slowly oxidized to sulphate.

Odor, Taste, and Reaction.—Odorless; cooling, saline, sulphurous taste; neutral or feebly alkaline reaction.

Solubility.—*Water.* In 2 parts at 25° C. (77° F.), and in 1.4 parts of boiling water.

Alcohol. Sparingly soluble.

Tests for Identity.—When gently heated, the salt softens somewhat, but it does not fuse. Above 100° C. (212° F.) the crystals lose all their water (50 percent.), without fusing or changing their shape. At a red heat the salt fuses to a reddish-yellow mass of sodium sulphate and sodium sulphide. To a non-luminous flame the salt imparts an intense yellow color.

Upon the addition of hydrochloric acid to the salt, sulphur dioxide gas is liberated, which is recognized by its odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. and held in the escaping gas.

Impurities and Tests for Impurities.—*Thiosulphate.* If 1 Gm. of the salt be dissolved in 10 Cc. of diluted nitric acid, and the solution heated sufficiently to expel the gases, the liquid should not become turbid.

Heavy metals.—If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid and heated sufficiently to expel the sulphur dioxide, the remaining solution, after being restored to its original volume, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If to 50 Cc. of tenth-normal iodine V.S., measured from a burette into a glass-stoppered vial (of about 100 Cc. capacity), 0.5 Gm. of the finely powdered crystals of Sodium Sulphite be added, and after solution has taken place, not more than 12.45 Cc. of tenth-normal sodium thiosulphate V.S. should be required to discharge the color of the solution.

Uses.—Sodium sulphite is one of the most useful antiferments. It is given in doses of ten to thirty grains (0.6 to 2 Gm.).

SODII THIOSULPHAS. U.S. Sodium Thiosulphate

$$Na_2S_2O_3 + 5H_2O = 246.46$$

[SODII HYPOSULPHIS, PHARM. 1890 SODIUM HYPOSULPHITE]

It should contain not less than 98 percent. of pure Sodium Thiosulphate, and should be kept in well-stoppered bottles.

Preparation.—Sodium thiosulphate, official in the U. S. P. 1890 as *sodium hyposulphite*, is made by decomposing soluble calcium thiosulphate, obtained by the oxidation of alkali waste, with either sodium sulphate or sodium carbonate.

$$\underset{\substack{\text{Calcium}\\ \text{Thiosulphate}}}{CaS_2O_3} + \underset{\substack{\text{Sodium}\\ \text{Sulphate}}}{Na_2SO_4} = \underset{\substack{\text{Sodium}\\ \text{Thiosulphate}}}{Na_2S_2O_3} + \underset{\substack{\text{Calcium}\\ \text{Sulphate}}}{CaSO_4}$$

Other methods of making "hyposulphite of soda" have been used, but the above process has superseded them because of its economy. It is now made on a very large scale.

Official Description.—Colorless, transparent, monoclinic prisms. Permanent in the air below 33° C. (91.4° F.), but efflorescent in dry air above that temperature; slightly deliquescent in moist air.

Odor, Taste, and Reaction.—Odorless; cooling, afterwards bitter taste; neutral or faintly alkaline reaction.

Solubility.—*Water.* In about 0.35 part at 25° C. (77° F.) at a boiling heat the solution is rapidly decomposed.

Alcohol. Insoluble.

Other solvents. Slightly soluble in oil of turpentine.

Tests for Identity.—When rapidly heated to 50° C. (122° F.), the salt melts. When slowly heated until it is effloresced, and afterwards to 100° C. (212° F.), it loses all of its water of crystallization (36.3 percent.), and at a red heat is decomposed, sulphur being liberated, while a residue of sodium sulphide and sodium sulphate remains. To a non-luminous flame it imparts an intense yellow color.

An aqueous solution of Sodium Thiosulphate readily dissolves many salts of silver (chloride, bromide, iodide, oxide, etc.), and discharges the color of a solution of iodine or of starch iodide.

If ferric chloride T.S. be dropped into the aqueous solution (1 in 20), a dark violet color will be produced, which disappears rapidly on agitation.

Addition of sulphuric or hydrochloric acid to the aqueous solution liberates from it sulphur dioxide (recognized by its odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. held in the escaping gas); a white precipitate of sulphur is also formed (distinction from *sulphite* or *bisulphite*).

Impurities and Tests for Impurities.—*Arsenic.* If to 5 Cc. of an aqueous solution of the salt (1 in 10), 3 Cc. of nitric acid be added, the solution cautiously evaporated to dryness on a water-bath, and the residue treated with distilled water, the liquid filtered, and the filtrate and washings evaporated to dryness, this residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Heavy metals. The residue from 20 Cc. of an aqueous solution (1 in 20), treated as directed above, when dissolved in 20 Cc. of water and slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Calcium. The aqueous solution (1 in 20) should not be rendered turbid by the addition of ammonium oxalate T.S.

Sulphide. An aqueous solution of the salt (1 in 20) should not be colored red by a drop of phenolphthalein T.S. (absence of *caustic alkali* or *carbonate*); nor should a drop of silver nitrate T.S. produce a brown or a black precipitate in 5 Cc. of this solution.

Quantitative Test.—If 1 Gm. of Sodium Thiosulphate be dissolved in 20 Cc. of water, it should require the addition of not less than 39.75 Cc. of tenth-normal iodine V.S. to produce a slight yellow tint.

Uses.—This compound is used in the official volumetric test solution of sodium thiosulphate, and occasionally in medicine, as an alterative and resolvent, in doses of ten to thirty grains (0.6 to 2 Gm.). Externally, it is used in baths, and also as an ointment. Its principal use is in the arts, as an *antichlor* in paper manufacture; while in photography, under the abbreviated name of "hypo," it is invaluable as a solvent for the unaltered silver chloride or bromide in the film.

CHAPTER XL

THE LITHIUM SALTS

THE lithium salts resemble those of potassium and sodium. The metal lithium is comparatively rare, for although widely distributed in nature, it occurs in such small quantities that the necessary labor to extract it makes it expensive; it is found in *lepidolite,* in *petalite*, in *spodumene*, and in many mineral waters.

Lithium is a metal resembling potassium and sodium, although much less prone to oxidation; it is soft, *and is the lightest of all known metals*, having the specific gravity of 0.5891. Heated in the air, lithium ignites at a temperature above its fusing point, burning with a bright white light; when thrown on water, it oxidizes, but does not fuse like sodium. Chemically, lithium is a monad, like sodium and potassium.

Tests for Lithium Salts

1. A colorless flame is colored a vivid red by volatile salts of lithium.

2. Concentrated solutions of lithium salts yield a white precipitate with ammonium carbonate; no precipitate is produced in dilute solution or if ammonium salts are present.

3. Sodium phosphate produces a white precipitate in alkaline or neutral solutions, which is soluble in acids and in solutions of ammonium salts.

Official Salts and Preparation of Lithium

Official Name	Preparation
Inorganic Radicals	
Lithii Bromidum	By decomposing ferrous bromide with lithium carbonate
Carbonas	By precipitating lithium sulphate with ammonium carbonate
Organic Radicals	
Lithii Benzoas	By treating lithium carbonate with benzoic acid
Citras	By treating lithium carbonate with citric acid
Citras Effervescens	Prepared by mixing finely powdered lithium citrate, sodium bicarbonate, tartaric acid, and citric acid, heating the mass until the whole is uniformly moist, granulating and drying
Salicylas	By treating lithium carbonate with salicylic acid

Unofficial Lithium Salts

Litbii Borocitras Lithium Borocitrate	Dissolve 20 Gm. citric acid, 4 Gm. lithium carbonate, and 6 Gm. boric acid in sufficient boiling water, evaporate carefully to dryness, and reduce to a powder
Lithii Chloridum, LiCl Lithium Chloride	Dissolve lithium carbonate in hydrochloric acid, concentrate, and crystallize
Lithii Diborocitras Lithium Diborocitrate	Dissolve 20 Gm. citric acid, 7 Gm. lithium carbonate, and 12 Gm. boric acid in sufficient boiling water, evaporate carefully to dryness, and reduce to a powder
Lithii Iodidum, LiI Lithium Iodide	Digest a solution of calcium iodide with lithium carbonate in slight excess, filter, and evaporate to dryness
Lithii Nitras, $LiNO_3$ Lithium Nitrate	Dissolve lithium carbonate in nitric acid, filter, concentrate, and crystallize
Lithii Phosphas, Li_3PO_4 Lithium Phosphate	Add a solution of lithium carbonate to a solution of sodium phosphate with sodium hydroxide; a crystalline powder will be precipitated
Lithii Sulphas, $Li_2SO_4+H_2O$ Lithium Sulphate	Dissolve lithium carbonate in sulphuric acid, filter, concentrate, and crystallize

LITHII BENZOAS. U.S. **Lithium Benzoate**

$LiC_7H_5O_2 = 127.11$

It should contain not less than 98.5 percent. of pure Lithium Benzoate [$C_6H_5.COOLi$], and should be kept in well-stoppered bottles.

Preparation.—This may be made by Shuttleworth's process, which is as follows:

One ounce (av.) of lithium carbonate is put in an evaporating dish with 9 fluidounces of water, the mixture is heated, and three and a quarter ounces (av.) of benzoic acid in small portions added, until the carbonate is all decomposed and effervescence ceases; the solution is filtered and evaporated to dryness, or crystallized if desired. The yield is three and a half ounces. The advantage of this process is a saving in time and labor in evaporating.

$$\underset{\text{Lithium Carbonate}}{Li_2CO_3} + \underset{\text{Benzoic Acid}}{2HC_7H_5O_2} = \underset{\text{Lithium Benzoate}}{2LiC_7H_5O_2} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon Dioxide}}{CO_2}$$

Official Description.—A light, white powder, or small, shining, crystalline scales; permanent in the air.

Odor, Taste, and Reaction.—Odorless, or of faint benzoin-like odor; cooling, sweetish taste. The aqueous solution (1 in 20) has an alkaline reaction upon litmus, but is neutral to phenolphthalein T.S.

Solubility.—*Water.* Soluble in 3 parts at 25° C. (77° F.), and in 2.5 parts of boiling water.

Alcohol. In 13 parts at 25° C. (77° F.), and in 10 parts of boiling alcohol.

Its solubility in water is increased by the presence of sodium benzoate, but lessened when alcohol is the solvent.

Tests for Identity.—When heated, the salt fuses; at a higher temperature it chars, emits inflammable vapors having a benzoin-like odor, and finally leaves a residue of lithium carbonate mixed with carbon. This residue imparts a crimson color to a non-luminous flame, and its aqueous solution has an alkaline reaction upon litmus paper.

The addition of a few drops of ferric chloride T.S. to the above solution will produce a voluminous flesh-colored precipitate of ferric benzoate.

If an excess of hydrochloric acid be added to a concentrated aqueous solution of 0.6 Gm. of Lithium Benzoate, a white precipitate of benzoic acid will be formed, which, after collecting upon a filter and thoroughly washing and drying, should respond to the tests of purity given under *Acidum Benzoicum.*

Impurities and Tests for Impurities.—*Limit of other alkalies.* If the filtrate and washings from this precipitate be evaporated almost to dryness on a water-bath, in a flat-bottomed flask of 50 Cc. capacity, and 10 Cc. of amyl alcohol (boiling point 132° C.) be added, and the mixture cautiously heated until the lower aqueous layer has evaporated, then, after the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.004 Gm. The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

If 1 Gm. of the salt be dissolved in 20 Cc. of water, and the benzoic acid precipitated by the addition of a sufficient quantity of hydrochloric acid, the filtrate should respond to the following tests of purity:

Limit of iron, aluminum, etc. The addition of ammonia water until the solution has an alkaline reaction should produce neither turbidity nor precipitation, either before or after boiling.

Heavy metals. Another portion of this solution should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Gravimetric Test.—If 0.5 Gm. of Lithium Benzoate be thoroughly mixed with about 1 Gm. of powdered anhydrous ammonium sulphate and cautiously ignited in a porcelain crucible, until of constant weight, the residue should weigh not less than 0.210 Gm., nor more than 0.216 Gm.

Uses.—Lithium benzoate is used as a remedy in gout and rheumatism, in doses of fifteen to twenty grains (1 to 1.3 Gm.).

LITHII BROMIDUM. U.S. **Lithium Bromide**

$LiBr = 86.34$

It should contain when well dried not less than 97 percent. of pure Lithium Bromide, and should be kept in well-stoppered bottles.

Preparation.—There are several methods of making this salt: 1. By dissolving lithium carbonate in hydrobromic acid. 2. By mixing solutions of lithium sulphate and potassium bromide. 3. By mixing lithium carbonate, bromine, and water together, and passing hydrogen sulphide gas through the mixture. 4. By placing 300 grains of iron and 2 fluidounces of water in a flask, and adding gradually 1 oz. av. of bromine, shaking with the application of moderate heat until the mixture has acquired a green color and lost the odor of bromine; the solution of ferrous bromide is then filtered, heated, and 200 grains of lithium carbonate are added. The solution is filtered, and evaporated until the salt granulates.

$$\underset{\substack{\text{Ferrous}\\\text{Bromide}}}{FeBr_2} + \underset{\substack{\text{Lithium}\\\text{Carbonate}}}{Li_2CO_3} = \underset{\substack{\text{Lithium}\\\text{Bromide}}}{2LiBr} + \underset{\substack{\text{Ferrous}\\\text{Carbonate}}}{FeCo_3}$$

Official Description.—A white, granular salt; very deliquescent.

Odor, Taste, and Reaction.—Odorless, and having a sharp, slightly bitter taste. The aqueous solution is slightly alkaline to litmus paper.

Solubility.—*Water.* Soluble in 0.6 part at 25° C. (77° F.), and in 0.3 part of boiling water.

Alcohol. Very soluble.

Other solvents. Soluble in ether.

Tests for Identity.—At a low red heat the salt fuses, and at a higher heat it is slowly volatilized. It imparts a crimson color to a non-luminous flame.

Silver nitrate T.S. produces a yellowish-white precipitate insoluble in nitric acid, and in a moderate excess of ammonia water.

Impurities and Tests for Impurities.—*Iodine.* If there be added to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform, followed by chlorine water added cautiously, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint.

Limit of potassium. If 0.5 Cc. of sodium cobaltic nitrite T.S. be added to 5 Cc. of an aqueous solution of the salt (1 in 20), no precipitate or turbidity should occur within 10 minutes.

Limit of other alkalies. If to 0.4 Gm. of Lithium Bromide contained in a flat-bottomed flask of 50 Cc. capacity, an excess of hydrochloric acid be added, and the mixture evaporated almost to dryness on a water-bath, and if 10 Cc. of amyl alcohol (boiling point 132° C.) be added and the mixture cautiously heated until the lower aqueous layer has evaporated, then, upon the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.007 Gm. The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

Limit of iron, aluminum, etc. The addition of a slight excess of ammonia water to the aqueous solution of the salt (1 in 20), which has been acidulated with hydrochloric acid, should produce neither turbidity nor precipitation, either before or after boiling.

Heavy metals. An aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If 1 Gm. of dry Lithium Bromide be dissolved in sufficient distilled water to measure 100 Cc., then 20 Cc. of this solution, to which 2 drops of potassium chromate T.S. are added, should require not less than 22.5 Cc., nor more than 23.9 Cc., of tenth-normal silver nitrate V.S. to produce a permanent red color.

Uses.—Lithium bromide is probably the most efficient of all the bromides as an hypnotic. The dose is fifteen to thirty grains (1 to 2 Gm.).

LITHII CARBONAS. U.S. Lithium Carbonate

$Li_2CO_3 = 73.51$

It should contain not less than 98.5 percent. of pure Lithium Carbonate [$CO.(OLi)_2$], and should be kept in well-stoppered bottles.

Preparation.—Lithium carbonate may be prepared from lepidolite, one of the minerals in which it is found, in the following manner: 10 parts of finely powdered lepidolite, 10 parts of barium carbonate, 5 parts of barium sulphate, and 3 parts of potassium sulphate are fused at a very high temperature in a wind furnace. The heavy silicate and barium sulphate sink to the bottom, and a layer of potassium and lithium sulphate is found at the top of the fused mass. These can be extracted by simple lixiviation, and then the carbonate prepared by double decomposition with ammonium carbonate.

Official Description.—A light, white powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless, and having an alkaline taste. The aqueous solution has an alkaline reaction upon litmus paper.

Solubility.—*Water.* In 75 parts at 25° C. (77° F.), also in 140 parts of boiling water; much more soluble in water saturated with carbon dioxide.

Alcohol. Insoluble.

Other solvents. In diluted acids with active effervescence.

Tests for Identity.—At a low red heat the salt fuses; at a higher temperature it loses some of its carbon dioxide, and is partially converted into lithium oxide. Its solution in hydrochloric acid imparts a crimson color to a non-luminous flame.

If 1 Gm. of Lithium Carbonate be dissolved in 40 Cc. of diluted acetic acid, no insoluble residue should remain.

If 1 part of Lithium Carbonate be mixed with 20 parts of water, and hydrochloric acid be added, drop by drop, with agitation until solution takes place, the resulting solution should, after boiling and cooling, respond to the following tests when applied to separate portions:

Impurities and Tests for Impurities.—*Limit of iron, aluminum, etc.* The addition of ammonia water, until the solution has an alkaline reaction, should produce neither turbidity nor precipitation, either before or after boiling.

Heavy metals. Another portion of this solution should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of other alkalies. If to 0.2 Gm. of Lithium Carbonate contained in a flat-bottomed flask of 50 Cc. capacity a slight excess of hydrochloric acid be added, and the mixture evaporated almost to dryness on a water-bath, and if 10 Cc. of amyl alcohol (boiling point 132° C.) be added and the mixture cautiously heated, until the lower aqueous layer has evaporated, then, upon the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.003 Gm. The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

Quantitative Test.—If 0.5 Gm. of Lithium Carbonate be dissolved in 20 Cc. of normal sulphuric acid V.S., the resulting solution should require not more than 6.6 Cc. of normal potassium hydroxide V.S. for complete neutralization, methyl-orange T.S. being used as indicator.

Uses.—This salt is the source of the lithium salts, and it is prescribed in gout, in doses of five to fifteen grains (0.3 to 1 Gm.).

LITHII CITRAS. U.S. Lithium Citrate

$$Li_3C_6H_5O_7 + 4H_2O = 280.08$$

It should, when carefully dried, contain not less than 98.5 percent. of pure Lithium Citrate [$C_3H_4(OH)(COOLi)_3$], and should be kept in well-stoppered bottles.

Preparation.—The process formerly official may be usefully employed in making this salt:

Take of Lithium Carbonate 100 grains; Citric Acid, in crystals, 200 grains; Distilled Water 2 fl. oz. Dissolve the Citric Acid in the water gently heated, and to the solution gradually add the Lithium Carbonate until perfectly dissolved, heating the solution so long as effervescence is produced. Evaporate, by means of a steam- or sand-bath, to a viscid consistence, dry the residue in an oven, at a temperature of about 240° F., then rapidly pulverize it, and preserve the powder in a well-stoppered bottle.

$$\underset{\substack{\text{Lithium}\\\text{Carbonate}}}{3Li_2CO_3} + \underset{\text{Citric Acid}}{2H_3C_6H_5O_7} = \underset{\text{Lithium Citrate}}{2Li_3C_6H_5O_7} + \underset{\text{Water}}{3H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{3CO_2}$$

Lithium citrate should be kept in well-stoppered bottles.

Official Description.—A white powder, or colorless crystals; deliquescent on exposure to moist air.

Odor, Taste, and Reaction.—Odorless, and having a cooling, faintly alkaline taste. The aqueous solution (1 in 20), is faintly alkaline to litmus paper, and should not redden phenolphthalein T.S.

Solubility.—*Water.* Soluble in about 2 parts at 25° C. (77° F.), and in 1.5 parts of boiling water.

Alcohol. Almost insoluble.

Other solvents. Almost insoluble in ether.

Tests for Identity.—At a red heat the salt chars, emits inflammable vapors having a pungent odor, and finally leaves a black residue of lithium carbonate mixed with carbon. It imparts a crimson color to a non-luminous flame.

If an aqueous solution of Lithium Citrate (1 in 20) be boiled with an equal volume of calcium chloride T.S., a white precipitate will form.

Impurities and Tests for Impurities.—*Limit of other alkalies.* If the residue obtained by igniting 0.2 Gm. of the salt at a red heat be treated with a slight excess of diluted hydrochloric acid, and the filtrate and washings evaporated almost to dryness on a water-bath, in a flat-bottomed flask of 50 Cc. capacity, and if 10 Cc. of amyl alcohol (boiling point 132° C.) be added, and the mixture cautiously heated until the lower aqueous layer has evaporated, then, upon the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.002 Gm. The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

Heavy metals. The solution of the salt (1 in 20), acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of iron, aluminum, etc. The residue of lithium sulphate resulting from the ignition (see Gravimetric Test below), after being dissolved in 10 Cc. of boiling water and acidified with hydrochloric acid, should, upon the addition of ammonia water until the solution has an alkaline reaction, not become turbid or form a precipitate, either before or after boiling.

Gravimetric Test.—If 0.5 Gm. of Lithium Citrate dried at 150° C. (302° F.) be cautiously ignited in a porcelain crucible, and if, after cooling, the residue be moistened with a few drops each of nitric and sulphuric acids and again cautiously ignited, repeating the operation until the residue becomes white and of constant weight, then the residue of lithium sulphate should weigh not less than 0.387 Gm., nor more than 0.394 Gm.

Uses.—Lithium citrate is used for the same purpose as lithium carbonate; it is more soluble than the latter. The dose is from five to twenty grains (0.3 to 1.3 Gm.).

LITHII CITRAS EFFERVESCENS. U.S. Effervescent Lithium Citrate

	Metric	Old form
* **Lithium Citrate**	50 Gm.	1 oz. av.
Sodium Bicarbonate, dried and powdered	570 Gm.	11 oz. av. 175 gr.
Tartaric Acid, dried and powdered	300 Gm.	6 oz. av.
Citric Acid, uneffloresced crystals	195 Gm.	3 oz. av. 394 gr.
To make about	1000 Gm.	20 oz. av.

Powder the Citric Acid and mix it intimately with the Lithium Citrate and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated between 93° and 104° C. (199.4° and 219.2° F.).

When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles.

Uses.—This salt forms a pleasant mode of administering a lithium salt; the dose is one to two drachms (4 to 8 Gm.).

LITHII SALICYLAS. U.S. Lithium Salicylate

$LiC_7H_5O_3 = 142.99$

It should contain not less than 98.5 percent. of pure Lithium Salicylate [C_6H_4-(OH)COOLi], and should be kept in well-stoppered bottles.

Preparation.—This salt may be prepared by adding 60 grains of lithium carbonate to 1 fluidounce of distilled water and heating the mixture to boiling, then adding 220 grains of salicylic acid and continuing the heat until effervescence ceases, filtering, and evaporating.

$$\underset{\substack{\text{Lithium}\\\text{Carbonate}}}{Li_2CO_3} + \underset{\text{Salicylic Acid}}{2HC_7H_5O_3} = \underset{\substack{\text{Lithium}\\\text{Salicylate}}}{2LiC_7H_5O_3} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

This salt should be kept in well-stoppered bottles.

Official Description.—A white or grayish-white powder; deliquescent in a moist atmosphere.

Odor, Taste, and Reaction.—Odorless, and having a sweetish taste. The aqueous solution (1 in 20) should be neutral or slightly acid to litmus paper.

Solubility.—*Water.* Very soluble.

Alcohol. Very soluble.

Tests for Identity.—When heated, the salt is decomposed, emitting the odor of phenol, and finally leaving a residue of lithium carbonate and carbon. It imparts a crimson color to a non-luminous flame.

If copper sulphate T.S. be added to an aqueous solution of the salt (1 in 20), the mixture should have a bright green color.

If a few drops of ferric chloride T.S. be added to an excess of a concentrated aqueous solution of Lithium Salicylate (1 in 4), a deep red color will be produced, which, after the liquid is largely diluted and mixed with more ferric chloride T.S., will change to a deep bluish-violet tint.

Upon adding to 0.5 Gm. of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and cautiously, drop by drop, about 1 Cc. of methyl alcohol, then, on heating the mixture to boiling, the odor of oil of gaultheria will be evolved.

If an excess of hydrochloric acid be added to a concentrated aqueous solution of 0.7 Gm. of Lithium Salicylate, a voluminous precipitate of salicylic acid will be formed, which, after collecting upon a filter and thoroughly washing and drying, should conform to the reactions and tests given under *Acidum Salicylicum.*

Impurities and Tests for Impurities.—*Iron and organic coloring matters.* The aqueous solution should be colorless.

Carbonate. The aqueous solution should not effervesce upon the addition of diluted acids.

Limit of other alkalies. If the filtrate and washings from this precipitate be evaporated almost to dryness on a water-bath, in a flat-bottomed flask of 50 Cc. capacity, and 10 Cc. of amyl alcohol (boiling point 132° C.) added, and if, after cautiously heating until the lower aqueous layer has evaporated, 3 drops of hydrochloric acid be added and the solution boiled for three minutes, the resulting insoluble residue should weigh not more than 0.005 Gm. The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution.

If 1 Gm. of the salt be dissolved in 20 Cc. of water, and the salicylic acid precipitated by the addition of a sufficient quantity of hydrochloric acid, the filtrate should respond to the following tests of purity:

Limit of iron, aluminum, etc. The addition of ammonia water until the solution has an alkaline reaction should produce neither turbidity nor precipitation, either before or after boiling.

Heavy metals. Another portion of this solution should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Gravimetric Test.—If 0.5 Gm. of dry Lithium Salicylate be thoroughly mixed with about 1 Gm. of powdered anhydrous ammonium sulphate, and cautiously ignited in a porcelain crucible until of constant weight, the residue should weigh not less than 0.188 Gm., nor more than 0.192 Gm.

Uses.—This salicylate is used, like sodium salicylate, for rheumatism and gout; it is given in doses of fifteen to forty grains (1 to 2.6 Gm.).

CHAPTER XLI

AMMONIUM

THE ammonium salts resemble those of the alkali metals so closely in their physical and chemical properties that they are appropriately considered in this place.

The metal ammonium has not yet been isolated in the free state, so that its appearance cannot be described. An *ammonium amalgam* is known, however, made by dissolving potassium in mercury and adding a strong solution of ammonium chloride to it. It is a spongy, metallic substance, which easily decomposes into ammonia, mercury, and hydrogen.

Tests for Ammonium Salts

1. At high temperatures ammonium compounds are volatilized.

2. When heated with sodium, potassium, or calcium hydroxide, the odor of ammonia is evolved; the latter restores the color of reddened litmus paper, and darkens the blue color of paper moistened with solution of copper sulphate. Ammonia forms a white cloud with vapor of hydrochloric acid.

3. Solution of platinic chloride, with a few drops of hydrochloric acid, if added to a solution of an ammonium salt, produces a yellow precipitate.

4. Ammonium salts are mostly colorless, and generally very soluble in water.

Official Salts and Preparations of Ammonium

Official Name	Composition and Preparation
Aqua Ammoniæ	10 percent. by weight aqueous solution of NH_3
Ammoniæ Fortior	28 percent. by weight aqueous solution of NH_3
Spiritus Ammoniæ	10 percent. by weight alcoholic solution of NH_3
Ammoniæ Aromaticus	An aromatic hydro-alcoholic solution of ammonium carbonate
Linimentum Ammoniæ	35 Cc. ammonia water; 5 Cc. alcohol; 57 Cc. cotton seed oil; 3 Cc. oleic acid
Liquor Ammonii Acetatis	Made by mixing solution of acetic acid and ammonium carbonate
Ammonii Benzoas	By dissolving benzoic acid in ammonia water
Bromidum	By adding ammonia water gradually to bromine under water
Carbonas	By subliming a mixture of ammonium chloride and calcium carbonate
Chloridum	By subliming a mixture of ammonium sulphate and sodium chloride
Iodidum	By mixing solutions of potassium iodide and ammonium sulphate
Salicylas	By neutralizing ammonia water with salicylic acid
Valeras	By passing ammonia gas into monohydrated valeric acid
Trochisci Ammonii Chloridi	1.5 gr. ammonium chloride in each lozenge

Unofficial Salts and Preparations of Ammonium

Ammonii Arsenas, $(NH_4)_2HAsO_4$ Ammonium Arsenate	Saturate a concentrated solution of arsenic trioxide with ammonia water and allow it to evaporate spontaneously
Ammonii Bicarbonas, NH_4HCO_3 Ammonium Bicarbonate	Treat 1 Gm. powdered ammonium carbonate with 2 Gm. water, and decant the liquid, the residue being the bicarbonate

Unofficial Salts and Preparations of Ammonium—*Continued*

Ammonii Boras, $2(NH_4HBr_2O_4)+3H_2O$ Ammonium Borate	Dissolve 1 Gm. boric acid in 3 Gm. warm ammonia water, sp. gr. 0.960, and allow to cool slowly
Ammonii Carbonas Pyro-oleosus Pyro-oleous Ammonium Carbonate	Incorporate thoroughly 32 Gm. ammonium carbonate with 1 Gm. ethereal animal oil
Ammonii Citras, $(NH_4)_3C_6H_5O_7+3H_2O$ Ammonium Citrate	Dissolve 1 Gm. citric acid in water, add sufficient ammonia water to neutralize, filter, concentrate, and crystallize
Ammonii Dichromas, $(NH_4)_2Cr_2O_7$ Ammonium Dichromate	Add chromium trioxide to ammonia water, concentrate, and crystallize
Ammonii et Ferri Chloridum Ammonium and Iron Chloride	Mix 32 Gm. ammonium chloride with 9 Gm. solution of ferric chloride, and evaporate to dryness with constant stirring
Ammonii et Potassii Tartras Ammonium and Potassium Tartrate	Add ammonium carbonate to a hot solution of acid potassium tartrate until neutralized, evaporate, and crystallize
Ammonii Formas, NH_4CHO_2 Ammonium Formate	Neutralize formic acid with ammonia water, evaporate, and crystallize
Ammonii Fluoridum, NH_4F Ammonium Fluoride	Saturate hydrofluoric acid with ammonia water
Ammonii Nitras, NH_4NO_3 Ammonium Nitrate	Treat ammonium carbonate with nitric acid
Ammonii Nitris, NH_4NO_2 Ammonium Nitrite	Add a solution of ammonium chloride to one of silver nitrate, and evaporate the clear solution over sulphuric acid to dryness
Ammonii Phosphas, $(NH_4)_2HPO_4$ Ammonium Phosphate	By mixing solutions of phosphoric acid and ammonia
Ammonii Salicylas, $(NH_4)C_7H_5O_3$ Ammonium Salicylate	Neutralize salicylic acid with ammonia water, evaporate, and crystallize
Ammonii Sulphas, $(NH_4)_2SO_4$ Ammonium Sulphate	By saturating gas liquor with sulphuric acid and crystallizing
Ammonii Sulphis, NH_4HSO_3 Ammonium Sulphite	Pass sulphurous acid into an alcoholic solution of ammonia, and collect the precipitate
Ammonii Sulphocyanidum, NH_4CNS Ammonium Sulphocyanide	Dissolve carbon disulphide in alcohol, and heat in the presence of ammonia water. Lastly, concentrate and crystallize

AQUA AMMONIÆ. U.S. Ammonia Water

An aqueous solution of Ammonia [$NH_3=16.93$] containing 10 percent., by weight, of gaseous ammonia. This solution deteriorates on keeping, and should be tested frequently. It must not be dispensed for medicinal purposes if it contains less than 10 percent., by weight, of the gas. Ammonia Water should be kept in glass-stoppered bottles, in a cool place.

Preparation.—This useful liquid is rarely prepared by the pharmacist, for the reason that it can be made more economically by the manufacturer. The official process of 1870 (see U. S. Dispensatory, 18th edition, page 203) directed that it should be made by mixing ammonium chloride, in small pieces, with milk of lime, and placing the mixture in a retort, connected with a cooled receiver by means of a glass tube, the end of which was dipped beneath the surface of distilled water contained in the receiver. The rationale of this process is that the lime is converted into calcium chloride, while the ammonia gas, liberated by the heat, is dissolved in the distilled water.

$$\underset{\text{Ammonium Chloride}}{2NH_4Cl} + \underset{\text{Calcium Hydroxide}}{Ca(OH)_2} = \underset{\text{Ammonia}}{2NH_3} + \underset{\text{Calcium Chloride}}{CaCl_2} + \underset{\text{Water}}{2H_2O}$$

The manufacturer rarely uses ammonium chloride; the sulphate is cheaper, and it is frequently employed instead. But upon the large scale the ammonia liquor obtained from gas works is used directly as the source, being mixed with milk of lime and heated; the gaseous ammonia is then passed through a series of tubes filled with charcoal, which retain the empyreumatic products. If the tubes are long enough, and sufficient charcoal is employed, a pure product is assured; but much of the commercial ammonia water is empyreumatic through defective purification.

Official Description.—A colorless, transparent liquid.

Odor, Taste, and Reaction.—Very pungent, characteristic odor; caustic alkaline taste; strongly alkaline reaction.

Specific Gravity.—0.958 at 25° C. (77° F.).

Tests for Identity.—It is completely volatilized at 100° C. (212° F.).

On bringing a glass rod dipped into hydrochloric acid near cold Ammonia Water, dense white fumes are produced.

Impurities and Tests for Impurities.—*Limit of readily oxidizable substances.* If 0.1 Cc. of tenth-normal potassium permanganate V.S. be added to 10 Cc. of ammonia water, which has been slightly supersaturated with diluted sulphuric acid, the pink color should not be completely destroyed within ten minutes.

Heavy metals. When neutralized and made slightly acid with hydrochloric acid, Ammonia Water should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Sulphates. If Ammonia Water be slightly supersaturated with nitric acid, it should not be affected by barium chloride T.S.

Chlorides. Nor by silver nitrate T.S.

Coal-tar bases and fixed impurities. If a third portion of the acidulated liquid be evaporated on a water-bath to dryness, it should afford a colorless residue which, on ignition, should be completely volatilized.

Quantitative Test.—Introduce into a stoppered weighing bottle 3 Cc. of Ammonia Water and weigh accurately. Dilute with 50 Cc. of distilled water and titrate with normal sulphuric acid V.S., using litmus or methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal sulphuric acid V.S. consumed, by 1.693, and divide this product by the weight of the Ammonia Water taken; the quotient represents the percentage of Ammonia gas.

Uses.—Pharmaceutically, ammonia water is frequently used to precipitate iron salts by combining with the acid radicals, ferric hydroxide being thrown down. Its advantage over the fixed alkalies consists in its volatility, any excess being readily detected by the odor. It is largely used for cleaning fabrics. The strength technically known as "Aqua Ammoniæ F. F. F.," or "20° Ammonia," is employed most frequently in the arts; the latter may be diluted with water, according to the formula given on page 98, if it is desirable to make official ammonia water from it. In round numbers, three parts of 20° ammonia water require two parts of water to reduce it to the strength of official ammonia water. Ammonia water is rarely used internally, the aromatic spirit being preferred. The dose is ten to twenty minims (0.6 to 1.2 Cc.), largely diluted. Externally, it is caustic and stimulating. Its old name is *Spirits of Hartshorn*, but it is desirable to supplant such names, and use those which are modern, the name *ammonia* is thoroughly established by common usage.

AQUA AMMONIÆ FORTIOR. U.S. Stronger Ammonia Water

An aqueous solution of Ammonia [$NH_3 = 16.93$] containing 28 percent., by weight, of gaseous ammonia. This solution deteriorates on keeping, and should be tested frequently. Stronger Ammonia Water should be kept in partially filled, strong, glass-stoppered bottles, in a cool place. *Great caution should be used in handling this liquid.*

Preparation.—Stronger ammonia water is prepared in the same way that ammonia water is, the only difference between the two solutions being that of relative strength.

Official Description.—A colorless, transparent liquid.

Odor, Taste, and Reaction.—Excessively pungent odor; very caustic and alkaline taste; strongly alkaline reaction.

Specific Gravity.—0.897 at 25° C. (77° F.).

Tests for Identity.—If Stronger Ammonia Water be diluted with twice its volume of distilled water, it should respond to the reactions and tests described under *Aqua Ammoniæ*.

Quantitative Test.—The percentage of ammonia gas in Stronger Ammonia Water should be determined by the same test as that given under *Aqua Ammoniæ*.

Uses.—This liquid is used externally as a caustic and vesicant, and for making ammonia water by dilution and also in spirit of ammonia. It is too strong for internal administration.

SPIRITUS AMMONIÆ. U.S. Spirit of Ammonia

An alcoholic solution of Ammonia [$NH_3 = 16.93$] containing 10 percent., by weight, of the gas. This solution deteriorates on keeping, and should be tested frequently. It must not be dispensed for medicinal purposes if it contains less than 10 percent. of gaseous ammonia.

This is an alcoholic solution of ammonia gas, of exactly the same strength as ammonia water (see page 313 for the process). The object of selecting a stronger aqueous solution of the same gas, to furnish the active ingredient, was to obtain an accurate and uniform quantity of the latter conveniently and without contamination. Practically, considerable difficulty will be experienced in maintaining the temperature of 60° C. (140° F.) for ten minutes. The amount of ammonia present is determined by a volumetric assay (see below).

Official Description.—A colorless liquid.

Odor.—Strong odor of ammonia.

Specific Gravity.—About 0.808 at 25° C. (77° F.).

Tests for Identity.—When diluted with water, it should respond to the tests for identity and purity given under *Aqua Ammoniæ*.

Assay.—Introduce into a weighing bottle about 2 Cc. of the Spirit, weigh accurately, dilute with 50 Cc. of distilled water, and titrate with half-normal sulphuric acid V.S., using litmus T.S. as indicator. Multiply the number of Cc. of half-normal sulphuric acid V.S. consumed, by 0.008465, and this product by 100, and divide by the weight in grammes of the Spirit taken to obtain the percentage of ammonia gas.

Uses.—Spirit of ammonia is antacid and stimulant. It is not used internally to any extent, the aromatic spirit of ammonia being preferred. The dose is from ten to twenty minims (0.6 to 1.2 Cc.), largely diluted with water.

SPIRITUS AMMONIÆ AROMATICUS. U.S. Aromatic Spirit of Ammonia

	Metric	Old form
* **Ammonium Carbonate,** in translucent pieces	34 Gm.	1 oz. av. 1 dr.
Ammonia Water	90 Cc.	2 fl. oz. 7 fl. dr.
Oil of Lemon	10 Cc.	2½ fl. dr.
Oil of Lavender Flowers	1 Cc.	15 minims
Oil of Myristica	1 Cc.	15 minims
Alcohol	700 Cc.	22 fl. oz. 3 fl. dr.
Distilled Water, a sufficient quantity,		
To make	1000 Cc.	2 pints

To the Ammonia Water, contained in a flask, add 140 Cc. [old form 4½ fl. oz.] of Distilled Water, and afterwards the Ammonium Carbonate reduced to a moderately fine powder. Close the flask and agitate the contents until the Ammonium Carbonate is dissolved, and allow it to stand for twelve hours. Introduce the Alcohol into a graduated bottle of suitable capacity, add first the oils, then gradually the solution of Ammonium Carbonate, and afterwards enough Distilled Water to make the product measure 1000 Cc. [old form 2 pints]. Set the liquid aside during twenty-four hours in a cool place, occasionally agitating, then filter it, through paper, in a well-covered funnel.

As ordinarily prepared, from unselected ammonium carbonate, precipitation is very apt to take place ; this is due to the use of exposed and effloresced ammonium carbonate, which contains more than the proper quantity of bicarbonate (see Ammonii Carbonas). The addition of ammonia water in the formula is to convert the bicarbonate into the carbonate, the latter being soluble in the mixture of water and alcohol, while the bicarbonate is insoluble in alcohol. Sufficient time should be given to effect the solution. The ammonium carbonate should be carefully selected, and only the translucent pieces used.

Official Description.—A nearly colorless liquid when freshly prepared, but gradually acquiring a somewhat darker tint.
Odor and Taste.—Pungent odor and taste of ammonia.
Specific Gravity.—About 0.900 at 25° C. (77° F.).

Uses.—This is a very valuable and largely used antacid and stimulant. The dose is from twenty to sixty minims (1.3 to 4 Cc.), largely diluted with water.

LIQUOR AMMONII ACETATIS. U.S. Solution of Ammonium Acetate

[SPIRIT OF MINDERERUS]

An aqueous solution which should contain not less than 7 percent. of Ammonium Acetate [$CH_3.COONH_4 = 76.51$], with small amounts of acetic and carbonic acids.

	Metric	Old form
***Ammonium Carbonate**	**5 Gm.**	365 grains
Diluted Acetic Acid	**100 Cc.**	16 fl. oz.

Add the Ammonium Carbonate (which should be in translucent pieces, free from white, pulverulent bicarbonate) gradually to the cold Diluted Acetic Acid, and stir until it is dissolved.

This preparation should be freshly made when wanted.

Solution of Ammonium Acetate may also be prepared in the following manner :

	Metric	Old form
Ammonium Carbonate	**10 Gm.**	2 oz. av.
Acetic Acid	**28 Gm.**	4⅔ fl. oz.
Distilled Water	**142 Gm.**	about 27 fl. oz.

Dissolve the Ammonium Carbonate in 80 Gm. [old form 1 pint] of Distilled Water, and filter the solution. To the Acetic Acid add 62 Gm. [old form sufficient to make 1 pint] of Distilled Water. Keep the solutions in separate, well-stoppered bottles, and, when Solution of Ammonium Acetate is to be dispensed, weigh (or, if the alternative formula is used, measure) equal quantities of each solution and mix them.

The reaction involved in this process depends upon the decomposition of the ammonium carbonate with acetic acid ; the free carbonic acid is a desirable addition to the solution, which should be dispensed with a moderate amount in solution.

$$\underset{\text{Acid Ammonium Carbonate and Carbamate}}{(NH_4HCO_3)NH_4NH_2CO_2} + \underset{\text{Acetic Acid}}{3HC_2H_3O_2} = \underset{\text{Ammonium Acetate}}{3NH_4C_2H_3O_2} + \underset{\text{Carbon Dioxide}}{2CO_2} + \underset{\text{Water}}{H_2O}$$

It will be found in practice that the last formula is much more satisfactory than the first. The solutions keep well, and it is very convenient to mix them at the time of dispensing, and thus always be enabled to send out a fresh preparation, which retains sufficient carbonic acid to be grateful to the patient.

Official Description.—A clear, colorless liquid.
Odor, Taste, and Reaction.—Free from empyreuma; mildly saline, acidulous taste; acid reaction.
Tests for Identity.—It is wholly volatilized by heat.
When Solution of Ammonium Acetate is heated with potassium hydroxide T.S., ammonia is evolved.
If to 5 Cc. of the Solution 1 Cc. each of sulphuric acid and alcohol be added, and the mixture boiled, the odor of acetic ether will be developed.

Uses.—This solution is used as a diaphoretic or diuretic, in the dose of half a fluidounce (16 Cc.).

AMMONII BENZOAS. U.S. Ammonium Benzoate

$NH_4C_7H_5O_2 = 138.06$

It should contain not less than 98 percent. of pure Ammonium Benzoate [$C_6H_5.COONH_4$], and should be kept in well-stoppered bottles.

Preparation.—This salt may be advantageously prepared by a former official process, which is as follows:

Take of Benzoic Acid 480 grains; Ammonia Water, 3½ fl. oz., or a sufficient quantity; Distilled Water, 4. fl. oz. Dissolve the Acid in 3½ fl. oz. of the Ammonia Water, previously mixed with the Distilled Water; evaporate with a gentle heat, occasionally adding Ammonia Water, if necessary, to maintain a slight excess of the alkali; then set aside to crystallize, and dry the crystals without heat.

Ammonium Benzoate should be kept in well-stoppered bottles.

The process is one of direct combination, the reaction being as follows:

$$\underset{\substack{\text{Benzoic}\\\text{Acid}}}{HC_7H_5O_2} + \underset{\substack{\text{Ammonia}\\\text{Water}}}{NH_4HO} = \underset{\substack{\text{Ammonium}\\\text{Benzoate}}}{NH_4C_7H_5O_2} + \underset{\text{Water}}{H_2O}$$

The object of retaining an excess of alkali in the process is to prevent the formation of the acid benzoate, which is less soluble than the official salt.

Official Description.—Thin, white, laminar crystals or a crystalline powder; gradually losing ammonia on exposure to the air.
Odor, Taste, and Reaction.—Odorless, or having a slight odor of benzoic acid; saline, bitter, afterwards slightly acrid taste; neutral or very slightly acid reaction.
Solubility.—*Water.* In about 10.5 parts at 25° C. (77° F.); in 1.2 parts of boiling water.
Alcohol. In 28 parts at 25° C. (77° F.); in 7.6 parts of boiling alcohol.
Tests for Identity.—The salt fuses at 193° to 194° C. (379.4° to 381.2° F.), with decomposition, and when strongly heated emits vapors having the odor of ammonia and benzoic acid, and is finally completely volatilized.

A saturated aqueous solution of Ammonium Benzoate affords with ferric chloride T.S. a flesh-colored precipitate, and when such a solution is gently heated with potassium hydroxide T.S. ammonia is evolved.

Impurities and Tests for Impurities.—*Sulphate.* If diluted nitric acid be added in slight excess to the aqueous solution of the salt (1 in 10), the precipitated benzoic acid, after collecting and washing, should respond to the tests of purity and identity given under *Acidum Benzoicum*, and the filtrate from this precipitate should not be affected by barium chloride T.S.

Chloride. Or by silver nitrate T.S.

Heavy metals. If the aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No 121, Chap. LXII).

Uses.—Ammonium benzoate is used as a stimulant diuretic, in doses of five to twenty grains (0.3 to 1.3 Gm.).

AMMONII BROMIDUM. U.S. Ammonium Bromide

$NH_4Br = 97.29$

It should contain not less than 97 percent. of pure Ammonium Bromide, and should be kept in well-stoppered bottles.

Preparation.—Several methods have been employed in making this salt: 1. By double decomposition between solutions of ammonium sulphate and potassium bromide, alcohol being added to separate the ammonium bromide. 2. By adding ammonia water to a solution of ferrous bromide. 3. By Pile's process, one pound of bromine is poured carefully into four times its weight of distilled water in a stone jar, then about one quart of ammonia water is added *very gradually*, a fluidounce at a time, and the top of the jar covered with a glass plate when vapors arise; when all the ammonia has been added, and the solution is free from the smell of bromine, it is evaporated and the salt granulated; the yield is about twenty ounces.

$$\underset{\text{Bromine}}{6Br} + \underset{\text{Ammonia}}{8NH_3} = \underset{\substack{\text{Ammonium}\\\text{Bromide}}}{6NH_4Br} + \underset{\text{Nitrogen}}{N_2}$$

Official Description.—Colorless, transparent, prismatic crystals, or a white, crystalline powder; permanent in dry air.

Odor, Taste, and Reaction.—Odorless; pungent, saline taste; slightly acid reaction.

Solubility.—*Water.* In 1.2 parts at 25° C. (77° F.); in 0.7 part of boiling water.

Alcohol. In 12.5 parts at 25° C. (77° F.); in 9 parts of boiling alcohol.

Tests for Identity.—When heated, Ammonium Bromide volatilizes completely, without fusing.

When the aqueous solution is gently heated with potassium hydroxide T.S., ammonia is evolved.

Silver nitrate T.S. produces a yellowish-white precipitate, insoluble in nitric acid or in a moderate excess of ammonia water.

Impurities and Tests for Impurities.—*Iodide.* If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and if chlorine water, which has been diluted with an equal volume of water, be cautiously introduced drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint.

Bromate. If a few drops of diluted sulphuric acid be brought in contact with a little of the powdered salt on a porcelain plate, the salt should not at once assume a yellowish color.

Limit of iron. An aqueous solution of the salt (1 in 150) should not at once assume a blue color with potassium ferrocyanide T.S.

Barium. Ten Cc. of an aqueous solution of Ammonium Bromide (1 in 20), when acidulated with acetic acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If 3 Gm. of the salt be dissolved in sufficient water to measure 100 Cc., then 10 Cc. of this solution, after the addition of a few drops of potassium chromate T.S., should require not more than 31.6 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red coloration.

Uses.—Ammonium bromide is sometimes preferred to potassium bromide as an hypnotic and sedative; it is asserted that it does not produce bromism. The dose is from ten to sixty grains (0.6 to 4 Gm.).

AMMONII CARBONAS. U.S. Ammonium Carbonate

$C_2H_{11}N_3O_5 = 156.01$

It should contain not less than 97 percent. of a mixture of Acid Ammonium Carbonate [$CO(OH)ONH_4$] and Ammonium Carbamate [$CO(NH_2)ONH_4$], and should yield not less than 31.58 percent. of ammonia gas. It should be kept in well-stoppered bottes; in a cool place. For dispensing purposes, only the translucent portions should be used.

Preparation.—The large consumption of this salt of ammonium has led to several methods of preparation. The one which is most used at present is the dry sublimation of ammonium sulphate with chalk or calcium carbonate; by double decomposition calcium sulphate and ammonium carbonate are produced.

$$\underset{\substack{\text{Ammonium}\\\text{Sulphate}}}{2(NH_4)_2SO_4} + \underset{\substack{\text{Calcium}\\\text{Carbonate}}}{2CaCO_3} = \underset{\substack{\text{Ammonium Carbonate}\\\text{(Official)}}}{NH_4HCO_3.NH_4NH_2CO_2} + \underset{\text{Water}}{H_2O} + \underset{\text{Ammonia}}{NH_3} + \underset{\text{Calcium Sulphate}}{2CaSO_4}$$

The advantage claimed for the use of ammonium sulphate over ammonium chloride is simply that of greater economy.

Official ammonium carbonate is, chemically, a mixed salt. It consists of one molecule of acid ammonium carbonate or bicarbonate and one of ammonium *carbamate;* the latter may be regarded as ammonium carbonate minus a molecule of water. If ammonium carbamate is dissolved in water, it is soon changed to normal ammonium carbonate.

$$\underset{\substack{\text{Ammonium}\\\text{Carbamate}}}{NH_4NH_2CO_2} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Normal Ammonium}\\\text{Carbonate}}}{(NH_4)_2CO_3}$$

Hence an aqueous solution of commercial ammonium carbonate contains both the neutral and acid carbonates. If the official ammonium carbonate is exposed to the air, it is soon changed into the acid carbonate or bicarbonate, through loss of ammonia, and it is thus depreciated in quality. The bicarbonate may be converted back into the carbonate by treating it with ammonia water. This fact is officially recognized in the preparation of Aromatic Spirit of Ammonia, and *smelling salts* is frequently made by coarsely grinding ammonium carbonate, placing it in a bottle, and adding strong ammonia water until it is saturated.

The principal impurity in the commercial salt is empyreuma, due to the presence of substances which communicate a disagreeable, charred odor and taste. The official test provides for the detection of empyreumatic products by first neutralizing the alkali with nitric acid and evaporating on a water-bath. The residue should be odorless and colorless.

Official Description.—White, hard, translucent, striated masses On exposure to the air, the salt loses both ammonia and carbon dioxide, becoming opaque, and is finally converted into friable, porous lumps, or a white powder.

Odor, Taste, and Reaction.—Strong odor of ammonia without empyreuma; sharp, saline taste; alkaline reaction.

Solubility.—*Water.* Slowly but completely in about 4 parts at 25° C. (77° F.), it is decomposed by hot water, with the elimination of carbon dioxide and ammonia. By prolonged boiling with water, the salt is completely volatilized.

Alcohol. Alcohol dissolves the carbamate, and leaves the acid carbonate.

Tests for Identity.—When heated, Ammonium Carbonate is completely volatilized, without charring.

The aqueous solution effervesces with acids.

Impurities and Tests for Impurities.—*Sulphate.* The aqueous solution of the salt (1 in 20), when slightly supersaturated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No 121, Chap. LXII). Another portion of this solution should not be affected by barium chloride T.S.

Thiosulphate. The aqueous solution of the salt (1 in 20), on the addition of a slight excess of silver nitrate T.S., and subsequent supersaturation with nitric acid, should neither assume a brown color.

Limit of chloride. Nor become more than slightly opalescent within two minutes.

Empyreumatic or non-volatile matters. If an aqueous solution containing 1 Gm. of the salt be slightly supersaturated with nitric acid, and then evaporated to dryness on a water-bath, it should afford a colorless and odorless residue, which, upon gentle ignition, should be completely volatilized.

Quantitative Test.—If 2 gm. of unaltered, translucent Ammonium Carbonate be dissolved in a mixture of 50 Cc. each of distilled water and normal sulphuric acid V.S., boiled for a few minutes to expel the liberated carbon dioxide, and then cooled, not more than 12.7 Cc. of normal potassium hydroxide V.S. should be required for exact neutralization, litmus T.S. being used as indicator.

Uses.—Ammonium carbonate is a stimulant in doses of three to five grains (0.2 to 0.3 Gm.). It is generally administered in mucilaginous syrups. Pharmaceutically, it is employed in making the well known solution of ammonium acetate, in the aromatic spirit of ammonia, and in elixir of iron, quinine and strychnine phosphates.

AMMONII CHLORIDUM. U.S. Ammonium Chloride

$NH_4Cl = 53.11$

[Ammonium Muriate Muriate of Ammonia]

It should contain not less than 99.5 percent. of pure Ammonium Chloride.

Preparation.—*Sal ammoniac*, as it is termed commercially, is chiefly made from *gas liquor*, the ammonical liquid obtained from gas works during the destructive distillation of the coal. The ammonia is generally neutralized with hydrochloric acid, the solution evaporated, and the dry mass sublimed in iron pots. The tough, fibrous sublimate is fitted for pharmaceutical and medicinal purposes by purification. It nearly always contains traces of iron, due to the reaction of a portion of the salt upon the cast iron dome. This may be separated by treatment with ammonia water, as shown in the following process of purification, formerly official:

Take of Chloride of Ammonium, in small pieces, 20 oz. troy; Water of Ammonia, 5 fl. dr.; Water, 2 pints. Dissolve the Chloride of Ammonium in the Water, in a porcelain dish, with the aid of heat; add the Water of Ammonia, and continue the heat for a short time; filter the solution while hot, and evaporate to dryness, with constant stirring, at a moderate heat, until it granulates; the ferrous chloride is converted into insoluble ferric hydroxide, through the combination of the hydrochloric acid with ammonia water.

Official Description.—A white, crystalline powder; permanent in the air.

Odor, Taste, and Reaction.—Without odor; cooling, saline taste. The aqueous solution (1 in 20) in ice-cold water, should not redden blue litmus paper at once.

Solubility.—*Water.* In 3 parts at 25° C. (77° F.); in 1 part of boiling water.

Alcohol. In 80 parts at 25° C. (77° F.).

Other solvents. In 10 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—On ignition, Ammonium Chloride is volatilized, without charring.

The aqueous solution of the salt (1 in 20) in ice-cold water, should not redden blue litmus paper at once; it affords, with silver nitrate T.S., a white, curdy precipitate, which is soluble in ammonia water.

The aqueous solution, when gently heated with potassium hydroxide T.S., evolves ammonia.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Sulphate. Nor should it be affected by barium chloride T.S.

Barium. Nor diluted sulphuric acid.

Calcium. Nor ammonium oxalate T.S.

Sulphocyanate. When acidulated with hydrochloric acid, the solution should not assume a red color on the addition of a few drops of ferric chloride T.S.

Limit of iron. Twenty Cc. of the aqueous solution of salt (1 in 150) should not at once assume a blue color on the addition of 5 drops of potassium ferrocyanide T.S.

Limit of empyreumatic or non-volatile substances. If to 1 Gm. of the salt a little nitric acid be added, and the mixture evaporated to dryness in a porcelain dish on a water-bath, a white residue should be obtained, which, when ignited should yield not more than 0.0005 Gm. of non-volatile, residue.

Quantitative Test.—If 1 Gm. of Ammonium Chloride be dissolved in sufficient distilled water to measure 100 Cc., then 10 Cc. of this solution should, after the addition of 5 drops of potassium chromate T.S., require not less than 18.7 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color.

Uses.—Ammonium chloride is a stimulant, and largely used as an addition to expectorant remedies, in doses of five to ten grains (0.3 to 0.6 Gm.). It is sometimes used as an inhalation in catarrh, by drawing the vapors of hydrochloric acid and ammonia into a bottle, where they combine to form ammonium chloride in very fine powder. It should never be combined with potassium chlorate, particularly in compressed tablets; for, although the combination is often desirable from a therapeutic standpoint, in time the tablets explode and serious results have been experienced. The crude form of this salt, *sal ammoniac,* is used largely in solution as an exciting fluid for voltaic batteries.

AMMONII IODIDUM. U.S. Ammonium Iodide

$NH_4I = 143.83$

It should contain not less than 97 percent. of pure Ammonium Iodide, and should be kept in small amber-colored, well-stoppered vials, protected from light.

When deeply colored, the salt should not be dispensed, but it may be deprived of free iodine by adding to its concentrated aqueous solution sufficient ammonium sulphide T.S. to render it colorless, then filtering, and evaporating on a water-bath to dryness.

Preparation.—This salt may be made by a modification of a former official process, as follows:

Take of Iodide of Potassium, in coarse powder, 4 oz. troy; Sulphate of Ammonium, in coarse powder, 867 grains; Boiling Distilled Water 2 fl. oz.; Alcohol, Water, each, a sufficient quantity. Mix the salts, add them to the Boiling Water, stir well, and allow the mixture to cool; then add a fluidounce of Alcohol, mix well, and reduce the temperature, by a bath of iced water, to about 40° F.; throw the mixture into a cool glass funnel, stopped with moistened cotton, and, when the clear solution has passed, pour upon the salt a fluidounce of a mixture containing two parts of Water and one part of Alcohol. Lastly, evaporate the solution rapidly to dryness, stirring constantly; and preserve the residue in a well-stoppered bottle.

In this process double decomposition takes place, ammonium iodide and potassium sulphate being produced.

$$\begin{array}{ccccccc} 2KI & + & (NH_4)_2SO_4 & = & 2NH_4I & + & K_2SO_4 \\ \text{Potassium} & & \text{Ammonium} & & \text{Ammonium} & & \text{Potassium} \\ \text{Iodide} & & \text{Sulphate} & & \text{Iodide} & & \text{Sulphate} \end{array}$$

The object of cooling the mixture and adding alcohol is to cause as much of the potassium sulphate to separate as possible, potassium sulphate being almost insoluble in alcohol.

Official Description.—Minute, colorless, cubical crystals, or a white, granular powder. The salt is very hygroscopic, and soon becomes yellow or yellowish-brown on exposure to the air and light, owing to the loss of ammonia and the liberation of iodine.

Odor, Taste, and Reaction.—Without odor when colorless, but emitting a slight odor of iodine when colored; sharp, saline taste; neutral reaction.

Solubility.—*Water.* In 0.6 part at 25° C. (77° F.); in 0.43 part of boiling water.

Alcohol. In 9 parts at 25° C. (77° F.); in 3.7 parts of boiling alcohol.

Tests for Identity.—When heated on platinum foil, Ammonium Iodide evolves vapor of iodine, and volatilizes completely without fusing.

The aqueous solution of the salt, when gently heated with potassium hydroxide T.S., evolves ammonia.

If to 5 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated and impart to the solution a light reddish-brown color. On agitating the mixture with a few drops of chloroform, the latter will acquire a violet color.

Impurities and Tests for Impurities.—*Barium.* Ten Cc. of the aqueous solution of Ammonium Iodide (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S.

Limit of iron. An aqueous solution of the salt (1 in 150) should not at once assume a blue color with potassium ferrocyanide T.S.

Limit of free iodine. Nor, after being agitated with 1 Cc. of chloroform, should the latter assume a violet color.

Heavy metals. The aqueous solution of Ammonium Iodide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

More than about 3 percent. of chlorides or bromides. If 0.25 Gm. of the salt, dried at 100° C. (212° F.), be dissolved in 5 Cc. of ammonia water (10 percent.), the solution shaken with 16.9 Cc. of tenth-normal silver nitrate V.S., and the filtrate supersaturated with 5 Cc. of nitric acid, no cloudiness should make its appearance within ten minutes.

Uses.—Ammonium iodide is used as a resolvent and alterative, for the same purposes as potassium iodide. The dose is from three to five grains (0.2 to 0.3 Gm.).

AMMONII SALICYLAS. U.S. Ammonium Salicylate

$NH_4C_7H_5O_3 = 153.94$

It should contain not less than 98 percent. of pure Ammonium Salicylate [$C_6H_4(OH)COONH_4$], and should be kept in well-stoppered bottles, protected from heat and light.

Preparation.—This salt may be made by adding salicylic acid to ammonia water until nearly saturated, evaporating the solution, crystallizing, and purifying the product by recrystallization.

Official Description.—Colorless, lustrous, monoclinic prisms, or plates, or a white, crystalline powder; permanent in dry air.

Odor, Taste, and Reaction.—Odorless, and having at first a slightly saline, bitter taste, with a sweetish after-taste; acid reaction.

Solubility.—*Water.* In 0.9 part at 25° C. (77° F.): freely in boiling water.

Alcohol. In 2.3 parts at 25° C. (77° F.); in 1 part of boiling alcohol.

Tests for Identity.—When heated, the salt fuses with decomposition, giving off inflammable vapors and an odor of phenol, and is finally completely volatilized.

The concentrated aqueous solution should be colorless, it should redden blue litmus paper, and when gently heated with potassium hydroxide T.S. evolves ammonia.

Ferric chloride T.S., added to an excess of a concentrated solution of Ammonium Salicylate, produces a dark red precipitate, but imparts to a very dilute solution (1 in 100) a deep violet-blue color.

If copper sulphate T.S. be added to the aqueous solution of the salt (1 in 20), a green color will be produced.

If to 0.2 Gm. of the salt, contained in a test-tube, about 1 Cc. of concentrated sulphuric acid be added, and then cautiously about 1 Cc. of methyl alcohol, drop by drop, on heating the mixture to boiling, methyl salicylate will be formed, which can be recognized by its odor.

If diluted nitric acid be added in slight excess to the aqueous solution of the salt (1 in 10), the precipitated salicylic acid, after collecting and washing, should respond to the tests of purity and identity given under *Acidum Salicylicum.*

Impurities and Tests for Impurities.—*Heavy metals.* If an aqueous solution of Ammonium Salicylate (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII)

Uses.—Ammonium salicylate is preferred to sodium salicylate by many physicians ; it is used in gout and rheumatism in doses of three to five grains (0.2 to 0.3 Gm.).

AMMONII VALERAS. U. S. Ammonium Valerate

[AMMONII VALERIANAS, PHARM. 1890 AMMONIUM VALERIANATE]

Ammonium Valerate should be kept in well-stoppered bottles.

Preparation.—This valerate, formerly called valerianate, may be prepared by passing dried gaseous ammonia into monohydrated valeric acid. The former official process may be used, which is as follows :

Take of Valerianic Acid 4 fl. oz. ; Chloride of Ammonium, Lime, each, a sufficient quantity. From a mixture of Chloride of Ammonium, in coarse powder, and an equal weight of Lime, previously slaked and in powder, contained in a suitable vessel, obtain gaseous ammonia, and cause it to pass, first through a bottle filled with pieces of Lime, and afterwards into the Valerianic Acid, in a tall, narrow, glass vessel, until the acid is neutralized. Then discontinue the process, and set the vessel aside that the Valerianate of Ammonium may crystallize. Lastly, break the salt into pieces, drain it in a glass funnel, dry it on bibulous paper, and keep it in a well-stoppered bottle.

The salt which is found in commerce is usually the acid salt ; hence, in making a solution of it, as in the process for elixir of ammonium valerate, the excess of acid should be neutralized by the addition of sufficient ammonia water.

Official Description.—Colorless, or white, quadrangular plates ; deliquescent in moist air.

Odor, Taste, and Reaction.—Emitting the odor of valeric acid ; sharp and sweetish taste; acid reaction.

Solubility.—*Water.* Very soluble.
Alcohol. Very soluble.
Other solvents. Soluble in ether.

Tests for Identity.—When heated, the salt fuses, gives off vapor of ammonia and of valeric acid, and is finally completely volatilized.

The aqueous solution, when gently heated with potassium hydroxide T.S., evolves ammonia.

If a concentrated, aqueous solution of Ammonium Valerate be slightly supersaturated with sulphuric acid, an oily layer of valeric acid will rise to the surface.

Impurities and Tests for Impurities.—*Acetate.* If a neutral solution of the salt be completely precipitated by ferric chloride T.S., the filtrate should not possess a deep red color.

Heavy metals. The aqueous solution of the salt (1 in 20), when slightly acidulated with hydrochloric acid and filtered through a small, wetted filter, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Uses.—Ammonium valerate is used in hysteria, neuralgia, and similar diseases as a nervine, in doses of five to twenty grains (0.3 to 1.3 Gm.). It is used pharmaceutically in the preparation of an elixir. See Elixir Ammonii Valerianas, N. F.

SATURATION TABLES. U. S. (8th Revision)

I.—Table showing the Quantity of Official Alkalies required to saturate 100 Parts of an Official Acid, together with the Quantity of Product

ACIDS		AMMONIUM				POTASSIUM					SODIUM				
	Official Percent.	Ammon. Carbonate, 97 percent.	Ammonia Water, 10 percent.	Ammonia Water, 28 percent.	Product	Potassium Hydroxide, 85 percent.	Solution of Potassium Hydroxide, 5 percent.	Potassium Bicarbonate, 99 percent.	Potassium Carbonate, 98 percent.	Product	Sodium Hydroxide, 90 percent.	Solution of Sodium Hydroxide, 5 percent.	Sodium Bicarbonate, 99 percent.	Monohydrated Sodium Carbonate, 99.5 percent.	Product
Acetic	36.0	32.39	102.30	36.53	**46.23**	39.62	673.60	60.67	42.32	**58.88**	26.69	480.48	50.92	37.40	**81.63**
" Diluted	6.0	5.40	17.05	6.09	**7.70**	6.60	112.27	10.11	7.05	**9.81**	4.45	80.08	8.49	6.23	**13.61**
" Glacial	99.0	89.08	281.31	100.47	**127.13**	108.96	1852.38	166.85	116.37	**161.91**	73.41	1321.33	140.03	102.86	**224.49**
Benzoic	100.0	44.26	139.77	49.92	**113.98**	54.14	920.33	82.90	57.82	**175.54**	36.47	656.48	69.57	51.11	**118.06**
Citric	99.5	76.75	242.38	86.56	**115.21**	93.88	1596.01	143.76	100.27	**153.70**	63.25	1138.45	120.65	88.63	**169.22**
Hydrobromic, Diluted	10.0	6.67	21.07	7.52	**12.11**	8.16	138.73	12.50	8.72	**14.71**	5.50	98.95	10.49	7.70	**12.72**
Hydrochloric	31.9	47.27	149.27	53.31	**46.83**	57.82	982.92	88.54	61.75	**65.28**	38.95	701.13	74.30	54.58	**51.19**
" Diluted	10.0	14.82	46.79	16.71	**14.68**	18.13	308.13	27.75	19.36	**20.46**	12.21	219.79	23.29	17.11	**16.05**
Lactic	75.0	44.99	142.08	50.74	**89.21**	55.03	935.55	84.27	58.77	**106.77**	37.07	667.34	70.72	51.95	**93.36**
Nitric	68.0	58.26	183.99	65.71	**86.40**	71.27	1211.55	109.13	76.11	**109.15**	48.01	864.21	91.58	67.28	**91.78**
" Diluted	10.0	8.57	27.06	9.66	**12.71**	10.48	178.17	16.05	11.19	**16.05**	7.06	127.09	13.47	9.89	**13.50**
Phosphoric	85.0	93.68	295.83	105.65	**114.58**	114.59	1947.95	175.46	122.38	**151.15**	77.19	1389.50	147.25	108.17	**310.69**
" Diluted	10.0	11.02	34.80	12.43	**13.48**	13.48	229.17	20.64	14.40	**17.78**	9.08	163.47	17.32	12.73	**36.55**
Salicylic	100.0	39.13	123.57	44.13	**112.36**	47.86	813.66	73.29	51.12	**127.63**	32.24	580.40	61.51	45.18	**115.97**
Sulphuric	92.5	101.88	321.73	114.90	**124.67**	124.62	2118.52	190.82	133.09	**164.45**	83.95	1511.17	160.15	117.64	**303.97**
" Diluted	10.0	11.01	34.78	12.42	**13.48**	13.47	229.03	20.63	14.39	**17.78**	9.08	163.37	17.31	12.72	**32.86**
Tartaric	99.5	71.64	226.23	80.80	**122.12**	87.63	1489.69	134.18	93.59	**156.07**	59.03	1062.62	112.61	82.72	**152.63**
Arsenic Trioxide	99.8	54.47	172.02	61.44	**126.09**	66.63	1132.73	102.03	71.16	**147.35**	44.89	807.99	85.63	62.90	**131.12**

II.—Table showing the Quantity of Official Acids required to saturate 100 parts of an Official Alkali, together with the Quantity of Product

ACIDS

ALKALIES	Official Percent.	ACETIC				BENZOIC		CITRIC		HYDROBROMIC		HYDROCHLORIC			LACTIC	
		36 percent.	6 percent.	99 percent.	Product	100 percent.	Product	99.5 percent.	Product	10 percent.	Product	31.9 percent.	10 percent.	Product	75 percent.	Product
Ammonium Carbonate	97.0	308.70	1852.21	112.26	**142.71**	225.94	**257.52**	130.29	**150.10**	1498.93	**181.47**	211.55	674.85	**99.06**	222.26	**198.28**
Ammonia Water .	10.0	97.76	586.53	35.55	**45.19**	71.55	**81.55**	41.26	**47.53**	474.66	**57.47**	66.99	213.70	**31.37**	70.38	**62.79**
Ammonia Water, Stronger	28.0	273.72	1642.29	99.53	**126.54**	200.33	**228.33**	115.52	**133.09**	1329.05	**160.90**	187.58	598.37	**87.84**	197.08	**175.81**
Potassium Hydroxide	85.0	252.38	1514.26	91.77	**148.59**	184.72	**324.25**	106.52	**163.72**	1225.44	**180.28**	172.95	551.72	**112.91**	181.71	**194.02**
Solution of Potassium Hydroxide	5.0	14.85	89.07	5.40	**8.74**	10.87	**19.07**	6.27	**9.63**	72.08	**10.60**	10.17	32.45	**6.64**	10.69	**11.41**
Potassium Bicarbonate.........	99.0	164.82	988.90	59.93	**97.04**	120.63	**211.75**	69.56	**106.92**	800.29	**117.73**	112.95	360.31	**73.73**	118.67	**126.71**
Potassium Carbonate....	99.0	236.31	1417.85	85.93	**139.13**	172.95	**303.60**	99.73	**153.29**	1147.41	**168.80**	161.94	516.59	**105.72**	170.14	**181.66**
Sodium Hydroxide	90.0	374.62	2247.74	136.23	**305.81**	274.19	**323.71**	158.11	**267.56**	1819.01	**231.43**	256.73	818.96	**131.42**	269.73	**251.82**
Solution of Sodium Hydroxide	5.0	20.81	124.87	7.57	**16.99**	15.23	**17.98**	8.78	**14.86**	101.06	**12.86**	14.26	45.50	**7.30**	14.98	**13.99**
Sodium Bicarbonate...........	99.0	196.39	1178.32	71.41	**160.31**	143.74	**169.70**	82.89	**140.26**	953.57	**121.31**	134.58	429.32	**68.90**	141.40	**132.01**
Monohydrated Sodium Carbonate..........	99.5	267.35	1604.08	97.22	**218.24**	195.67	**231.02**	112.83	**190.94**	1298.13	**165.16**	183.21	584.45	**93.79**	192.49	**179.71**

Continuation of Table showing the Quantity of Official Acids required to saturate 100 Parts of an Official Alkali, together with the Quantity of Product

ACIDS

ALKALIES		NITRIC			PHOSPHORIC			SALICYLIC		SULPHURIC			TARTARIC		ARSENIC TRIOXIDE	
	Official Percent.	68 percent.	10 percent.	Product	85 percent.	10 percent.	Product	100 percent.	Product	92.5 percent.	10 percent.	Product	99.5 percent.	Product	99.8 percent.	Product
Ammonium Carbonate	97.0	171.63	1167.10	**148.29**	106.75	907.36	**122.32**	255.56	**287.14**	98.15	907.92	**122.37**	139.59	**170.47**	183.57	**231.46**
Ammonia Water	10.0	54.35	369.58	**46.96**	33.80	287.33	**38.73**	80.93	**90.93**	31.08	287.51	**38.75**	44.20	**53.98**	58.13	**73.30**
Ammonia Water, Stronger	28.0	152.18	1034.83	**131.48**	94.65	804.52	**108.45**	226.60	**254.60**	87.03	805.02	**108.50**	123.77	**151.15**	162.77	**205.23**
Potassium Hydroxide	85.0	140.32	954.15	**153.15**	87.27	741.81	**131.91**	208.93	**266.67**	80.24	742.26	**131.96**	114.12	**178.10**	150.08	**221.15**
Solution of Potassium Hydroxide	5.0	8.25	56.13	**9.01**	5.13	43.64	**7.76**	12.29	**15.69**	4.72	43.66	**7.76**	6.71	**10.48**	8.83	**13.01**
Potassium Bicarbonate	99.0	91.64	623.12	**100.02**	56.99	484.44	**86.15**	136.44	**174.15**	52.40	484.74	**86.18**	74.53	**116.31**	98.01	**144.42**
Potassium Carbonate	98.0	131.38	893.40	**143.40**	81.71	694.57	**123.52**	195.63	**249.69**	75.14	695.00	**123.56**	106.85	**166.76**	140.52	**207.07**
Sodium Hydroxide	90.0	208.28	1416.32	**191.16**	129.54	1101.12	**402.48**	310.13	**359.66**	119.11	1101.80	**362.07**	169.39	**258.55**	222.77	**292.09**
Solution of Sodium Hydroxide	5.0	11.57	78.68	**10.62**	7.20	61.17	**22.36**	17.23	**19.98**	6.62	61.21	**20.12**	9.41	**14.36**	12.38	**16.23**
Sodium Bicarbonate	99.0	109.19	742.47	**100.21**	67.91	577.23	**210.99**	162.58	**188.54**	62.44	577.59	**189.81**	88.80	**135.54**	116.78	**153.12**
Monohydrated Sodium Carbonate	99.5	148.64	1010.75	**136.42**	92.45	785.81	**287.22**	221.32	**256.67**	85.00	786.29	**258.39**	120.89	**184.51**	158.98	**208.45**

III. Table showing the Quantity of Official Alkalies and Acids required to make 100 Parts of the Corresponding Salts

AMMONIUM SALTS

AMMONIUM SALTS	Parts of Alkali required			Parts of Acid required		
	Ammonium Carbonate, 97 percent.	Ammonia Water, 10 percent.	Ammonia Water, 28 percent.	Parts		Official Percent.
Ammonium Acetate .....$NH_4C_2H_3O_2$ = 76.51......	70.07	221.28	79.03	216.31	Acetic Acid	36.0
				1297.87	" " Diluted	6.0
				78.66	" " Glacial	99.0
" Arsenite ....NH_4AsO_2 = 124.09......	43.20	136.43	48.73	79.31	Arsenic Trioxide	99.8
" Benzoate....$NH_4C_7H_5O_2$ = 138.06......	38.83	122.63	43.80	87.74	Benzoic Acid	100.0
" Bromide ....NH_4Br = 97.29......	55.11	174.01	62.15	825.97	Hydrobromic Acid, Diluted..	10.0
" Chloride ....NH_4Cl = 53.11......	100.94	318.77	113.85	213.55	Hydrochloric Acid	31.9
				681.23	" " Diluted...	10.0
" Citrate......$(NH_4)_3C_6H_5O_7$ = 241.41......	66.62	210.39	75.14	86.80	Citric Acid	99.5
" Lactate .....$NH_4C_3H_5O_3$ = 106.30......	50.43	159.27	56.88	112.10	Lactic Acid	75.0
" Nitrate......NH_4NO_3 = 79.50......	67.44	212.96	76.06	115.74	Nitric Acid	68.0
				787.04	" " Diluted	10.0
" Phosphate ..$(NH_4)_2HPO_4$ = 131.15......	81.76	258.18	92.21	87.27	Phosphoric Acid	85.0
				741.82	" " Diluted.....	10.0
" Salicylate ...$NH_4C_7H_5O_3$ = 153.94......	34.83	109.98	39.28	89.00	Salicylic Acid	100.0
" Sulphate ....$(NH_4)_2SO_4$ = 131.21......	81.72	258.06	92.16	80.21	Sulphuric Acid..............	92.5
				741.95	" " Diluted	10.0
" Tartrate.....$(NH_4)_2C_4H_4O_6$ = 182.78......	58.66	185.25	66.16	81.88	Tartaric Acid	99.5

Continuation of Table showing the Quantity of Official Alkalies and Acids required to make 100 Parts of the Corresponding Salts

POTASSIUM SALTS

POTASSIUM SALTS	Parts of Alkali required				Parts	Parts of Acid required	
	Potassium Hydroxide, 85 percent.	Solution of Potassium Hydroxide, 5 percent.	Potassium Bicarbonate, 99 percent.	Potassium Carbonate, 98 percent.			Official Percent.
Potassium Acetate ....$KC_2H_3O_2$ = 97.44...	67.30	1144.09	103.05	71.88	169.85	Acetic Acid	36.0
					1019.09	" " Diluted	6.0
					61.76	" " Glacial	99.0
" Arsenite ...$KAsO_2$ = 145.02...	45.22	768.72	69.24	48.29	67.86	Arsenic Trioxide	99.8
" Benzoate ...$KC_7H_5O_2 + 3H_2O$ = 212.63...	30.84	524.29	47.22	32.94	56.97	Benzoic Acid	100.0
" Bromide ...KBr = 118.22...	55.47	943.00	84.94	59.22	679.76	Hydrobromic Acid, Diluted..	10.0
" Chloride ...KCl = 74.04...	88.57	1505.67	135.62	94.59	153.18	Hydrochloric Acid	31.9
					488.66	" " Diluted...	10.0
" Citrate .....$K_3C_6H_5O_7 + H_2O$ = 322.08...	61.08	1038.37	93.53	65.23	65.06	Citric Acid	99.5
" Lactate.....$KC_3H_5O_3$ = 127.23...	51.54	876.21	78.92	55.05	93.66	Lactic Acid	75.0
" Nitrate.....KNO_3 = 100.43...	65.30	1110.03	99.98	69.74	91.62	Nitric Acid	68.0
					623.02	" " Diluted..........	10.0
" Phosphate..K_2HPO_4 = 173.01...	75.81	1288.71	116.08	80.96	66.16	Phosphoric Acid	85.0
					562.33	" " Diluted.....	10.0
" Salicylate ..$KC_7H_5O_3$ = 174.87...	37.50	637.50	57.42	40.05	78.35	Salicylic Acid	100.0
" Sulphate ...K_2SO_4 = 173.07...	75.78	1288.26	116.04	80.93	60.81	Sulphuric Acid..............	92.5
					562.49	" " Diluted	10.0
" Tartrate....$2K_2C_4H_4O_6 + H_2O$ = 467.16...	56.15	954.53	85.98	59.97	64.08	Tartaric Acid	99.5

Continuation of Table showing the Quantity of Official Alkalies and Acids required to make 100 Parts of the Corresponding Salts

SODIUM SALTS

SODIUM SALTS	Parts of Alkali required				Parts	Parts of Acid required	
	Sodium Hydroxide, 90 percent.	Solution of Sodium Hydroxide, 5 percent.	Sodium Bicarbonate, 99 percent.	Monohydrated Sodium Carbonate, 99.5 percent.			Official Percent.
Sodium Acetate ....$NaC_2H_3O_2 + 3H_2O$ = 135.10...	32.70	588.60	62.38	45.82	122.50	Acetic Acid	36.0
					735.01	" " Diluted	6.0
					44.55	" " Glacial	99.0
" Arsenite ...$NaAsO_2$ = 129.04...	34.24	616.24	65.31	47.97	76.27	Arsenic Trioxide	99.8
" Benzoate ...$NaC_7H_5O_2$ = 143.01...	30.89	556.04	58.93	43.29	84.70	Benzoic Acid	100.0
" Bromide ...$NaBr$ = 102.24...	43.21	777.78	82.43	60.55	786.00	Hydrobromic Acid, Diluted..	10.0
" Chloride ...$NaCl$ = 58.06...	76.09	1369.62	145.15	106.62	195.34	Hydrochloric Acid	31.9
					623.15	" " Diluted...	10.0
" Citrate .....$2Na_3C_6H_5O_7 + 11H_2O$ = 709.20...	37.38	672.76	71.30	52.37	59.09	Citric Acid	99.5
" Lactate ....$NaC_3H_5O_3$ = 111.25...	39.71	714.78	75.75	55.65	107.11	Lactic Acid	75.0
" Nitrate.....$NaNO_3$ = 84.45...	52.31	941.62	99.79	73.30	108.96	Nitric Acid	68.0
					740.91	" " Diluted..........	10.0
" Phosphate..$Na_2HPO_4 + 12H_2O$ = 355.61...	24.84	447.23	47.40	34.81	32.19	Phosphoric Acid	85.0
					273.59	" " Diluted.....	10.0
" Salicylate ..$NaC_7H_5O_3$ = 158.89...	27.80	500.47	53.04	38.96	86.22	Salicylic Acid	100.0
" Sulphate ...$Na_2SO_4 + 10H_2O$ = 319.91...	27.62	497.14	52.68	38.70	32.90	Sulphuric Acid..............	92.5
					304.30	" " Diluted	10.0
" Tartrate ....$Na_2C_4H_4O_6 + 2H_2O$ = 228.44...	38.67	696.20	73.78	54.20	65.52	Tartaric Acid	99.5

CHAPTER XLII

MAGNESIUM, CALCIUM, BARIUM, AND STRONTIUM

Mg; 24.18. Ca; 39.8. Ba; 136.4. Sr; 86.94

THE compounds of these metals form a natural group. They have numerous physical and chemical characteristics in common. Barium no longer enters into any official salts; although some of its compounds are used as tests. Strontium salts were admitted to the U. S. P. 1890, and they are used to a limited extent. Magnesium was formerly classed with the alkali earths, but it is now usually separated from them, because of its closer chemical analogies to zinc. It is so closely allied to the alkali earths in its pharmaceutical and medical aspects that it will be more useful to consider it in its former relation.

Magnesium, in the forms of chloride, sulphate, carbonate, magnesia-calcic carbonate, and silicate, is widely distributed. The metal is of a silver-white color, losing its lustre through the oxidation of its surface, and burning with a radiant light when heated to redness, magnesium oxide being formed. The oxide, MgO, is official, and is largely used medicinally.

Tests for Salts of Magnesium

1. The caustic alkalies produce gelatinous, white precipitates with solutions of magnesium salts, insoluble in excess, but soluble in solution of ammonium chloride.

2. Sodium carbonate or potassium carbonate produces white precipitates with solutions of magnesium salts.

3. Solution of sodium phosphate produces a white crystalline precipitate, on the addition of a small quantity of ammonia water, of ammonio-magnesium phosphate, NH_4MgPO_4.

Official Salts and Preparations of Magnesium

Official Name	Preparation
Magnesii Carbonas	Double decomposition between magnesium sulphate and sodium carbonate
Oxidum	Made by calcining light magnesium carbonate
Oxidum Ponderosum	Made by calcining heavy magnesium carbonate
Sulphas	By treating native magnesium hydroxide with sulphuric acid
Sulphas Effervescens	Prepared by powdering and thoroughly mixing, magnesium sulphate, sodium bicarbonate, tartaric acid, and citric acid, heating the whole until it is uniformly moist, granulating and drying
Liquor Magnesii Citratis	By dissolving magnesium carbonate in citric acid, flavoring, and adding potassium bicarbonate

Unofficial Salts of Magnesium

Magnesii Acetas, $Mg(C_2H_3O_2)_2$ Magnesium Acetate	By dissolving magnesium carbonate in sufficient acetic acid, filtering and concentrating, then crystallizing
Magnesii Iodidum, MgI_2 Magnesium Iodide	By dissolving magnesium oxide in hydriodic acid, filtering, and concentrating, then crystallizing

Unofficial Salts of Magnesium—*Continued*

Magnesii Lactas, $Mg_2C_3H_5O_3 + 3H_2O$ Magnesium Lactate	By dissolving separately in hot water 6 parts calcium lactate and 5 parts magnesium sulphate, mixing the solutions and filtering, evaporating the filtrate, then crystallizing.
Magnesii Salicylas Magnesium Salicylate	Given in typhoid fever, in daily doses of fifty to one hundred grains continuously
Magnesii Silicas, $H_2Mg_2Si_3O_9 + H_2O$ Magnesium Silicate	Occurs in nature as *asbestos*, as meerschaum, and in other forms
Magnesii Sulphas Exsiccatus, $MgSO_4$ Dried Magnesium Sulphate	By exposing the crystallized sulphate in a warm place until it has lost 35 percent. of its weight, then sifting it
Magnesii Sulphis Magnesium Sulphite	By treating in suspension with sulphurous acid
Magnesii Phenolsulphonas, $Mg2C_6H_5SO_4 + 7H_2O$ Magnesium Phenolsulphonate	By mixing concentrated solutions of barium phenolsulphonate and magnesium carbonate and collecting the precipitate
Crab Orchard Salt	A mild saline purgative, consisting mainly of magnesium sulphate, obtained by evaporating the waters of Crab Orchard Springs, Kentucky. Dose, from one to two teaspoonfuls

MAGNESII CARBONAS. U.S. Magnesium Carbonate

Approximately $(MgCO_3)_4.Mg(OH)_2 + 5H_2O = 482.26$

Magnesium Carbonate $[(CO.O_2Mg)_4.Mg(OH)_2 + 5H_2O]$ should yield, upon ignition, not less than 40 percent. of residue, of which not less than 96 percent. should consist of pure magnesium oxide.

Preparation.—The process of the British Pharmacopœia is as follows: Take of Magnesium Sulphate 10 ounces [avoirdupois]; Sodium Carbonate 12 ounces [avoird.]; Boiling Distilled Water, a sufficient quantity. Dissolve the Magnesium Sulphate and Sodium Carbonate each in a pint [Imp. Meas.] of the Distilled Water, mix the two solutions, and evaporate to dryness; digest the residue for half an hour with two pints [Imp. Meas.] of the Distilled Water, and, having collected the insoluble matter on a calico filter, wash it repeatedly with Distilled Water, until the washings are free from sulphates; dry the product at a temperature not exceeding 212° F. (100° C.).

Magnesium carbonate varies in composition somewhat according to the process used. The reaction in making the U. S. carbonate would in its preparation be as follows:

$$\underset{\text{Magnesium Sulphate}}{5MgSO_4} + \underset{\text{Sodium Carbonate}}{5Na_2CO_3} + \underset{\text{Water}}{H_2O} = \underset{\text{Magnesium Carbonate}}{4MgCO_3.Mg(HO)_2} + \underset{\text{Sodium Sulphate}}{5Na_2SO_4} + \underset{\text{Carbon Dioxide}}{CO_2}$$

The process for making light magnesium carbonate differs from the above in the substitution of a larger proportion of cold water for the boiling water. This furnishes a good illustration of the rule in precipitation, that dilute solutions produce light precipitates, and dense solutions heavy precipitates.

Official Description.—Light, white, friable masses, or a bulky, white powder; permanent in the air.

Odor and Taste.—Without odor; slightly earthy taste.

Solubility.—*Water.* Practically insoluble, imparting, however, a slightly alkaline reaction.
Alcohol. Insoluble.
Other solvents. Soluble in dilute acids with effervescence.

Tests for Identity.—When strongly heated, the salt loses water and carbon dioxide, and is converted into magnesium oxide.

A filtered solution of the salt in diluted sulphuric acid, when mixed with ammonium chloride T. S. and an excess of ammonia water, yields with sodium phosphate T. S. a white crystalline precipitate.

If 1 Gm. of Magnesium Carbonate be ignited in a porcelain crucible, the residue should weigh not less than 0.40 Gm.

Impurities and Tests for Impurities.—*Limit of foreign soluble salts.* If a mixture of 1 Gm. of Magnesium Carbonate with 50 Cc. of water be heated to boiling, and, after cooling, filtered, the filtrate, if evaporated to dryness upon a water-bath, should leave not more than 0.01 Gm. of residue.

Limit of calcium. Ten Cc. of a solution of the salt (1 in 50), prepared by the addition of sufficient acetic acid for solution, should not be rendered more than slightly opalescent within five minutes by ammonium oxalate T.S.

Limit of iron. If 1 Gm. of Magnesium Carbonate be dissolved in 20 Cc. of diluted hydrochloric acid and 130 Cc. of water the solution should be colorless and not give an immediate blue coloration upon the addition of potassium ferrocyanide T.S.

Heavy metals. Nor should another solution of the same strength respond to the Time-Limit Test for other *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Quantitative Test.—If 0.400 Gm. of recently ignited and cooled Magnesium Carbonate be dissolved in 25 Cc. of normal sulphuric acid V.S., not more than 5.8 Cc. of normal potassium hydroxide V.S. should be required for neutralization, methyl-orange T. S. being used as an indicator (each Cc. of normal sulphuric acid V.S. consumed, being equivalent to 5 percent. of pure magnesium oxide).

Uses.—Magnesium carbonate is antacid, and in large doses cathartic. The dose is from thirty to sixty grains (2 to 4 Gm.). It has been largely employed in making medicated waters to assist in diffusing the oils used in preparing them.

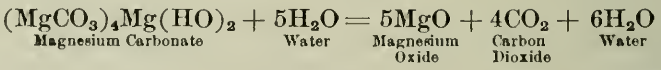
MAGNESII OXIDUM. U.S. Magnesium Oxide Magnesia

$MgO = 40.06$

[MAGNESIA, PHARM. 1890 CALCINED MAGNESIA LIGHT MAGNESIA]

It should contain, after ignition, not less than 96 percent. of pure Magnesium Oxide. It should be kept in well-closed vessels.

Preparation.—Magnesium carbonate is exposed in crucibles to a red heat, carbon dioxide and water are expelled, and magnesium oxide is left.



$$\underset{\text{Magnesium Carbonate}}{(MgCO_3)_4Mg(HO)_2} + \underset{\text{Water}}{5H_2O} = \underset{\text{Magnesium Oxide}}{5MgO} + \underset{\text{Carbon Dioxide}}{4CO_2} + \underset{\text{Water}}{6H_2O}$$

Magnesium Oxide is rendered less soluble if heated too strongly. It should always be kept in well closed vessels ; exposure to air and moisture causes the formation of carbonate and hydroxide.

Official Description.—A white, very bulky, and very fine powder. On exposure to the air, it slowly absorbs moisture and carbon dioxide.

Odor, Taste, and Reaction.—Without odor, and having an earthy, but not a saline, taste. When moistened with water, it has a faintly alkaline reaction upon red litmus paper.

Solubility.—*Water.* Almost insoluble.

Alcohol. Insoluble.

Other solvents. Soluble in dilute acids.

Tests for Identity.—On stirring 1 part of Magnesium Oxide with 15 parts of water, in a beaker, and allowing the mixture to stand for about half an hour, it will form a gelatinous mass of sufficient consistence to prevent it from dropping out when the beaker is inverted.

A solution of Magnesium Oxide in diluted sulphuric acid, mixed with ammonium chloride T.S. and an excess of ammonia water, yields, with sodium phosphate T.S., a white, crystalline precipitate.

Impurities and Tests for Impurities.—*Limit of foreign soluble salts.* If a mixture of 1 Gm. of Magnesium Oxide with 50 Cc. of water be heated to boiling, and, after cooling, filtered, the filtrate should not show more than a faintly alkaline reaction with red litmus paper, and when evaporated to dryness should not leave more than 0.04 Gm. of residue.

Limit of carbonate. If a mixture of 0.1 Gm. of Magnesium Oxide with 5 Cc. of water be heated to boiling, and, after cooling, be poured into 5 Cc. of acetic acid, solution should take place without the evolution of more than a few isolated gas bubbles.

Limit of calcium. Ten Cc. of a solution of Magnesium Oxide (1 in 50), prepared by the addition of sufficient acetic acid for solution, should not be rendered more than slightly opalescent within five minutes by ammonium oxalate T.S.

Limit of iron. If 1 Gm. of Magnesium Oxide be dissolved in 50 Cc. of diluted hydrochloric acid, the solution should be colorless and not give an immediate blue coloration upon the addition of potassium ferrocyanide T.S.

Heavy metals. A solution of Magnesium Oxide (1 in 20) in diluted hydrochloric acid and 100 Cc. of water should not respond to the Time-Limit Test for other *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of water of hydration. If Magnesium Oxide be exposed to a low red heat in a porcelain crucible, it should not lose more than 15 percent. of its weight.

Quantitative Test.—If 0.400 Gm. of recently ignited and cooled Magnesium Oxide be dissolved in 25 Cc. of normal sulphuric acid V.S., not more than 5.8 Cc. of normal potassium hydroxide V.S. should be required for neutralization, methyl-orange T.S. being used as indicator (each Cc. of the normal sulphuric acid V.S. consumed being an equivalent to 5 percent. of pure Magnesium Oxide).

Uses.—Magnesium Oxide or *magnesia* is popularly used as a laxative and antacid, in doses of thirty grains (2 Gm.). In administering, the magnesia should be added to the diluent (water or milk), and not *vice versa.*

MAGNESII OXIDUM PONDEROSUM. U.S. Heavy Magnesium Oxide Heavy Magnesia

$MgO = 40.06$

[MAGNESIA PONDEROSA, PHARM. 1890]

Heavy magnesium oxide is preferable to the ordinary magnesium oxide, on account of its density. This often permits the decrease in bulk of the dose in the ratio of nearly four to one. Magnesium oxide is rendered less bulky by trituration, and if the heavy carbonate is used for the calcination, a heavier powder is produced.

Official Description.—A white, dense, and very fine powder, which should conform to the reactions and tests given under *Magnesii Oxidum.*

It differs, however from the latter in not readily uniting with water to form a gelatinous hydroxide.

Uses.—The uses of heavy magnesia are the same as those of the light magnesia.

MAGNESII SULPHAS. U.S. Magnesium Sulphate

$MgSO_4 + 7H_2O = 244.69$

[EPSOM SALT]

It should contain not less than 99.7 percent. of pure Magnesium Sulphate [$SO_2.O_2Mg + 7H_2O$], and should be kept in well-closed vessels.

Preparation.—This well known salt is prepared from a number of mineral substances, but in the United States, from a silicious magnesium hydroxide, which is practically free from lime. The mineral is reduced to a fine powder and treated with sulphuric acid. The mass is then dried and calcined at a red heat, in order to convert into red oxide any ferrous sulphate which may be present. It is then dissolved in water, and calcium sulphide added to separate any remaining portion of iron. The salt is crystallized and dissolved a third time, in order to purify it.

Magnesium sulphate is largely made as a by-product in the manufacture of carbonated waters; the mineral magnesite is decomposed by sulphuric acid and the carbon dioxide passed into the water.

$$\underset{\text{Magnesite}}{MgCO_3} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Magnesium}\\\text{Sulphate}}}{MgSO_4} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O}$$

In England, Epsom salt is sometimes prepared from *dolomite*, the double carbonate of magnesium and calcium, by driving off the carbon dioxide by heat, converting the residue into hydroxides, and then treating these with hydrochloric acid. Calcium chloride is formed; this is dissolved out by washing with water, and the purified magnesium oxide is converted into sulphate by treating it with sulphuric acid.

Official Description.—Small, colorless, prismatic needles or rhombic prisms; slowly efflorescent in the air.

Odor, Taste, and Reaction.—Without odor; cooling, saline, and bitter taste; neutral reaction.

Solubility.—*Water.* Soluble in 1.1 parts at 25° C. (77° F.), and in 0.13 part of boiling water. *Alcohol.* Insoluble.

Tests for Identity.—When heated to 52° C. (125.6° F.), or exposed to warm air, the salt loses one molecule of water, and is converted into a white powder. At about 130° C. (266° F.) it still retains 1 molecule of water, and at a temperature between 200° and 238° C. (392° and 460.4° F.) it is rendered anhydrous.

When mixed with ammonium chloride T.S. and ammonia water, the aqueous solution of the salt yields with sodium phosphate T.S., a white crystalline precipitate. With barium choride T.S. it yields a white precipitate insoluble in hydrochloric acid.

Impurities and Tests for Impurities.—*Heavy metals.* Ten Cc. of the aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—Magnesium sulphate is a valuable refrigerant cathartic, in doses of from one-half to one ounce (16 to 32 Gm.); if dissolved in iced water, its nauseous taste is not so perceptible as when water of ordinary temperature is used.

MAGNESII SULPHAS EFFERVESCENS. U.S. Effervescent Magnesium Sulphate

	Metric	Old form
* **Magnesium Sulphate,** uneffloresced crystals	500 Gm.	10 oz. av.
Sodium Bicarbonate, dried and powdered	403 Gm.	8 oz. av.
Tartaric Acid, dried and powdered	211 Gm.	4¼ oz. av.
Citric Acid, uneffloresced crystals	136 Gm.	2¾ oz. av.
To make about	1000 Gm.	20 oz. av.

Dry the Magnesium Sulphate on a water-bath, until it ceases to lose weight, then, after powdering the dry salt, mix it intimately with the Citric Acid, which has previously been powdered, and the Tartaric Acid, and thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.).

When the mixture has acquired a moist consistence by the aid of careful manipulation with a wooden spatula, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles.

Uses.—This effervescent salt was introduced into the U. S. P. (8th Rev.) in preference to retaining the effervescent magnesium citrate (U. S. P. 1890). The dose is four drachms (16 Gm.).

LIQUOR MAGNESII CITRATIS. U.S. Solution of Magnesium Citrate

	Metric	Old form
* **Magnesium Carbonate**	15.0 Gm.	230 grains
Citric Acid	33.0 Gm.	1 oz. av. 65 gr.
Syrup of Citric Acid	60.0 Cc.	2 fl. oz.
Potassium Bicarbonate	2.5 Gm.	39 grains
Water, a sufficient quantity		

Dissolve the Citric Acid in 120 Cc. [old form 4 fl. oz.] of Water, and, having added the Magnesium Carbonate, stir until it is dissolved. Filter the solution into a strong bottle of the capacity of about 360 Cc. [old form 12 fl. oz.], containing the Syrup of Citric Acid. Then add enough Water to nearly fill the bottle, drop in the Potassium Bicarbonate, and immediately stopper the bottle securely. Lastly, shake the mixture occasionally, until the Potassium Bicarbonate is dissolved. This solution should be freshly prepared when wanted.

A few modifications in the manipulation of the official process are advisable. The bulky magnesium carbonate may be replaced by one-half of the quantity of light calcined magnesia. The syrup of citric acid should be introduced into the bottle, and the filtered solution of magnesium citrate very carefully poured in without stirring up the syrup. (For this purpose a hard rubber funnel, having the neck closed but with perforations on the side so that the liquid is delivered gently on the sides of the bottle, may be advantageously used.) The potassium bicarbonate, in large crystals (or in compressed blocks of the proper weight), is dropped into the bottle,—they gradually dissolve in the syrup of citric acid,—and the cork is at once inserted, to prevent loss of carbonic acid gas, but special bottles with patent stoppers are preferred (see Fig. 444). The bottle is not disturbed until it is called for, when a careful shake mixes the solution of the bicarbonate in the bottom of the bottle with the acid liquid above, liberating the carbonic acid gas, and the solution can then always be dispensed in a sparkling condition. Fig. 444 shows the top of an improved form of "Citrate bottle" made by the Whitall Tatum Company. It has many advantages and obviates the troublesome process of using corks for stoppers. It is a modification of the well known "beer bottle" stopper.

FIG. 444

Top of citrate bottle

The quantity of citric acid was slightly increased in the eighth revision of the U. S. Pharmacopœia in order to make a solution which would be more stable.

Uses.—"Solution of citrate of magnesia," as it will probably be always called, is one of the most agreeable cathartics known. It is usually given to adults in the quantity of the official formula, twelve fluidounces (360 Cc.). The practice of dividing the dose, taking one-half three or four hours after the other, is often preferable.

Calcium. Ca; 39.8

Calcium is a very abundant element, occurring in nature as carbonate, sulphate, phosphate, silicate, chloride, fluoride, etc. It belongs to the class of metals. When heated it burns with a bright light. It is of a light yellow color, and is ductile, like gold; it may be hammered into very thin sheets. It forms but one chloride. The oxide, carbonate, sulphate, phosphate, and hypophosphite are of pharmaceutical interest.

Tests for Salts of Calcium

1. Alkaline carbonates produce white precipitates with soluble salts of calcium, insoluble in excess.

2. The soluble oxalates (ammonium or potassium oxalate) produce, even in dilute solutions of calcium salts, a white precipitate of calcium oxalate, not soluble in an excess of acetic acid, but soluble in an excess of hydrochloric acid.

Official Salts and Preparations of Calcium

Official Name	Preparation
Calx	Made by calcining chalk or limestone
Chlorinata	By treating calcium hydroxide with chlorine
Sulphurata	By heating dried calcium sulphate, charcoal, and starch to a low red heat
Calcii Bromidum	By dissolving lime in hydrobromic acid
Carbonas Precipitatus	By double decomposition between calcium chloride and sodium carbonate
Chloridum	By acting on calcium carbonate with hydrochloric acid
Hypophosphis	By heating phosphorus with milk of lime
Phosphas Precipitatus	By treating bone ash with HCl, and precipitating with ammonia
Sulphas Exsiccatus	By heating calcium sulphate
Creta Præparata	By elutriating chalk and forming into cones
Pulvis Cretæ Compositus	Prepared chalk, sugar, and acacia, for making chalk mixture
Mistura Cretæ	Compound chalk powder suspended in cinnamon water and water
Liquor Calcis	By dissolving lime in water
Linimentum Calcis	Equal parts of lime water and linseed oil
Syrupus Calcis	A saccharine solution of lime
Calcii Lactophosphatis	A saccharine solution of calcium lactophosphate

Unofficial Salts of Calcium

Calcii Benzoas, $Ca(C_7H_5O_2)_2 + 3H_2O$ Calcium Benzoate	Made by adding calcium carbonate to a hot aqueous solution of benzoic acid, filtering, evaporating, and crystallizing
Calcii Hydroxidum, $Ca(OH)_2$ Calcium Hydroxide	By adding 1 part water to 2 parts lime contained in a metal pot, covering and setting aside to cool, sifting and preserving the fine powder
Calcii Iodas, $Ca2IO_3 + 6H_2O$ Calcium Iodate	By mixing gradually an alcoholic solution of iodine with excess of filtered aqueous solution of chlorinated lime. After decolorization, slightly acidulating with hydrochloric acid, heating to boiling, filtering, then crystallizing
Calcii Iodidum, CaI_2 Calcium Iodide	By dissolving slaked lime in hydriodic acid and concentrating, then crystallizing. Dose, one to four grains (0.06 to 0.2 Gm.)
Calcii Salicylas, $Ca(C_7H_5O_3)_2 + H_2O$ Calcium Salicylate	Dose, seven to twenty grains (0.45 to 1.2 Gm.) for diarrhœa and gastro-enteritis
Calcii Sulphidum, CaS Calcium Sulphide	By mixing 12 parts powdered gypsum with 4 parts powdered charcoal, and heating the mixture in a covered crucible until gas ceases to be evolved
Calcii Sulphas, $CaSO_4 + 2H_2O$ Calcium Sulphate	Occurs in nature
Calcii Sulphis, $CaSO_3$ Calcium Sulphite	By mixing concentrated solutions of sodium sulphite and calcium chloride and collecting the precipitate
Calcii Phenolsulphonas, $Ca2C_6H_5SO_4 + 6H_2O$ Calcium Phenolsulphonate	By mixing concentrated solutions of barium phenolsulphonate and calcium carbonate and collecting the precipitate
Calcii Sulphydras, CaH_2S_2 Calcium Sulphydrate	By passing hydrogen sulphide into a mixture of 2 parts slaked lime and 3 parts water as long as absorbed
Calcii Thiosulphas, $CaS_2O_3 + 6H_2O$ Calcium Thiosulphate	Medical properties are those of the sulphites. Dose, from ten to twenty grains (0.6 to 1.2 Gm.)

CALX. U.S. Lime Calcium Oxide

$CaO = 55.68$

Prepared by calcining white marble, or the purest varieties of native calcium carbonate, and containing, when in the anhydrous state, not less than 90 percent. of pure Calcium Oxide. It should be kept in well-closed vessels, in a dry place.

Preparation.—Lime, or calcium oxide, is a very important alkaline earth, and is made by calcining limestone, or native calcium carbonate, in kilns with strong heat; carbon dioxide and water are expelled.

Official Description.—Hard, white, or grayish-white masses, which, in contact with the air, gradually attract moisture and carbon dioxide, and fall to a white powder.
Odor, Taste, and Reaction.—Odorless; caustic taste; alkaline reaction.
Solubility.—*Water.* In about 760 parts at 25° C. (77° F.); in about 1600 parts of boiling water.
Alcohol. Insoluble.
Other solvents. It forms readily soluble salts with diluted acetic, hydrochloric, or nitric acids.
Tests for Identity.—When sprinkled with about half its weight of water, Calcium Oxide becomes heated, and is gradually converted into a white powder (calcium hydroxide or slaked lime). When this is mixed with about 3 or 4 parts of water, it forms a smooth magna (milk of lime).
Impurities and Tests for Impurities.—*Limit of carbonate.* If 1 Gm. of Calcium Oxide be slaked and then thoroughly mixed with 50 Cc. of water, and the greater portion of the milky liquid decanted, the addition of hydrochloric acid to this residue should not cause more than a slight effervescence.

For applying tests of identity and of purity, 5 Gm. of Calcium Oxide, after slaking, are mixed with 100 Cc. of distilled water, followed by hydrochloric acid, added drop by drop, with agitation until solution takes place. The resulting solution should, after boiling and cooling, be of acid reaction and not deposit more than 0.025 Gm. of insoluble matter.

With a portion of this solution, after neutralizing with ammonia water, ammonium oxalate T.S. produces a white precipitate of calcium oxalate, insoluble in acetic acid, but soluble in hydrochloric acid.

Uses.—Externally, lime acts as an escharotic; it enters into the composition of many depilatory powders; internally, in solution, it is a valuable antacid.

LIQUOR CALCIS. U.S. Lime Water Solution of Calcium Hydroxide

A saturated aqueous solution, which should contain not less than 0.14 percent. of pure Calcium Hydroxide [$Ca(OH)_2 = 73.56$].

The percentage of Calcium Hydroxide varies with the temperature at which the saturated solution is prepared, being about 0.17 percent. at 15° C. (59° F.), the percentage diminishing as the temperature rises.

	Metric	Old form
* **Lime**	12 Gm.	195 grains
Distilled Water, a sufficient quantity		

Slake the Lime by the very gradual addition of 400 Cc. [old form 1 pint] of Distilled Water, and agitate occasionally during half an hour. Allow the suspended particles to subside, decant the supernatant liquid and reject it. Then add to the residue 3600 Cc. [old form 8 pints] of Distilled Water, agitate thoroughly, let the mixture stand for twenty-four hours, agitate again, then let the coarser particles of solid matter subside, and pour the liquid, holding the undissolved calcium hydroxide in suspension, into a glass-stoppered bottle. From time to time shake the bottle, so as to keep the solution saturated.

Pour off the clear liquid when required for use.

Lime water is very extensively used in pharmacy; the object of keeping it upon undissolved lime is to insure a saturated solution. Lime is but sparingly soluble in water, and less soluble in hot water than in cold; when the solution is heated, a deposition of lime takes place, which is redissolved on cooling. A solution of lime containing particles of undissolved lime in suspension is termed *milk of lime.*

Official Description.—A clear, colorless liquid.
Odor, Taste, and Reaction.—Without odor; alkaline taste; strongly alkaline reaction.
Tests for Identity.—A clear, colorless liquid without odor, and having an alkaline taste.
It absorbs carbon dioxide from the air, a pellicle of calcium carbonate forming on the surface of the liquid.
On being heated it becomes turbid, due to the separation of calcium hydroxide, which redissolves when the liquid is cooled.
In other respects it should conform to the reactions and tests for an aqueous solution of lime given under *Calx*.
Impurities and Test.—*Alkalies and their carbonates.* The alkaline reaction of the Solution should entirely disappear, after it has been saturated with carbon dioxide, and subsequently boiled.
Quantitative Test.—Fifty Cc. should require, for complete neutralization, not less than 19 Cc. of tenth-normal sulphuric acid V.S. (corresponding to about 0.14 percent. of calcium hydroxide), phenolphthalein T.S. being used as indicator.

Uses.—Probably the most extensive use of lime water in medicine is in checking nausea. It is usually administered with milk when used for this purpose. It is employed externally to allay inflammation, and in washes of various kinds. The dose of lime water is from one to two fluidounces (30 to 60 Cc.).

SYRUPUS CALCIS. U.S. Syrup of Lime

A syrupy liquid made by boiling 65 Gm. of lime and 350 Gm. of sugar in 500 Cc. of water, during five minutes, adding sufficient water to measure 950 Cc., filtering and then adding water to filtrate, to make 1000 Cc. Lime is more soluble in syrup than in water, and hence this syrup is more strongly alkaline than lime water; this is accounted for by the fact that lime forms soluble saccharates with sugar (see page 291).

Official Description.—A transparent, pale yellow liquid.
Taste and Reaction.—Alkaline taste and reaction.
Specific Gravity.—About 1.145 at 25° C. (77° F.).
Tests for Identity.—The addition of a solution of an alkali carbonate produces a white precipitate, soluble in acids with effervescence.
The addition of ammonium oxalate T.S. produces a white precipitate, insoluble in acetic acid, but soluble in hydrochloric acid.

LINIMENTUM CALCIS. U.S. Lime Liniment

This liniment is made by mixing equal measures of lime water and linseed oil. It is used largely as an external application for burns, and is sometimes called Carron oil (see page 322).

CALX CHLORINATA. U.S. Chlorinated Lime

The activity of this compound depends upon the amount of chlorine present, and it is therefore most appropriately considered under that head (see page 486).

CALX SULPHURATA. U.S. Sulphurated Lime

[Crude Calcium Sulphide]

A mixture containing at least 55 percent. of calcium sulphide [$CaS = 71.63$], together with unchanged calcium sulphate [$CaSO_4 = 135.15$], and carbon, in varying proportions.

	Metric	Old form
* **Exsiccated Calcium Sulphate,** in fine powder	70 Gm.	7 oz. av.
Charcoal, in fine powder	10 Gm.	1 oz. av.
Starch	2 Gm.	87 grains

Mix the powder thoroughly, pack the mixture lightly into a crucible, cover this loosely, and heat it to bright redness, until the contents have lost their black color. Allow the crucible to cool, reduce the product to powder, and at once transfer it to small, glass-stoppered vials.

This is not a definite chemical compound, but contains varying amounts of the active constituent calcium sulphide.

Official Description.—A pale gray powder, gradually decomposing by exposure to moist air.

Odor and Taste.—Exhaling a faint odor of hydrogen sulphide; nauseous and alkaline taste.

Solubility.—*Water.* Very slightly in cold water, more readily in boiling water, which partially decomposes it.

Alcohol.—Insoluble.

Tests for Identity.—When Sulphurated Lime is decomposed by diluted acetic acid, calcium acetate is formed, hydrogen sulphide gas is evolved, and a residue of calcium sulphate and carbon remains.

The filtrate from this yields with ammonium oxalate T.S. a white precipitate, insoluble in acetic acid, but soluble in hydrochloric acid.

Quantitative Test.—If 1 Gm. of Sulphurated Lime be added to a cold solution of 1.9 Gm. of cupric sulphate in 50 Cc. of water, followed by 10 Cc. of diluted hydrochloric acid, added in small portions, with constant stirring, and the mixture digested on a water-bath for 15 minutes and filtered, the addition of an excess of ammonia water should impart no color to the filtrate (presence of at least 55 percent. of pure Calcium Sulphide).

Uses.—Sulphurated lime is used as a depilatory for removing superfluous hair from the body, by mixing a small quantity with water and applying the paste to the part. It is used internally in acne and other skin diseases. The dose is one-half grain to one grain (0.3 to 0.065 Gm.).

CALCII BROMIDUM. U.S. Calcium Bromide

$CaBr_2 = 198.52$

It should contain not less than 97 percent. of pure Calcium Bromide, and should be kept in well-stoppered bottles.

Preparation.—Calcium bromide may be made by the simple process of adding precipitated calcium carbonate, in excess, to hydrobromic acid, filtering, evaporating the solution to dryness, and granulating the product.

It may also be made by adding milk of lime to a boiling solution of ammonium bromide until ammoniacal vapors cease to be evolved. The solution is then filtered, and the salt granulated. Care should be used to protect the product from moisture.

$$\underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3} + \underset{\substack{\text{Hydrobromic}\\\text{Acid}}}{2HBr} = \underset{\substack{\text{Calcium}\\\text{Bromide}}}{CaBr_2} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

Official Description.—A white, granular salt; very deliquescent.

Odor, Taste, and Reaction.—Odorless; sharp, saline taste; neutral reaction.

Solubility.—Very soluble in water and alcohol.

Tests for Identity.—The aqueous solution of the salt (1 in 20) yields with ammonium oxalate T.S. a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid.

Silver nitrate T.S. produces a light yellow precipitate, insoluble in nitric acid and in a moderate excess of ammonia water.

Impurities and Tests for Impurities.—*Iodides.* If to 10 Cc. of the aqueous solution of the salt (1 in 20), 1 Cc. of chloroform be added, then chlorine water, which has been diluted with an equal volume of water, added cautiously, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color free from any violet tint.

Insoluble impurities. If 1 Gm. of Calcium Bromide be added to 20 Cc. of water, it should form a clear, colorless solution, leaving no residue.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Barium. If 1 Gm. of Calcium Bromide and 1 Gm. of sodium acetate be dissolved in 5 Cc. of distilled water, and the solution made slightly acid through the addition of from 3 to 5 drops (or a sufficient quantity) of diluted acetic acid, after boiling and thoroughly cooling, the solution should not become cloudy within five minutes upon the addition, with agitation, of 5 drops of potassium dichromate T.S.

Bromate. If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color.

Limit of nitrate and ammonia. To 5 Cc. of an aqueous solution of the salt (1 in 100), contained in a test-tube of about 40 Cc. capacity, add 5 Cc. of potassium hydroxide T.S. and about 0.2 Gm. of aluminum wire. In the upper portion of the test-tube, insert a plug of purified cotton or gauze, and over the mouth, a piece of moistened red litmus paper; place the tube in a bath of boiling water, and after fifteen minutes no blue coloration of the paper should be discernible.

Uses.—Calcium bromide is used as an hypnotic, in doses of fifteen to sixty grains (1 to 4 Gm.).

CALCII CARBONAS PRÆCIPITATUS. U.S. Precipitated Calcium Carbonate

$CaCO_3 = 99.35$

It should contain not less than 99 percent. of pure Calcium Carbonate.

Preparation.—This salt is readily prepared by double decomposition. The following process was official in the British Pharmacopœia:

Take of Chloride of Calcium 5 oz. av.; Carbonate of Soda 13 oz. av.; Boiling Distilled Water a sufficiency. Dissolve the Chloride of Calcium and the Carbonate of Soda each in 2 pints [Imperial measure] of the Water; mix the two Solutions; and allow the precipitate to subside. Collect this on a calico filter, wash it with boiling Distilled Water until the washings cease to give a precipitate with nitrate of silver, and dry the product at the temperature of 212° (F.).

Calcium carbonate precipitates, and sodium chloride remains in solution.

$$\underset{\substack{\text{Calcium}\\\text{Chloride}}}{CaCl_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3} + \underset{\substack{\text{Sodium}\\\text{Chloride}}}{2NaCl}$$

The fineness of the powder is greatly promoted by using hot, dense solutions.

This salt of calcium is also obtained as a by-product in the process for making solution of chlorinated soda, double decomposition taking place between solution of chlorinated lime and solution of monohydrated sodium carbonate. The precipitated calcium carbonate must be boiled in water, and afterwards thoroughly washed, to free it from the chlorinous odor; the product is unfit for internal use.

Official Description.—A fine, white powder; permanent in the air.

Odor and Taste.—Without odor or taste.

Solubility.—*Water.* Nearly insoluble; the solubility is increased by the presence of ammonium salts, and especially by carbon dioxide; alkali hydroxides diminish its solubility.

Alcohol. Insoluble.

Other solvents. In diluted acetic, hydrochloric, or nitric acid, it is completely soluble with effervescence.

Tests for Identity. When heated to full redness, with access of air, the salt gradually loses carbon dioxide, and a residue of calcium oxide remains.

For applying tests of identity and of purity, 5 Gm. of Calcium Carbonate are mixed with 100 Cc. of distilled water, followed by hydrochloric acid, added drop by drop, with agitation, until solution takes place. The resulting solution should, after boiling and cooling, be of acid reaction, and there should not remain more than traces of insoluble matter.

In a portion of this acid solution, after neutralizing with ammonia water, ammonium oxalate T.S. produces a white precipitate of calcium oxalate, insoluble in acetic acid but soluble in hydrochloric acid.

Impurities and Tests for Impurities.—*Limit of iron, aluminum, phosphates, etc.* If to 20 Cc. of the acid solution, ammonia water be added until of alkaline reaction, no turbidity or precipitation should take place either before or after boiling.

Heavy metals. The acid solution should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of soluble impurities. If 1 Gm. of the salt be agitated with 50 Cc. of water, the filtrate should not show an alkaline reaction with litmus paper, and, on evaporation, should not leave a weighable residue.

Uses.—This form of calcium carbonate, known popularly as *precipitated chalk*, is largely used in tooth powders and similar preparations; it is inferior to the prepared chalk as an ingredient in chalk mixtures, because it does not possess the adhesive powers of the latter. Dose, fifteen grains (1 Gm.).

CRETA PRÆPARATA. U.S. Prepared Chalk

$CaCO_3 = 99.35$

[DROP CHALK]

Native Calcium Carbonate, freed from most of its impurities by elutriation.

Preparation.—The process formerly official is as follows:

Take of Chalk a *convenient quantity*. Add a little water to the Chalk, and rub it into fine powder. Throw this into a large vessel nearly full of water, stir briskly, and, after a short interval, decant the supernatant liquor, while yet turbid, into another vessel. Treat the coarser particles of the Chalk, remaining in the first vessel, in a similar manner, and add the turbid liquid to that previously decanted. Lastly, set the liquor by, that the powder may subside, and, having poured off the water, dry the powder.

The object of this process is to effect the separation of the gritty particles in ordinary chalk by elutriation (see page 187). It is usual to form the moist powder into cones by trochiscation (see page 187). While elutriation effects the purification of the chalk to a certain extent, it does not separate the insoluble fine particles, and hence prepared chalk is chemically not so pure as precipitated calcium carbonate.

Prepared chalk differs greatly in appearance from precipitated chalk, even after it has been reduced to a fine powder. It is usually not so white as the latter, and it adheres to the fingers when handled. This adhesiveness fits it for many purposes. *Whiting*, a cheap form of prepared chalk, is used for polishing.

Official Description.—A white to grayish-white, very fine amorphous powder, often moulded into conical drops; permanent in the air.

Odor and Taste.—Odorless and tasteless.

Solubility.—*Water.* Almost insoluble.

Alcohol. Insoluble.

Other solvents. In diluted acetic, hydrochloric, or nitric acids, with copious effervescence, leaving not more than a trifling residue.

Test for Identity.—When heated to full redness, Prepared Chalk gradually loses carbon dioxide, and is converted into calcium oxide.

Uses.—This is the form of chalk which is used in medicine almost exclusively; it is an antacid, and is admirably adapted for the treatment of diarrhœa. It is used in the compound chalk powder. Dose, fifteen grains (1 Gm.).

CALCII CHLORIDUM. U.S. Calcium Chloride

$CaCl_2 = 110.16$

Calcium Chloride, rendered anhydrous by fusion at the lowest possible temperature. It should contain not less than 99 percent. of pure Calcium Chloride, and should be kept in well-stoppered bottles.

Preparation.—Calcium chloride may be readily formed by saturating hydrochloric acid with chalk or marble, evaporating to dryness, and heating to redness.

$$\underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3} + \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{2HCl} = \underset{\substack{\text{Calcium}\\\text{Chloride}}}{CaCl_2} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} + \underset{\text{Water}}{H_2O}$$

It is frequently obtained as a by-product in chemical operations.

Official Description.—White, slightly translucent, hard fragments; very deliquescent.
Odor, Taste, and Reaction.—Odorless; sharp, saline taste; strictly neutral reaction.
Solubility.—*Water.* In 1.3 parts at 25° C. (77° F.); very freely in boiling water, usually leaving a slight residue.
Alcohol. In 8 parts at 25° C. (77° F.); in 1.5 parts of boiling alcohol.
Tests for Identity.—Below a red heat the salt fuses, and, on cooling, solidifies without change in composition.
When perfectly pure, Calcium Chloride dissolves in water without residue.
When the salt has been overheated in fusing, the solution has an alkaline reaction, and a small residue of calcium oxide is left, which is soluble in hydrochloric acid.
The aqueous solution (1 in 20) yields, with ammonium oxalate T.S., a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid.
With silver nitrate T.S. it yields a white precipitate insoluble in nitric acid.
Impurities and Tests for Impurities.—*Limit of iron, aluminum, phosphates, etc.* If to the aqueous solution of the salt (1 in 20) ammonia water be added, until of alkaline reaction, no turbidity or precipitation should take place either before or after boiling.
Limit of magnesium and alkalies. If from 10 Cc. of the solution the calcium be completely precipitated by ammonium oxalate T.S., the filtrate should, on evaporation and ignition, leave not more than 0.1 percent. of fixed residue.
Arsenic. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic* or *lead* (see U. S. P. Test No. 121, Chap. LXII).

Uses.—Calcium chloride, when in fused masses, is used in chemical processes for dehydrating gases; this it does through its powerful affinity for water.

CALCII HYPOPHOSPHIS. U.S. Calcium Hypophosphite

$Ca(PH_2O_2)_2 = 168.86$

It should contain not less than 98 percent. of pure Calcium Hypophosphite [$(PO.OH_2)_2Ca$], and should be kept in well-stoppered bottles; caution should be observed in dispensing Calcium Hypophosphite, as explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents.

Preparation.—This salt is made by boiling milk of lime and phosphorus together until the spontaneously inflammable gas, hydrogen phosphide, ceases to be evolved; it is necessary to provide for the safe escape of this gas by conducting it by a hood into a powerful draught.

$$\underset{\text{Phosphorus}}{8P} + \underset{\substack{\text{Calcium}\\\text{Hydroxide}}}{3Ca(OH)_2} + \underset{\text{Water}}{6H_2O} = \underset{\substack{\text{Calcium}\\\text{Hypophosphite}}}{3CaH_4(PO_2)_2} + \underset{\substack{\text{Hydrogen}\\\text{Phosphide}}}{2PH_3}$$

The liquid is filtered to separate the insoluble phosphate and residuary lime, then concentrated, and refiltered to separate the calcium carbonate formed by the action of the air on a little lime held in solution, and lastly evaporated till a pellicle appears; after which the salt may be allowed to crystallize by setting the liquid aside, or may be obtained in the granular form by continuing the heat, and stirring.

The heat employed in evaporating the solution should not be above 85° C. (185° F.), for fear of explosions, several accidents having occurred through carelessness in this respect, even when the evaporation was conducted with a water bath.

Official Description.—Colorless, transparent, monoclinic prisms, or small, lustrous scales, or a white crystalline powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless; nauseous and bitter taste. One Gm. of the salt dissolved in 20 Cc. of water, should not require the addition of more than 1 Cc. of tenth-normal potassium hydroxide V.S. to produce a pink color (phenolphthalein being used as indicator).

Solubility.—*Water.* In 6.5 parts of water at 25° C. (77° F.), and in 6 parts of boiling water. *Alcohol.* Insoluble.

Tests for Identity.—When heated in a test-tube the salt decrepitates, and above 300° C. (572° F.) it begins to decompose, giving off water, and emitting inflammable gases (hydrogen and hydrogen phosphide), and leaving a residue of calcium pyrophosphate and metaphosphate, with some red phosphorus.

The aqueous solution (1 in 20) yields, with ammonium oxalate T.S., a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid.

The diluted aqueous solution, slightly acidulated with diluted nitric acid, yields with silver nitrate T.S. a precipitate, which is white at first but rapidly turns brown and black, due to the separation of metallic silver.

With copper sulphate T.S., on gentle heating, a reddish-brown precipitate is formed.

When the aqueous solution of Calcium Hypophosphite (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, with agitation, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed. On further addition of the hypophosphite solution in excess, the precipitate becomes gray in color, due to its reduction to metallic mercury.

Impurities and Tests for Impurities.—*Phosphate and Sulphate.* If 1 Gm. of the salt be added to 20 Cc. of water and well shaken, not more than a trace of residue should remain.

Arsenic. If 5 Cc. of an aqueous solution of the salt (1 in 10) be measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water, and evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Heavy metals. The aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Uses.—Calcium hypophosphite is used pharmaceutically to prepare the other hypophosphites, hypophosphorous acid, and as an ingredient in the syrup and compound syrup of hypophosphites and other preparations. Medicinally, it is used in phthisis and other wasting diseases, and in cases of defective nerve nutrition. The dose is from five to thirty grains (0.3 to 2 Gm.).

SYRUPUS HYPOPHOSPHITUM. U.S. Syrup of Hypophosphites

This syrup is made by dissolving 45 Gm. of calcium hypophosphite and 15 Gm. each of sodium and potassium hypophosphites in water, aiding the solution by the use of 2 Gm. of diluted hypophosphorous acid. After the addition of 2 Cc. of tincture of fresh lemon peel, the liquid is filtered and 650 Gm. of sugar and sufficient water to make 1000 Cc. of finished syrup are added (see page 293). There is usually a trifling residue left after dissolving the hypophosphites; this consists generally of insoluble calcium salts.

SYRUPUS HYPOPHOSPHITUM COMPOSITUS. U.S. Compound Syrup of Hypophosphites

This compound syrup is made by dissolving 2.25 Gm. each of ferric hypophosphite and manganese hypophosphite, with the aid of 3.75 Gm. of sodium citrate, in 30 Cc. of water, then dissolving 35 Gm. of calcium hypophosphite, and 17.5 Gm. each of sodium and potassium hypophosphite in 450 Cc. of water, to which 5 Cc. of diluted hypophosphorous acid has been added, then dissolving 1.10 Gm. of quinine, and 0.11 Gm. of Strychnine in 30 Cc. of water, with the aid of 10 Cc. of diluted hypophosphorous acid, and finally dissolving 775 Gm. of sugar in these mixed solutions, and adding enough water to make 1000 Cc. (see page 293).

CALCII PHOSPHAS PRÆCIPITATUS. U.S. Precipitated Calcium Phosphate

$Ca_3(PO_4)_2 = 307.98$

It should contain not less than 99 percent. of pure Calcium Phosphate $[(PO.O_3)_2Ca_3]$.

Preparation.—Take of Bone, calcined to whiteness, and in fine powder, 4 oz. troy; Hydrochloric acid, 8 oz. troy; Ammonia Water, 12 fl. oz., or a sufficient quantity; Distilled Water, a sufficient quantity. Macerate the Bone in the Acid, diluted with a pint of Distilled Water, until it is dissolved, and filter the solution. Add another pint of Distilled Water, and then, gradually, Ammonia Water, until the liquid acquires an alkaline reaction. Mix the precipitate obtained, while yet in the state of magma, with twice its bulk of boiling Distilled Water, and pour the whole upon a strainer. Wash the precipitate with boiling Distilled Water until the washings cease to be affected by a solution of nitrate of silver, acidulated with nitric acid. Lastly, dry the precipitate with a gentle heat.

Calcium phosphate exists in calcined bone; it is soluble in hydrochloric acid, but is precipitated from its solution by ammonia water, ammonium chloride remaining in solution.

Official Description.—A white, amorphous powder; permanent in the air.

Odor and Taste.—Odorless; tasteless.

Solubility.—*Water.* Almost insoluble in cold water; partly decomposed by boiling water, which dissolves out the acid salt.

Alcohol. Insoluble.

Other solvents. Almost insoluble in acetic acid, except when freshly precipitated; easily soluble in hydrochloric or nitric acid.

Tests for Identity.—At an intense white heat, the salt fuses without decomposition.

When moistened with silver nitrate T.S., either before or after ignition, the salt acquires a yellow color (distinction from *acid calcium phosphate*, which, after ignition, when moistened with silver nitrate T.S., remains white).

Impurities and Tests for Impurities.—*Carbonate.* For applying tests of identity and of purity, shake 2 Gm. of Precipitated Calcium Phosphate with 20 Cc. of water, add nitric acid, drop by drop, until solution is effected, and then add sufficient water to make the liquid measure 40 Cc. While making this solution, no effervescence should occur on adding the acid.

From a portion of this solution the salt is precipitated unchanged by a slight excess of ammonia water.

From another portion ammonium molybdate T.S. precipitates yellow ammonium phosphomolybdate: the reaction is accelerated by gentle heat, not exceeding 65° C. (149° F.).

Limit of chloride. If to 5 Cc. of the solution, acidulated with nitric acid, 0.5 Cc. of silver nitrate T.S. be added, not more than a slight turbidity should result.

Barium. If to 5 Cc. of the solution, strongly acidulated with nitric acid, 1 Cc. of potassium sulphate T.S. be added, no turbidity should result upon standing.

Heavy metals. An aqueous solution of Calcium Phosphate (1 in 20), obtained by shaking the salt with water, adding hydrochloric acid, drop by drop, and heating until solution is effected, should not respond to the Time-Limit Test for *heavy metals* omitting the addition of ammonia water (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of a solution (1 in 10) of Calcium Phosphate, in diluted hydrochloric acid should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—Precipitated calcium phosphate, on account of its insolubility in water, was used in making medicated waters in preference to magnesium carbonate and other similar substances in the U. S. P. 1890, but has been replaced by purified talc in the 8th Decennial Revision. It is admininistered largely now in proprietary medicines, in combination with lactic acid and phosphoric acid, for use in cases of defective nutrition. The dose is from ten to thirty grains (0.6 to 2 Gm.).

SYRUPUS CALCII LACTOPHOSPHATIS. U.S. Syrup of Calcium Lactophosphate

This syrup is made by dissolving precipitated calcium carbonate in lactic and phosphoric acids. Water, orange flower water, and sugar are added to the solution to complete the syrup (see page 291 for the working formula). It is sometimes made extemporaneously by dissolving 200 grains of calcium lactophosphate in one pint of syrup of orange flowers, which contains one fluidrachm of hydrochloric acid. It is given in doses of one to four fluidrachms (4 to 16 Cc.).

CALCII SULPHAS EXSICCATUS. U.S. Exsiccated Calcium Sulphate

[Dried Calcium Sulphate]

A powder containing about 95 percent., by weight, of Calcium Sulphate [$CaSO_4 = 135.15$], and about 5 percent. of water; prepared from the purer varieties of native gypsum [$CaSO_4 + 2H_2O = 170.91$], by carefully heating until about three-fourths of the water has been expelled.

Exsiccated Calcium Sulphate should be kept in well-closed vessels, carefully protected from moisture.

Official Description.—A fine, white powder.

Odor, Taste, and Reaction.—Without odor or taste; neutral reaction in saturated aqueous solution.

Solubility.—*Water.* In about 378 parts of water at 25° C. (77° F.), and in 451 parts at 100° C. (212° F.).

Alcohol. Insoluble.

Other solvents. Readily in diluted nitric or hydrochloric acid; also in saturated solutions of potassium nitrate, sodium thiosulphate, and of various ammonium salts.

Tests for Identity.—From moist air it attracts water, becomes granular, and then loses the property of hardening with water.

When mixed with half its weight of water, Exsiccated Calcium Sulphate forms a smooth, cohesive paste, which rapidly hardens.

When heated above 204° C. (399.2° F.), Exsiccated Calcium Sulphate becomes anhydrous and loses the property of forming a paste with water which hardens rapidly.

Its saturated solution in water forms white precipitates with barium chloride T.S., with ammonium oxalate T.S., and with alcohol.

Impurity and Test.—*Carbonate.* No effervescence should occur on the addition of diluted acids to Exsiccated Calcium Sulphate.

Uses.—This substance, known commonly as *Plaster of Paris*, is largely used by surgeons in the treatment of fractures, by filling the interstices of a soft cotton cloth bandage with the powder and then moistening with water, and applying the bandage to the fractured part in such a way that, when the dried gypsum has hardened, a support is afforded.

PULVIS CRETÆ COMPOSITUS. U.S. Compound Chalk Powder

The preparation is made by mixing 30 Gm. of prepared chalk with 20 Gm. of powdered acacia and 50 Gm. of powdered sugar. It is used for making chalk mixture (see page 305).

MISTURA CRETÆ. U.S. Chalk Mixture

This mixture is made by rubbing 20 Gm. of compound chalk powder with 40 Cc. of cinnamon water, and adding sufficient water to make 100 Cc. (see page 305).

Barium. Ba; 136.4

This element furnishes salts for use officially in making tests or test solutions. Barium Dioxide was used in the process for making solution of hydrogen dioxide, official in the U. S. P. 1890, but as that process is no longer official the salt has been omitted from the Pharmacopœia. *Barium* occurs abundantly as carbonate and sulphate. It is a malleable metal, having a silver-white lustre, decomposing water, and gradually oxidizing in the air.

Tests for Salts of Barium

1. A soluble barium salt produces with sulphuric acid or soluble sulphate a white precipitate of barium sulphate, which is entirely insoluble in all acids.

2. Barium causes a colorless flame to be colored green.

3. Alkaline carbonates produce white precipitates with soluble barium salts, insoluble in excess.

Official Test Solutions of Barium

Test solution of Barium Chloride	Used in testing for sulphates
Test solution of Barium Hydroxide	Known as baryta water and used in testing for sulphates
Test solution of Barium Nitrate	Used in testing for sulphates

Unofficial Salts of Barium

Barii Acetas, $Ba(C_2H_3O_2)_2$ Barium Acetate	By decomposing barium carbonate with acetic acid, evaporating, then crystallizing
Barii Benzoas, . $Ba(C_7H_5O_2)_2 + 2H_2O$ Barium Benzoate	By adding to a solution of barium carbonate benzoic acid until neutralized, then evaporating and crystallizing
Barii Boras Barium Borate	By adding to a solution of barium carbonate a solution of sodium borate, collecting and drying the precipitate
Barii Bromidum, $BaBr_2 + 2H_2O$ Barium Bromide	By saturating baryta water with hydrobromic acid, evaporating, then crystallizing
Barii Carbonas, $BaCO_3$ Barium Carbonate	Witherite, a native mineral used as a source of many barium salts, or it may be made by adding ammonium carbonate and ammonia water to a solution of barium chloride, washing precipitate, and drying
Barii Chloridum, $BaCl_2 + 2H_2O$ Barium Chloride (See U. S. P. Test Solution)	By dissolving barium carbonate in hydrochloric acid, evaporating, then crystallizing
Barii Chromas, $BaCrO_4$ Barium Chromate	By adding baryta water to a solution of potassium chromate, collecting and drying the precipitate
Barii Citras, $Ba_3 2C_6H_5O_7$ Barium Citrate	By adding citric acid to baryta water in excess, and collecting the precipitate
Barii Dioxidum, BaO_2 Barium Dioxide	By heating barium oxide to about 450° C. (874° F.)
Barii Hydroxidum, $Ba(OH)_2 + 8H_2O$ Barium Hydroxide (See U. S. P. Test Solution)	By treating barium monoxide with water
Barii Iodidum, $BaI_2 + 2H_2O$ Barium Iodide	Alterative. Dose, one-eighth of a grain three times a day, gradually increased to three grains
Barii Nitras, $Ba2NO_3$ Barium Nitrate (See U. S. P. Test Solution)	By adding to a solution of barium chloride a solution of sodium nitrate, and collecting and drying the precipitate
Barii Oxalas, $BaC_2O_4 + 2H_2O$ Barium Oxalate	By adding a solution of oxalic acid to an excess of baryta water, and collecting the precipitate
Barii Sulphas, $BaSO_4$ Barium Sulphate	By adding to a solution of barium chloride, sulphuric acid, and collecting the precipitate

Strontium. Sr; 86.94

Strontium enters into three official salts. It occurs in nature chiefly as sulphate and carbonate. It is a yellow metal, sp. gr. 2.5; malleable, but somewhat harder than lead. Its use in medicine is due to Laborde's demonstration in 1890 that its salts are not poisonous in ordinary doses, but, in certain cases, beneficial.

Tests for Salts of Strontium

1. A soluble strontium salt produces with alkaline carbonates or with soluble phosphates a white precipitate.
2. Strontium causes a colorless flame to be colored red.
3. Solution of calcium sulphate produces a white precipitate with soluble strontium salts. Slow precipitation is hastened by the addition of alcohol.

Official Salts of Strontium

Strontii Bromidum Strontium Bromide	Made by dissolving strontium carbonate in hydrobromic acid
Strontii Iodidum Strontium Iodide	Made by evaporating a solution of strontium hydroxide in hydriodic acid
Strontii Salicylas Strontium Salicylate	Made by neutralizing salicylic acid with strontium carbonate

Unofficial Salts of Strontium

Strontii Carbonas, $SrCO_3$ Strontium Carbonate	Occurs native as strontianite
Strontii Chloridum, $SrCl_2$ Strontium Chloride	Made by treating strontianite (native carbonate) with hot hydrochloric acid
Strontii Chromas, $SrCrO_4$ Strontium Chromate	Made by precipitating a strong solution of chloride or nitrate with neutral potassium chromate
Strontii Hydroxidum, $Sr(OH)_2$ Strontium Hydroxide	Obtained by treating the oxide with water
Strontii Lactas, $Sr(C_3H_5O_3)_2 + 3H_2O$ Strontium Lactate	Made by dissolving freshly precipitated strontium carbonate in lactic acid
Strontii Nitras, $Sr(NO_3)_2$ Strontium Nitrate	By treating the carbonate with diluted nitric acid, evaporating and crystallizing
Strontii Oxidum, SrO Strontium Oxide	Obtained by heating the nitrate to redness or igniting the carbonate
Strontii Sulphas, $SrSO_4$ Strontium Sulphate	Occurs native as celestine

STRONTII BROMIDUM. U.S. Strontium Bromide

$SrBr_2 + 6H_2O = 352.94$

It should contain not less than 97 percent. of pure Strontium Bromide, and should be kept in glass-stoppered bottles.

This salt may be made in several ways, but the simplest method is to dissolve strontium carbonate in hydrobromic acid and then evaporate and crystallize the salt from the solution.

Official Description.—Colorless, transparent, hexagonal crystals; very deliquescent, and also occasionally efflorescent.

Odor, Taste, and Reaction.—Odorless, and having a bitter, saline taste; neutral reaction.

Solubility.—*Water.* Soluble in about 1 part of water at 25° C. (77° F.), and in 0.4 part of boiling water.

Alcohol. Readily soluble in alcohol, and is precipitated from this solution upon the addition of an equal volume of ether, in which it is insoluble.

Tests for Identity.—When heated, the crystals at first melt, and then lose all their water (30.4 percent.). The anhydrous salt fuses at 630° C. (1166° F.).

To a non-luminous flame the salt communicates an intense red color.

With calcium sulphate T.S. the aqueous solution (1 in 20) slowly forms a white precipitate of strontium sulphate, insoluble in dilute acids; the same reaction occurs more quickly with diluted sulphuric acid and the readily soluble sulphates.

With potassium chromate T.S. it forms a yellow precipitate of strontium chromate, soluble in acetic acid.

With ammonium carbonate T.S., or sodium carbonate T.S., it forms a white precipitate of strontium carbonate, soluble, with effervescence, in acetic acid.

Impurities and Tests for Impurities.—*Iodide.* If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and then chlorine water, which has been diluted with an equal volume of water, introduced cautiously, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint.

Heavy metals. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of barium. If 1 Gm. each of Strontium Bromide and sodium acetate be dissolved in 5 Cc. of distilled water, and the solution made slightly acid by the addition of from 3 to 5 drops, or a sufficient quantity, of diluted acetic acid, the solution should not, upon the addition of 5 drops of potassium dichromate T.S. and agitating, become cloudy within three minutes.

Quantitative Test.—If 0.5 Gm. of Strontium Bromide be dissolved in about 50 Cc. of distilled water, and a few drops of potassium chromate T.S. be added, it should require the addition of not less than 27.4 (27.48) Cc. nor more than 29.4 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color (corresponding to at least 97 percent. of pure Strontium Bromide).

Uses.—Strontium bromide is used in place of potassium and sodium bromides in epilepsy. Dose, fifteen to thirty grains (1 to 2 Gm.).

STRONTII IODIDUM. U.S. Strontium Iodide

$$SrI_2 + 6H_2O = 446.02$$

It should contain not less than 98 percent. of pure Strontium Iodide, and should be kept in small, glass-stoppered vials, carefully protected from light.

This salt may be made by evaporating a solution of strontium hydroxide in hydriodic acid.

Official Description.—Colorless, transparent, hexagonal plates, or white granular powder, or crystalline crusts; deliquescent, and colored yellow by exposure to air and light.

Odor, Taste, and Reaction.—Odorless; bitter, saline taste; neutral or very slightly alkaline reaction.

Solubility.—*Water.* Soluble in about 0.5 part of water at 25° C. (77° F.), and in 0.27 part of boiling water.

Alcohol. Soluble in alcohol.

Other solvents. Slightly soluble in ether.

Tests for Identity.—When cautiously heated, the crystals melt and gradually lose their water (24.05 percent.), becoming anhydrous. At a red heat, the salt is decomposed, losing iodine, and leaving a residue of strontium oxide.

To a non-luminous flame it imparts an intense red color.

With calcium sulphate T.S. it slowly forms a white precipitate of strontium sulphate, insoluble in diluted acids; the same reaction occurs more quickly with diluted sulphuric acid and the readily soluble sulphates.

With potassium chromate T.S. it forms a yellow precipitate of strontium chromate, soluble in acetic acid.

With ammonium carbonate T.S., or sodium carbonate T.S., it forms a white precipitate of strontium carbonate, soluble, with effervescence, in acetic acid.

If to 5 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated, and impart to the solution a light reddish-brown color; on agitating the mixture with a few drops of chloroform, the latter will acquire a violet color.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of barium. If 1 Gm. each of Strontium Iodide and sodium acetate be dissolved in 5 Cc. of distilled water, and the solution be made slightly acid by the addition of from 3 to 5 drops, or a sufficient quantity, of diluted acetic acid, the solution should not, upon the addition of 5 drops of potassium dichromate T.S., and agitating, become cloudy within three minutes.

Quantitative Test.—If 0.5 Gm. of Strontium Iodide be dissolved in about 100 Cc. of distilled water contained in a flask, and 25 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of nitric acid, and 5 Cc. of ferric ammonium sulphate T.S. be successively added, the flask stoppered and thoroughly shaken, then the addition of not less than 1.7 Cc. nor more than 3.1 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to produce a permanent red tint (corresponding to 98 percent. of pure Strontium Iodide).

Uses.—This salt was introduced into the U. S. P. 1890 as a substitute for potassium iodide, as it is believed to be less irritating to the intestinal tract, or less depressing to the general nutrition. Dose, five to twenty grains (0.3 to 1.3 Gm.).

STRONTII SALICYLAS. U.S. Strontium Salicylate

$Sr(C_7H_5O_3)_2 + 2H_2O = 394.72$

It should contain not less than 98.5 percent. of pure Strontium Salicylate $[(C_6H_4.OH.COO)_2Sr + 2H_2O]$, and should be kept in well-stoppered bottles, protected from heat and light.

It may be made by decomposing strontium carbonate with a strong hot solution of salicylic acid, filtering and crystallizing.

Official Description.—A white, crystalline powder.

Odor, and Taste.—Odorless; sweetish, saline taste.

Solubility.—*Water.* In 18 parts at 25° C. (77° F.); in 3.5 parts of boiling water.
Alcohol. In 66 parts at 25° C. (77° F.); in 10.5 parts of boiling alcohol.

Tests for Identity.—When heated, the salt is decomposed, giving off inflammable vapors and an odor of phenol, and finally leaving a gray residue of strontium carbonate.

To a non-luminous flame its solution imparts an intense red color.

Its aqueous solution should be colorless, and slightly alkaline to litmus paper.

Ferric chloride T.S., when added to an excess of a concentrated aqueous solution of the salt, produces a violet precipitate; but when added to a very dilute solution (1 in 100), it produces a deep violet-blue color.

If copper sulphate T.S. be added to the aqueous solution (1 in 20), a green color will be produced.

On adding about 1 Cc. of concentrated sulphuric acid to about 0.2 Gm. of the salt, in a test-tube, then about 1 Cc. of methyl alcohol, in drops, and heating the mixture to boiling, the odor of methyl salicylate will be evolved.

With calcium sulphate T.S., the aqueous solution of the salt (1 in 20) slowly forms a white precipitate of strontium sulphate, insoluble in dilute acids; the same reaction occurs more quickly with diluted sulphuric acid or a readily soluble sulphate.

With potassium chromate T.S., Strontium Salicylate forms a yellow precipitate of strontium chromate, soluble in acetic acid.

With ammonium carbonate T.S., or sodium carbonate T.S., the salt forms a white precipitate of strontium carbonate, soluble, with effervescence, in acetic acid.

Impurities and Tests for Impurities.—*Heavy metals.* If to the aqueous solution of Strontium Salicylate (1 in 20) 5 drops of hydrochloric acid be added, and the mixture agitated and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of barium. If 2 Gm. of Strontium Salicylate be agitated with 10 Cc. of diluted acetic acid, heated, cooled, and filtered, the filtrate, upon the addition of 5 drops of potassium dichromate T.S., should not become cloudy within three minutes.

Quantitative Test.—If to 0.5 Gm. of Strontium Salicylate, contained in a porcelain crucible, 1 Cc. of sulphuric acid be added, the mixture cautiously heated until no more vapors are given off, the residue again moistened with a few drops of the acid, again heated, and finally ignited until white and of constant weight, the residue of strontium sulphate should weigh not less than 0.227 Gm.

Uses.—Strontium salicylate is used in place of sodium salicylate in doses of ten to fifteen grains (0.6 to 1 Gm.).

CHAPTER XLIII

ZINC, ALUMINUM, CERIUM, AND CADMIUM

Zn ; 64.9. Al ; 26.9. Ce ; 139.2. Cd ; 111.6

THESE metals are grouped together on account of the similarity in some of their physical properties, rather than because of the chemical analogies existing between them.

ZINCUM. U.S. Zinc

Zn = 64.9

It should contain not less than 99 percent. of pure metallic Zinc.

Preparation.—Zinc is made by roasting *calamine*, or the impure zinc carbonate, with charcoal, in powder, and collecting the zinc by distillation, the vapors being conducted into water, where the zinc is condensed. It is bivalent, and combines with oxygen, chlorine, and phosphorus, forming zinc oxide, chloride, and phosphide, and with numerous acids to form salts.

Tests for Zinc Salts

1. Ammonium sulphide, if added to a solution of a zinc salt containing an excess of alkaline hydroxide, produces a characteristic white precipitate of zinc sulphide.
2. The alkali hydroxides of either sodium, potassium, or ammonium produce white precipitates of zinc hydroxide, freely soluble in an excess of alkali.
3. Sodium and potassium carbonates yield white precipitates, insoluble in an excess.
4. The zinc salts are all colorless.

Official Description.—A bluish-white metal, showing a crystalline fracture; in the form or thin sheets, or in irregular, granulated pieces, or moulded into thin pencils, or in fine powder.

Specific Gravity.—Ranging from 6.9 when it is cast to 7.2, after it is rolled.

Solubility.—Soluble in diluted sulphuric or hydrochloric acid with evolution of hydrogen.

Tests for Identity.—When heated above 100° C. (212° F.) and not above 150° C. (302° F.), the metal becomes malleable and ductile; above 200° C. (392° F.) it becomes sufficiently brittle to be powdered in an iron mortar; at 412° to 415° C. (773.6° to 779° F.) it melts, and at 940° C. (1724° F.) it boils, and may be readily distilled.

Impurities and Tests for Impurities.—*Absence of sulphur.* If 1 Gm. of Zinc be added to 20 Cc. of diluted hydrochloric acid, the liberated hydrogen should not have a disagreeable odor, nor should it color a strip of paper moistened with lead acetate T.S.

Absence of arsenic, antimony, and phosphorus. Or with silver nitrate T.S. The resulting solution should be clear and colorless, and should yield a white gelatinous precipitate with potassium ferrocyanide T.S., and a white precipitate with ammonium sulphide T.S.

Arsenic, cadmium, lead, and copper. If 1 Gm. of Zinc be dissolved in a mixture of 10 Cc. each of nitrohydrochloric acid and water, the solution evaporated to dryness, the residue moistoned with 2 Cc. of hydrochloric acid and again evaporated, and the final residue dissolved in 10 Cc. of water, this solution should not respond to the Time-Limit Test for *arsenic, cadmium, lead, and copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Uses.—Zinc is used in making hydrogen and in preparing the zinc salts.

Zinc and Official Salts and Preparations

Official Name	Preparation
Zincum	Made by roasting the impure carbonate with charcoal and distilling
Zinci Acetas	By treating zinc carbonate with acetic acid
Bromidum	By double decomposition of zinc sulphate and potassium bromide
Carbonas Præcipitatus	By double decomposition of zinc sulphate and sodium carbonate
Chloridum	By evaporating the solution of zinc chloride
Iodidum	By digesting zinc with iodine diffused in water
Oxidum	By calcining zinc carbonate
Phenolsulphonas	By mixing solutions of barium phenolsulphonate and zinc sulphate, evaporating the supernatant liquid, and collecting the crystals
Stearas	By mixing solutions of castile soap and zinc sulphate, collecting precipitate, and drying
Sulphas	By acting on zinc with diluted sulphuric acid
Valeras	By double decomposition of zinc sulphate and sodium valerate
Liquor Zinci Chloridi	By treating zinc with hydrochloric acid
Unguentum Zinci Oxidi	By incorporating zinc oxide with benzoinated lard
Zinci Stearatis	By incorporating zinc stearate with white petrolatum

Unofficial Salts of Zinc

Zinci Cyanidum, $Zn(CN)_2$ Zinc Cyanide	By adding hydrocyanic acid to a solution of zinc acetate and collecting the precipitate
Zinci et Potassii Cyanidum, K_2ZnCN_4 Zinc and Potassium Cyanide	By dissolving zinc cyanide in a solution of pure potassium cyanide, filtering, concentrating, then crystallizing
Zinci Ferrocyanidum, $Zn_2FeCN_6 + 2H_2O$ Zinc Ferrocyanide	By making a solution of zinc sulphate and one of potassium ferrocyanide, mixing them, and collecting the precipitate
Zinci Lactas, $Zn(C_3H_5O_3)_2 + 3H_2O$ Zinc Lactate	Dissolving, by the aid of heat, zinc carbonate in diluted lactic acid, filtering and concentrating, then crystallizing
Zinci Phosphidum Zinc Phosphide	By passing vapors of phosphorus over fused zinc in a current of dry hydrogen
Zinci Salicylas, $Zn(C_7H_5O_3)_2 + 3H_2O$ Zinc Salicylate	By heating salicylic acid with distilled water, gradually adding zinc oxide suspended in water, until no longer dissolved, filtering, and then crystallizing
Zinci Tartras Zinc Tartrate	By mixing hot concentrated solutions of zinc sulphate and neutral potassium tartrate, collecting the precipitate, and drying it
Oleatum Zinci Oleate of Zinc. U.S.P. 1890	By sifting zinc oxide upon oleic acid and heating gently until dissolved

ZINCI ACETAS. U.S. Zinc Acetate

$$Zn(C_2H_3O_2)_2 + 2H_2O = 217.82$$

It should contain in the uneffloresced condition not less than 99.5 percent. o pure Zinc Acetate [$(CH_3.COO)_2Zn + 2H_2O$], and should be kept in well-stoppered bottles.

Preparation.—This salt may be made by a former official process: Take of Commercial Oxide of Zinc, 2 oz. troy; Acetic Acid, 8½ fl. oz.; Distilled Water, 5 fl. oz. Mix the Acid and Water, and digest the Oxide of Zinc in the mixture for half an hour, then heat to the boiling point, filter while hot, and set aside to crystallize. Drain the crystals in a funnel, and dry them upon bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother liquor to one-half, slightly acidulating with acetic acid, and crystallizing.

The reaction is expressed as follows:

$$\underset{\text{Zinc Oxide}}{ZnO} + \underset{\text{Acetic Acid}}{2HC_2H_3O_2} = \underset{\text{Zinc Acetate}}{Zn(C_2H_3O_2)_2} + \underset{\text{Water}}{H_2O}$$

Official Description.—Soft, white, six-sided, monoclinic plates, of a pearly lustre. Exposed to the air, the salt gradually effloresces and loses some of its acid.

Odor, Taste, and Reaction.—Faintly acetous odor; in dilute solutions an astringent, metallic taste; acid reaction.

Solubility.—*Water.* In about 2.5 parts at 25° C. (77° F.); in 1.5 parts of boiling water. On protracted boiling with water acetic acid is lost, and an insoluble basic salt formed.

Alcohol. In 36 parts at 25° C. (77° F.); in 0.6 part of boiling alcohol.

Tests for Identity.—When heated, the salt is partially fused, losing water and acid. At a higher temperature it is decomposed, evolving acetone and other combustible vapors, and leaving a residue of zinc oxide.

The aqueous solution of the salt (1 in 20) yields, with potassium ferrocyanide T.S., a white gelatinous precipitate, and with ammonium sulphide T.S. a pure white precipitate.

The addition of a few drops of ferric chloride T.S. to an aqueous solution of the salt (1 in 20) produces a red color.

Ammonium carbonate T.S., or potassium hydroxide T.S., when added in small portions to the aqueous solution of the salt (1 in 20), produces at first a precipitate of a pure white color, which dissolves completely upon the addition of an excess of the reagent.

Impurities and Tests for Impurities.—*Arsenic, cadmium, lead, and copper.* Ten Cc. of the aqueous solution of the salt (1 in 20), to which 1 Cc. of hydrochloric acid has been added, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Sulphate. The aqueous solution of the salt (1 in 20), after the addition of a few drops of diluted nitric acid, should remain clear upon the addition of either barium chloride T.S.

Chloride. Or silver nitrate T.S.

Uses.—Zinc acetate is used principally as a local remedy, in eye washes, injections, etc.

ZINCI BROMIDUM. U.S. Zinc Bromide

$ZnBr_2 = 223.62$

It should contain, when anhydrous, at least 97 percent. of pure Zinc Bromide, and should be kept in small, glass-stoppered bottles.

Preparation.—Zinc bromide may be made by the process suggested by Lyons, of dissolving potassium bromide and crystallized zinc sulphate, each, in the smallest quantity of hot water, and mixing while hot. When the mixture has cooled, twice its bulk of alcohol is added, and the whole filtered through asbestos to separate the potassium sulphate. The filtrate is evaporated to dryness, and the residue granulated.

This salt may also be made by adding bromine to water and dropping in *mossy zinc*, a form of metallic zinc made by pouring the pure melted metal in water (the pieces bear some resemblance to moss); zinc bromide remains in solution, and may be obtained by filtration, evaporation, and granulation.

$$\underset{\substack{\text{Zinc}\\\text{Sulphate}}}{ZnSO_4} + \underset{\substack{\text{Potassium}\\\text{Bromide}}}{2KBr} = \underset{\substack{\text{Zinc}\\\text{Bromide}}}{ZnBr_2} + \underset{\substack{\text{Potassium}\\\text{Sulphate}}}{K_2SO_4}$$

Official Description.—A white, or nearly white, granular powder; very deliquescent.

Odor, Taste, and Reaction.—Odorless, having, even in dilute solutions, a sharp, saline and metallic taste; slightly acid reaction.

Solubility.—*Water.* Readily.

Alcohol. Readily.

Tests for Identity.—When heated to 394° C. (741.2° F.), the salt fuses, and, with a careful increase of heat, may be sublimed in the form of needle-shaped prisms.

The aqueous solution of the salt (1 in 20) yields a pure white precipitate with hydrogen sulphide T.S. and ammonium sulphide T.S., and also with potassium ferrocyanide T.S.

Silver nitrate T.S. produces a yellowish-white precipitate insoluble in nitric acid and in a moderate excess of ammonia water.

On adding ammonium carbonate T.S. to the aqueous solution of Zinc Bromide, a white precipitate is produced, which should completely redissolve in an excess of the reagent.

Impurities and Tests for Impurities.—*Iodide.* If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, then chlorine water (which has been diluted with an equal volume of water), cautiously introduced, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint.

Arsenic, cadmium, lead, and copper. The aqueous solution of the salt (1 in 20), to which sufficient hydrochloric acid has been added to insure a clear solution, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Sulphate. Another portion of this aqueous solution should not be rendered turbid by the addition of barium chloride T.S.

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of chloride. If 1 Gm. of Zinc Bromide be dissolved in 50 Cc. of acetic acid, 2 Gm. of lead dioxide (free from chloride) be added, and the mixture evaporated in a small beaker to at least 10 Cc., then the residue, diluted with 10 Cc. of distilled water and filtered, should give not more than a slight turbidity on the addition of 2 Cc. of nitric acid and a few drops of silver nitrate T.S.

Quantitative Test.—If 0.3 Gm. of the anhydrous salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate T.S. be added, it should require not less than 26 Cc. nor more than 26.8 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color, corresponding to not less than 97 percent. of the pure salt.

Uses.—Zinc bromide is used medicinally as an hypnotic, in doses of from two to five grains (0.12 to 0.3 Gm.).

ZINCI CARBONAS PRÆCIPITATUS, U.S. Precipitated Zinc Carbonate

Hydrated Zinc Carbonate, which, upon ignition, should yield not less than 72 percent. of zinc oxide [$ZnO = 80.78$].

Preparation.—This salt may be made by a former official British process, as follows:

Take of Sulphate of Zinc, 10 oz. av.; Carbonate of Soda, 10½ oz. av.; Boiling Distilled Water, a sufficiency. Dissolve the Carbonate of Soda with a pint [Imperial measure] of the Water in a capacious porcelain vessel, and pour into it the Sulphate of Zinc also dissolved in a pint [Imp. meas.] of the Water, stirring diligently. Boil for fifteen minutes after effervescence has ceased, and let the precipitate subside. Decant the supernatant liquor, pour on the precipitate 3 pints of boiling Distilled Water, agitating briskly; let the precipitate again subside; and repeat the process of affusion of hot Distilled Water and subsidence, till the washings are no longer precipitated by chloride of barium. Collect the precipitate on calico, let it drain, and dry it with a gentle heat.

$$\underset{\substack{\text{Sodium}\\\text{Carbonate}}}{5Na_2CO_3} + \underset{\substack{\text{Zinc}\\\text{Sulphate}}}{5ZnSO_4} + \underset{\text{Water}}{3H_2O} = \underset{\text{Zinc Carbonate}}{(ZnCO_3)_2 3Zn(HO)_2} + \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{5Na_2SO_4} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{3CO_2}$$

If cold solutions of zinc sulphate and sodium carbonate are mixed together, neutral zinc carbonate is precipitated. This carbonate quickly decomposes, carbon dioxide being evolved, which, upon escaping, makes a portion of the precipitate soluble. This loss is prevented by conducting the precipitation at the boiling temperature, whereby the carbon dioxide is driven off as quickly as it is formed, and solution is thereby prevented.

Official Description.—An impalpable, white powder, of somewhat variable chemical composition. Permanent in the air.

Odor and Taste.—Without odor or taste.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Completely in diluted acids with copious effervescence; also soluble in ammonia water, and in ammonium carbonate T.S.

Tests for Identity.—When strongly heated, the salt loses water and carbon dioxide, and leaves a residue, which is yellow while hot, but becomes white on cooling.

When a small portion of the salt is moistened with a drop of cobaltous nitrate T.S., and heated before the blowpipe, it will assume a vivid green color.

For making tests of identity and purity, make a solution by adding 10 Cc. of diluted sulphuric acid and 10 Cc. of water to 1.25 Gm. of the salt, and, after effervescence has ceased, remove the undissolved excess by filtration.

In a portion of this solution a white gelatinous precipitate is produced by potassium ferrocyanide T.S., and a pure white precipitate by ammonium sulphide T.S.

Another portion of the solution, acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Another portion of the solution should yield, with ammonium carbonate T.S., a white precipitate, which should redissolve completely in an excess of the reagent.

Impurity and Test.—*Limit of alkali.* If 1 Gm. of the salt be placed in a flask with 10 Cc. of boiling water, and 2 drops of phenolphthalein T.S. added, not more than 1 Cc. of tenth-normal hydrochloric acid V.S. should be required to discharge the red color.

Quantitative Test.—One Gm. of Zinc Carbonate, after strong ignition in a porcelain crucible, should leave a residue of zinc oxide weighing not less than 0.720 Gm.

Uses.—Precipitated zinc carbonate is used principally in ointments, and takes the place of the former impure carbonate termed *calamine.* It is sometimes dusted upon inflamed surfaces as an astringent and absorbent.

ZINCI CHLORIDUM. U.S. Zinc Chloride

$ZnCl_2 = 135.26$

It should contain, when anhydrous, not less than 99.5 percent. of pure Zinc Chloride, and should be kept in small, glass-stoppered bottles.

Preparation.—Zinc chloride is easily prepared by digesting metallic zinc in hydrochloric acid and evaporating the solution to dryness; or, preferably, by evaporating the official solution of zinc chloride.

$$\underset{\text{Zinc}}{2Zn} + \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{4HCl} = \underset{\substack{\text{Zinc}\\\text{Chloride}}}{2ZnCl_2} + \underset{\text{Hydrogen}}{4H}$$

Official Description.—A white, or nearly white, granular powder, or porcelain-like masses, irregular, or moulded in pencils. Very deliquescent.

Odor, Taste, and Reaction.—Odorless, *of such intensely caustic properties as to make tasting dangerous,* unless the salt be dissolved in much water; the dilute solution has an astringent, metallic taste; acid reaction.

Solubility.—*Water.* In about 0.4 part of water at 25° C. (77° F.), forming a clear solution, which, on protracted boiling, deposits a basic salt.

Alcohol. Very soluble.

Tests for Identity.—When heated to 115° C. (239° F.), Zinc Chloride fuses to a clear liquid. At a higher temperature it is partly volatilized in dense, white fumes, and partly decomposed, leaving a residue of zinc oxide.

The aqueous solution of the salt (1 in 20) yields, with potassium ferrocyanide T.S., a white gelatinous precipitate, and with ammonium sulphide T.S. a pure white precipitate.

Silver nitrate T.S. produces a white precipitate insoluble in nitric acid.

If ammonium carbonate T.S. be added, in small portions, to the aqueous solution (1 in 20), the precipitate produced should be of a pure white color, and should redissolve completely in an excess of the reagent.

Impurities and Tests for Impurities.—*Arsenic, cadmium, lead, and copper.* The aqueous solution of the salt (1 in 20), to which 1 Cc. of diluted hydrochloric acid has been added, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Limit of oxychloride. The aqueous solution (1 in 20) should be clear, or at most only very slightly opalescent; and if it be mixed with an equal volume of alcohol, a single drop of hydrochloric acid should suffice to render 10 Cc. of the mixture perfectly clear.

Sulphate. The aqueous solution of the salt (1 in 20), after the addition of 1 Cc. of diluted hydrochloric acid, should not be rendered turbid by the addition of barium chloride T.S.

Quantitative Test.—Dissolve 0.5 Gm. of Zinc Chloride in 200 Cc. of boiling distilled water, add about 5 drops of phenolphthalein T.S., and then sufficient sodium carbonate T.S., with constant stirring, to cause the solution to assume a permanent red color; transfer the resulting precipitate to a plain filter, wash it with boiling distilled water until all soluble matter has been removed, then dissolve it in a sufficient quantity of nitric acid, evaporate the solution to dryness, and ignite the salt until it ceases to lose weight; the residue should weigh not less than 0.297 Gm.

Uses.—Zinc chloride in solution is used as an antiseptic and disinfectant (see Liquor Zinci Chloridi, below). Externally, mixed with flour and water, it is used as an escharotic.

LIQUOR ZINCI CHLORIDI. U.S. Solution of Zinc Chloride

An aqueous solution, containing about 50 percent., by weight, of Zinc Chloride [$ZnCl_2 = 135.26$].

	Metric	Old form
* **Zinc,** granulated	240 Gm.	6¼ oz. av.
Hydrochloric Acid	840 Gm.	21 oz. av. 5 dr.
Nitric Acid	12 Gm.	100 minims
Precipitated Zinc Carbonate	12 Gm.	136 grains
Distilled Water, a sufficient quantity,		
To make about	1000 Gm.	1 pint

To the Zinc, contained in a glass or porcelain vessel, add 150 Cc. [old form 4½ fl. oz.] of Distilled Water; then gradually add the Hydrochloric Acid, and digest until reaction ceases and the Acid is saturated. Pour off the solution, add the Nitric Acid, and heat the solution at a temperature not exceeding 115° C. (239° F.), until a portion, if removed and cooled, solidifies. Allow it to cool, and dissolve the solidified mass in a sufficient quantity of Distilled Water to make the product weigh 1000 Gm. [or measure, old form, 1 pint]. Then add the Precipitated Zinc Carbonate, agitate the mixture occasionally during twenty-four hours, and set it aside until it has become clear by subsidence. Finally, separate the clear Solution by decantation, or by means of a siphon.

When zinc is treated with hydrochloric acid, hydrogen is evolved and zinc chloride is produced.

$$\underset{\text{Zinc}}{2Zn} + \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{4HCl} = \underset{\substack{\text{Zinc}\\\text{Chloride}}}{2ZnCl_2} + \underset{\text{Hydrogen}}{4H}$$

Zinc is almost invariably contaminated with iron, and more or less ferrous chloride is present in the first solution. Nitric acid is added, and the solution is evaporated to dryness. The iron salt is thus oxidized, and it is then precipitated by the addition of zinc carbonate, the insoluble ferric hydroxide and carbonate, with any excess of zinc carbonate, being filtered out.

Official Description.—A clear, colorless liquid.
Odor, Taste, and Reaction.—Odorless, having a very astringent, metallic taste, and an acid reaction.
Specific Gravity.—About 1.548 at 25° C. (77° F.).
Tests for Identity.—It should conform to the reactions and tests for an aqueous solution of the salt given under *Zinci Chloridum* (see page 606).

Uses.—This solution, sometimes called *Burnett's disinfecting fluid*, is used principally as an antiseptic and disinfectant. Among its advantages, absence of odor is one of the most prominent.

ZINCI IODIDUM. U.S. Zinc Iodide

$ZnI_2 = 316.70$

It should contain, when anhydrous, not less than 98 percent. of pure Zinc Iodide, and should be kept in small, glass-stoppered bottles protected from light.

Preparation.—Zinc iodide may be formed by digesting an excess of zinc with iodine diffused in water, in a manner similar to that used in making the corresponding iron salt.

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Hydriodic Acid}}{2HI} = \underset{\text{Zinc Iodide}}{ZnI_2} + \underset{\text{Hydrogen}}{2H}$$

Official Description.—A white, or nearly white, granular powder. Very deliquescent, and, upon exposure to air and light, becoming brown from liberated iodine.

Odor, Taste, and Reaction.—Odorless; sharp, saline and metallic taste; acid reaction.

Solubility.—*Water.* Readily.

Alcohol. Readily.

Other solvents. Readily soluble in ether.

Tests for Identity.—When heated to about 446° C. (834.8° F.), the salt fuses to a colorless liquid, and at a higher temperature sublimes, forming quadratic needles, while a small part is decomposed and leaves a residue of zinc oxide.

An aqueous solution of the salt (1 in 20) yields a white gelatinous precipitate with potassium ferrocyanide T.S., and a pure white precipitate with ammonium sulphide T.S.

With silver nitrate T.S. it yields a pale yellow precipitate, insoluble in ammonia water; with mercuric chloride T.S., a red precipitate, soluble in potassium iodide T.S.

If ammonium carbonate T.S. be added to the aqueous solution of the salt (1 in 20), a pure white precipitate will form, which should redissolve completely in an excess of the reagent.

Impurities and Tests for Impurities.—*Arsenic, cadmium, lead, and copper.* The aqueous solution of the salt (1 in 20), to which sufficient diluted hydrochloric acid has been added to insure a clear solution, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Sulphate. Another portion of the aqueous solution should not be rendered turbid upon the addition of barium chloride T.S.

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of Chloride. If 1 Gm. of Zinc Iodide be mixed with 5 Cc. of distilled water, and sufficient ammonia water be added to redissolve the precipitate formed, followed by a solution of 1.5 Gm. of silver nitrate in 10 Cc. of water, then, after shaking and filtering, the filtrate should not be rendered more than slightly turbid by the addition of an excess of nitric acid.

Quantitative Test.—If 0.5 Gm. of dry Zinc Iodide be dissolved in 20 Cc. of water, and if 35 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of nitric acid, and 3 Cc. of ferric ammonium sulphate T.S. be added, and the mixture well shaken, then the addition of not less than 3.4 Cc. nor more than 4 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to give a permanent reddish-brown tint to the solution.

Uses.—Zinc iodide is used as an alterative, in doses of one-half grain to two grains (0.03 to 0.12 Gm.).

ZINCI OXIDUM. U.S. Zinc Oxide

$ZnO = 80.78$

It should contain not less than 99 percent. of pure Zinc Oxide.

Preparation.—Zinc oxide may be prepared by a former official process, as follows:

Take of Precipitated Carbonate of Zinc 12 oz. troy. Expose it, in a shallow vessel, to a low red heat until the water and carbonic acid are wholly expelled.

$$\underset{\text{Zinc Carbonate}}{2ZnCO_3.3Zn(OH)_2} = \underset{\text{Zinc Oxide}}{5ZnO} + \underset{\text{Carbon Dioxide}}{2CO_2} + \underset{\text{Water}}{3H_2O}$$

Commercial zinc oxide is made on the large scale by heating calamine and coal ground together, roasting in a furnace of peculiar construction, and separating the impurities by blowing the mixed vapors up a large tower, allowing the heavier particles to subside in the tower, and then by a powerful draught blowing the zinc oxide into a room containing muslin bags, when the oxide is deposited.

This kind of zinc oxide will not usually conform to the official tests; it is generally very white and filled with hard lumps, which are difficult to reduce to powder. The official powder has a marked cream tint, and can be mixed with ointment so that a smooth preparation is easily made without trituration. (See Unguentum Zinci Oxidi.)

Official Description.—A very fine, amorphous, white or yellowish-white powder, free from gritty particles; it gradually absorbs carbon dioxide from the air.

Odor and Taste.—Without odor or taste.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Completely without effervescence, in diluted acids; also in ammonia water, and in ammonium carbonate T.S.

Tests for Identity.—When heated, it assumes a yellow color, which disappears on cooling.

If a small portion of Zinc Oxide be moistened with a drop of cobaltous nitrate T.S., and heated before the blowpipe, it will assume a vivid green color.

For making tests of identity and purity, digest 1 Gm. of Zinc Oxide, with occasional agitation, in a mixture of 10 Cc. of diluted hydrochloric acid and 10 Cc. of water until saturated; then remove the undissolved Zinc Oxide by filtration.

In a portion of the filtrate a white gelatinous precipitate is produced by potassium ferrocyanide T.S., and a pure white precipitate by ammonium sulphide T.S.

Another portion of the filtrate, acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Another portion of the filtrate should yield, upon the gradual addition of ammonium carbonate T.S., a pure white precipitate, which should almost completely redissolve in an excess of the reagent.

Impurities and Tests for Impurities.—*Limit of alkali.* If 1 Gm. of Zinc Oxide be placed in a flask with 10 Cc. of boiling water, and 2 drops of phenolphthalein T.S. be added, not more than 1 Cc. of tenth-normal hydrochloric acid V.S. should be required to discharge the red color.

Chloride. If 1 Gm. of Zinc Oxide be dissolved in a sufficient quantity of diluted nitric acid, the solution should remain clear upon the addition of silver nitrate T.S.

Limit of sulphate. The above solution should not become more than slightly turbid upon the addition of barium chloride T.S.

Quantitative Test.—If 1 Gm. of freshly ignited Zinc Oxide be digested with 30 Cc. of normal hydrochloric acid V.S. until solution is complete, and 2 drops of methyl-orange T.S. be added, not more than 5.5 Cc. of normal potassium hydroxide V.S. should be required for neutralization (each Cc. of normal hydrochloric acid consumed corresponding to 4.04 percent. of zinc oxide). The normal potassium hydroxide V.S. should be added slowly with constant stirring, waiting until the precipitated zinc hydroxide has redissolved before adding further portions of the reagent.

Uses.—Zinc oxide is rarely used internally; externally, it is used as an exsiccant to inflamed surfaces, and it may be dusted on the part or used in the form of an ointment.

UNGUENTUM ZINCI OXIDI. U. S. Ointment of Zinc Oxide

Made by incorporating 200 Gm. of zinc oxide with 800 Gm. of benzoinated lard. (See Unguenta, Part V.)

ZINCI PHENOLSULPHONAS. U. S. Zinc Phenolsulphonate

$Zn(C_6H_5O_4S)_2 + 8H_2O = 551.56$

[Zinc Sulphocarbolate]

It should contain, in uneffloresced crystals, not less than 99.5 percent. of pure Zinc Paraphenolsulphonate [$(C_6H_4(OH)SO_3)_2Zn$ 1 : 4 + $8H_2O$], and should be kept in small, well-stoppered bottles.

This salt is made by mixing solutions of barium phenolsulphonate and zinc sulphate; barium sulphate is precipitated, the solution is evaporated, and the crystals which separate are washed and dried.

Official Description.—Colorless, transparent, rhombic prisms or tabular crystals. Exposed to the air the salt effloresces, and upon exposure to light and air may become slightly pink.

Odor, Taste, and Reaction.—Odorless; astringent, metallic taste; acid reaction.

Solubility.—*Water.* In 1.7 parts at 25° C. (77° F.); in 0.3 part of boiling water.

Alcohol. In 1.7 parts at 25° C. (77° F.); in 0.56 part of boiling alcohol.

Tests for Identity.—When heated to 100° C. (212° F.), the salt loses 6 molecules of water of crystallization, and it loses the remainder at 125° C. (257° F.). At a higher temperature it chars, emitting inflammable vapors having the odor of phenol, and finally leaves a residue amounting to about 14.6 percent. of the original weight.

A dilute solution of the salt (1 in 100) is colored pale violet by ferric chloride T.S.

The aqueous solution of the salt (1 in 20) yields, with potassium ferrocyanide T.S., a white gelatinous precipitate, and, with ammonium sulphide T.S., a pure white precipitate.

Ammonium carbonate T.S., or potassium hydroxide T.S., when added in small portions to the aqueous solution of the salt (1 in 20), produces a precipitate of a pure white color, which dissolves completely upon the addition of an excess of the reagent.

Impurities and Tests for Impurities.—*Arsenic, cadmium, lead, and copper.* The aqueous solution of the salt (1 in 20), to which 1 Cc. of diluted hydrochloric acid has been added, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Sulphate. The aqueous solution of the salt (1 in 20) should not become turbid upon the addition of barium chloride T.S.

Chloride. Or silver nitrate T.S.

Arsenic. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—Zinc phenolsulphonate is used as an antiseptic astringent and stimulant. When used internally it may be given in doses of two grains (0.12 Gm.).

ZINCI STEARAS. U.S. Zinc Stearate

This salt is made by adding a solution of 75 Gm. of Zinc Acetate in 5000 Cc. of water to a solution of 200 Gm. of dried Castile Soap in 3000 Cc. of hot water. The latter solution must be cold before mixing. The precipitate is washed and dried without heat.

Official Description.—A very fine, white powder. Zinc Stearate contains a small but varying proportion of zinc palmitate.

Odor, Taste, and Reaction.—Very faint odor, resembling that of fat; tasteless; neutral reaction.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Insoluble in ether.

Tests for Identity.—When heated, the salt fuses. At a higher temperature it is decomposed, giving off inflammable vapors and the odor of burning fat, and finally leaves about 13.5 percent. of residue, which consists chiefly of zinc oxide.

If 0.5 Gm. of Zinc Stearate be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of hydrochloric acid, stearic acid will be liberated and float as an oily layer on the surface of the liquid.

Impurities and Tests for Impurities.—*Alkalies, alkali earths, etc.* If, after filtering this liquid through a small wetted filter, all of the zinc be precipitated by ammonium sulphide T.S., the filtrate should leave no fixed residue on evaporation.

More than traces of chlorides If 0.5 Gm. of Zinc Stearate be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of nitric acid, and filtered, the filtrate should not become more than slightly turbid upon the addition of silver nitrate T.S.

Quantitative Test.—If 1 Gm. of Zinc Stearate be boiled with 50 Cc. of distilled water containing 2 Cc. of nitric acid, and filtered through a wetted filter, after thoroughly washing the precipitate with boiling water, the filtrate and washings, when evaporated to dryness and ignited, should leave a residue weighing not less than 0.14 Gm. and not more than 0.16 Gm.

Uses.—Zinc stearate is used in the official ointment of zinc stearate, and as a dusting powder in dermatological practice.

UNGUENTUM ZINCI STEARATIS. U.S. Ointment of Zinc Stearate

Made by incorporating 50 Gm. of zinc stearate with 50 Gm. of white petrolatum (see page 1267).

ZINCI SULPHAS. U.S. Zinc Sulphate

$ZnSO_4 + 7H_2O = 285.41$

It should contain, in uneffloresced crystals, not less than 99.5 percent. of pure Zinc Sulphate [$SO_2.O_2Zn + 7H_2O$], and should be kept in well-stoppered bottles.

Preparation.—Zinc sulphate is made by acting on metallic zinc with diluted sulphuric acid, hydrogen being evolved; the resulting solution is freed from the contamination of iron by first passing chlorine into it, when ferric chloride is produced, and, upon the addition of zinc carbonate, decomposition takes place, ferric hydroxide separating as an insoluble precipitate, which is removed by filtration, and a small quantity of zinc chloride is formed, which, being very soluble, remains in the mother liquor after the crystallization of the sulphate.

$$\underset{\text{Zinc}}{2Zn} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{2H_2SO_4} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Zinc}\\\text{Sulphate}}}{2ZnSO_4} + \underset{\text{Hydrogen}}{4H} + \underset{\text{Water}}{H_2O}$$

Official Description.—Colorless, transparent, rhombic crystals, or a granular crystalline powder. Efflorescent in dry air.

Odor, Taste, and Reaction.—Without odor; astringent, metallic taste; acid reaction.

Solubility.—*Water.* Completely in 0.53 part of water at 25° C. (77° F.), and in 0.2 part of boiling water.

Alcohol. Insoluble.

Other solvents. In about 3 parts of glycerin.

Tests for Identity.—When rapidly heated, the salt melts. At a higher temperature it is partly decomposed, losing both water and sulphuric acid. When very gradually heated to 50° C. (122° F.), it loses 5 molecules of its water of crystallization (31.2 percent.) without melting. At 100 C. (212° F.), a sixth molecule is lost, while the last is removed, with decomposition of the salt, at a temperature of about 240° C. (464° F.).

The aqueous solution of the salt (1 in 20) yields a white gelatinous precipitate with potassium ferrocyanide T.S., and a white precipitate with ammonium sulphide T.S., and with barium chloride T.S.

If a small portion of the salt be moistened with a drop of cobaltous nitrate T.S., and heated before the blowpipe, it will assume a vivid green color.

Impurities and Tests for Impurities.—*Arsenic, cadmium, lead, and copper.* The aqueous solution of Zinc Sulphate (1 in 20), after being acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

The aqueous solution should yield, with ammonium carbonate T.S., a white precipitate, which should redissolve completely in an excess of the reagent.

Limit of chloride. The aqueous solution (1 in 20) should not be rendered more than slightly turbid by silver nitrate T.S.

Free acid. If 1 Gm. of Zinc Sulphate, in small fragments, be agitated for some time with 10 Cc. of alcohol, the filtrate should not redden moistened blue litmus paper.

Uses.—This salt is the most important of those made from zinc. It is used medicinally as a prompt and certain emetic in doses of ten to thirty grains (0.6 to 2 Gm.); as a tonic and astringent, one to two grains (0.065 to 0.12 Gm.).

ZINCI VALERAS. U.S. Zinc Valerate

$Zn(C_5H_9O_2)_2 + 2H_2O = 301.28$

[ZINCI VALERIANAS, PHARM. 1890 ZINC VALERIANATE]

It should contain not less than 99 percent. of pure Zinc Valerate [$(C_4H_9.COO)_2Zn + 2H_2O$], and should be kept in small, well-stoppered bottles.

Preparation.—The process for making this salt affords an illustration of the rather rare instance of "upward precipitation," the crystals of zinc valerate being lighter than the mixed solutions.

"Take of Sodium Valerate, 2½ oz. troy; Zinc Sulphate, 2 oz. troy, 420 grains; Distilled Water, a sufficient quantity. Dissolve the salts separately, each in 20 fluidounces of Distilled Water, and, having heated the solutions to 100° C. (212° F.), mix them, and set the mixture aside to crystallize. Decant the mother water from the crystals, and put them upon a filter in a funnel to drain. Mix the mother water and the drainings, evaporate at a heat not exceeding 93.3° C. (200° F.) to 4 fluidounces, and again set aside to crystallize. Add the crystals, thus obtained, to those in the funnel, wash the whole with a little Distilled Water, and, having removed them with the filter, spread them on bibulous paper, and dry them with a heat not exceeding 93.3° C. (200° F.)."

$$\underset{\text{Sodium Valerate}}{2NaC_5H_9O_2} + \underset{\text{Zinc Sulphate}}{ZnSO_4} = \underset{\text{Zinc Valerate}}{Zn(C_5H_9O_2)_2} + \underset{\text{Sodium Sulphate}}{Na_2SO_4}$$

Official Description.—White, pearly scales. On exposure to the air, it slowly loses valeric acid.

Odor, Taste, and Reaction.—Odor of valeric acid; sweetish, astringent, and metallic taste; acid reaction.

Solubility.—*Water.* In about 50 parts at 25° C. (77° F.). Boiling renders the aqueous solution turbid from loss of acid and formation of a basic salt.

Alcohol. In about 35 parts at 25° C. (77° F.); somewhat more soluble in absolute alcohol.

Tests for Identity.—When heated, the salt melts. At a higher temperature it is decomposed, giving off inflammable vapors, and finally leaving a residue of zinc oxide.

Zinc Valerate should dissolve without residue in ammonium carbonate T.S.

If 0.5 Gm. of Zinc Valerate be dissolved in a mixture of 0.5 Cc. of hydrochloric acid and 9 Cc. of water, the valeric (isovaleric) acid will be liberated and float as an oily layer on the surface of the liquid.

Impurities and Tests for Impurities.—*Arsenic, cadmium, lead, and copper.* After filtering through a small wetted filter, the clear solution should not respond to the Time-Limit Test for *arsenic, cadmium, lead*, and *copper* (see U. S. P. Test No. 121, Chap. LXII); in applying this test the addition of ammonia water should be omitted.

Sulphate. If 0.5 Gm. of Zinc Valerate be dissolved in a mixture of 0.5 Cc. of nitric acid and 4.5 Cc. of distilled water, and the mixture filtered through a small wetted filter, the filtrate should show but a faint cloudiness upon the addition of either barium chloride T.S.

Chloride. Or silver nitrate T.S.

Acetate. If 0.5 Gm. of Zinc Valerate be triturated with 3 Cc. of water, and 0.2 Cc. of ferric chloride T.S. added, the filtrate should not show a red color.

Butyrate. If a concentrated solution of copper acetate in water be added to a concentrated aqueous solution of Zinc Valerate, the mixture should remain perfectly clear.

Arsenic. If 0.5 Gm. of Zinc Valerate be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of hydrochloric acid and filtered, the filtrate should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—Zinc valerate is used as a nervine and antispasmodic, in doses of one to three grains (0.065 to 0.19 Gm.).

Aluminum. Al; 26.9

This metal is found largely in combination with silicic acid, in the rocks and clays forming a great portion of the earth's surface. Some of the precious stones and valuable minerals are compounds of aluminum; the ruby and sapphire, corundum and emery, are crystallized forms of aluminum oxide. Aluminum is of a silver-white color. The metal, owing to improvements in its extraction, is much cheaper than it was formerly, and it is used in making ornamental and useful articles. Owing to its very low specific gravity (2.67), it is used for grain weights, because they are much larger, and thus more easily handled, than they would be if made from brass (see page 69). Aluminum forms but one class of compounds used in medicine; it is trivalent. The oxides and sulphates unite with those of the alkali metals and form double salts, called alums.

Tests for Salts of Aluminum

1. Potassium or sodium hydroxide produces white, gelatinous precipitates of aluminum hydroxide in solutions of alum, which are freely soluble in excess of the alkali.
2. Ammonia water produces a similar precipitate, insoluble in excess.
3. The alkaline carbonates precipitate the hydroxide, carbon dioxide being evolved.
4. Ammonium sulphide also precipitates the hydroxide, hydrogen sulphide being evolved.

Official Salts of Aluminum

Official Name	Preparation
Alumen	By treating alum clay with sulphuric acid and potassium sulphate
Exsiccatum	By heating alum to a temperature of 205° C. (401° F.)
Alumini Hydroxidum	By double decomposition of alum and sodium carbonate
Sulphas	By treating aluminum hydroxide with sulphuric acid and crystallizing

Unofficial Salts of Aluminum

Alumini Acetas, $Al(C_2H_3O_2)_3$ Aluminum Acetate	By dissolving aluminum hydroxide in cold acetic acid, filtering and concentrating, then crystallizing
Alumini Bromidum, $AlBr_3$ Aluminum Bromide	By passing the vapor of bromine over a heated mixture of aluminum oxide and carbon
Alumini Chloridum, $AlCl_3$ Aluminum Chloride	By dissolving aluminum hydroxide in hydrochloric acid and evaporating carefully, then crystallizing
Alumini Iodidum, AlI_3 Aluminum Iodide	By heating aluminum and iodine together in closed tubes and collecting the crystals
Alumini Nitras, $Al(NO_3)_3 + 9H_2O$ Aluminum Nitrate	By dissolving aluminum hydroxide in nitric acid, filtering and concentrating, then crystallizing
Alumini Oxidum, Al_2O_3 Aluminum Oxide	Occurs in nature
Alumini Phosphas, $AlPO_4$ Aluminum Phosphate	By adding a neutral solution of aluminum hydroxide to a solution of sodium phosphate, and collecting the gelatinous precipitate

ALUMEN. U.S. Alum

$$AlK(SO_4)_2 + 12H_2O = 471.02$$

[ALUMINUM AND POTASSIUM SULPHATE POTASSIUM ALUM]

It should contain not less than 99.5 percent. of pure Aluminum and Potassium Sulphate.

Preparation.—This valuable salt is made principally from alum clay, which is chiefly aluminum silicate, by treating it with sulphuric acid, thereby forming aluminum sulphate. Potassium sulphate is then added, when the double salt $AlK(SO_4)_2$ is produced. It crystallizes with twelve molecules of water. Ammonia alum, $AlNH_4(SO_4)_2$, is generally found in the market, because of its greater cheapness.

Official Description.—Large, colorless, octahedral crystals, sometimes modified by cubes, or in crystalline fragments.

Odor, Taste, and Reaction.—Without odor; sweetish and strongly astringent taste; acid reaction.

Solubility.— *Water.* In 9 parts at 25° C. (77° F.); in 0.3 part of boiling water.
Alcohol. Insoluble.
Other solvents. Freely soluble in warm glycerin.

Tests for Identity.—When gradually heated, it loses water; at 92° C. (197.6° F.) it fuses, and if the heat be gradually increased to 200° C. (392° F.), it loses all of its water of crystallization (45.55 percent. of its weight), leaving a voluminous white residue (see *Alumen Exsiccatum*).

An aqueous solution of the salt affords, with ammonia water, a white, gelatinous, precipitate, which is almost insoluble in an excess of ammonia; with barium chloride T.S., a white precipitate, insoluble in hydrochloric acid.

When a saturated solution of Alum is shaken with sodium bitartrate T.S., it produces, within half an hour, a white, crystalline precipitate.

The aqueous solution of Alum affords, with potassium hydroxide T.S., a white, gelatinous precipitate, which is completely soluble in an excess of the alkali.

Impurities and Tests for Impurities.—*Heavy metals.* The aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII). (The subsequent addition of ammonia water, as directed in this test, should be omitted.)

Limit of iron. The addition of 5 drops of potassium ferrocyanide T.S., to 20 Cc. of an aqueous solution of alum (1 in 150) should not at once produce a blue coloration.

Uses.—Alum is a powerful astringent. When powdered, it is used as an emetic in croup, in doses of a teaspoonful. It is sometimes used as a local styptic, and is frequently employed in making astringent lotions and injections. The dose as an astringent is from five to twenty grains (0.3 to 1.3 Gm.).

ALUMEN EXSICCATUM. U.S. Exsiccated Alum

$AlK(SO_4)_2 = 256.46$

[ALUMEN USTUM DRIED ALUM BURNT (BURNED) ALUM]

Exsiccated Alum should contain not less than 99 percent. of pure anhydrous Aluminum and Potassium Sulphate.

	Metric	Old form
* **Alum,** in small pieces	**100 Gm.**	20 oz. av.
To make	**55 Gm.**	11 oz. av.

Place the Alum in a tared shallow porcelain dish so as to form a thin layer, and heat it on a sand-bath until it liquefies. Then continue the application of a moderate heat, with constant stirring, until aqueous vapor ceases to be disengaged and a dry, white, porous mass weighing 55 Gm. [old form 11 oz. av.] is obtained. When cold, reduce the product to a fine powder, and preserve it in well-stoppered bottles.

This preparation represents alum nearly deprived of its water of crystallization; the latter exists in alum in the enormous proportion of nearly 45 percent., thus constituting almost half of its weight.

Official Description.—A white, granular powder; attracting moisture on exposure to the air.

Odor and Taste.—Without odor; sweetish, astringent taste.

Solubility.—*Water.* Slowly but completely in about 17 parts at 25° C. (77° F.); quickly in 1.4 parts of boiling water.

Tests for Identity.—Its aqueous solution should respond to the reactions and tests given under *Alumen.*

Uses.—It is used as an escharotic. It is more powerful than alum, although not so soluble.

ALUMINI HYDROXIDUM. U.S. Aluminum Hydroxide

[ALUMINI HYDRAS, PHARM. 1890]

	Metric	Old form
* **Alum**	100 Gm.	16 oz. av.
Monohydrated Sodium Carbonate	43 Gm.	6 oz. av. 385 gr.
Water, a sufficient quantity		

Dissolve each salt separately in 1000 Cc. [old form 10 pints] of Water, filter the solutions and heat them to boiling. Then having poured the hot solution of Monohydrated Sodium Carbonate into a capacious vessel, gradually pour in the hot solution of alum with constant stirring, and add 2000 Cc. [old form 20 pints] of boiling Water. Allow the precipitate to subside, decant the clear liquid, and pour upon the precipitate 2000 Cc. [old form 20 pints] of hot Water. Again decant, transfer the precipitate to a strainer, and wash it with hot Water, until the washings produce not more than a faint cloudiness with barium chloride T.S. Then allow it to drain, dry it at a temperature not exceeding 40° C. (104° F.), and reduce it to a uniformly fine powder.

$$\underset{\substack{\text{Potassium}\\\text{Alum}}}{2AlK(SO_4)_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate}}}{3Na_2CO_3} + \underset{\text{Water}}{3H_2O} = \underset{\substack{\text{Aluminum}\\\text{Hydroxide}}}{2Al(OH)_3} + \underset{\substack{\text{Potassium}\\\text{Sulphate}}}{K_2SO_4} + \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{3Na_2SO_4} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{3CO_2}$$

The direction to add the alum solution to that of the sodium carbonate is important. If the mixing of the solution is reversed, the precipitated hydroxide will be contaminated with the alkali sulphates, so that it will be much more difficult to separate them.

Official Description.—A white, light, amorphous powder; permanent in dry air.

Odor and Taste.—Odorless and tasteless.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Completely in hydrochloric or sulphuric acid and in potassium hydroxide T.S.

Test for Identity.—When heated to redness it loses about 34 percent. of its weight.

Impurities and Tests for Impurities.—*Limit of iron.* A solution of 1 Gm. of Aluminum Hydroxide in 20 Cc. of diluted hydrochloric acid and 130 Cc. of water should not at once assume a blue color on the addition of 1 drop of potassium ferrocyanide T.S.

Limit of sulphate. The above solution should not give more than a faint cloudiness with barium chloride T.S.

Limit of alkali salts. If 1 Gm. of the powder be boiled with 20 Cc. of distilled water, and the liquid filtered, the filtrate should not have an alkaline reaction, and on evaporation should leave a residue weighing not more than 0.005 Gm.

Heavy metals. A solution of the powder (1 in 20) in diluted hydrochloric acid should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII). (The subsequent addition of ammonia water, as directed in this test, should be omitted.)

Uses.—Aluminum hydroxide is a desiccant powder; it is absorbent and antacid. The dose is from two to five grains (0.13 to 0.3 Gm.). Externally, it is used like zinc oxide, by dusting on the inflamed surface.

ALUMINI SULPHAS. U.S. Aluminum Sulphate

$Al_2(SO_4)_3 + 16H_2O = 625.93$

It should contain not less than 99.5 percent. of pure Aluminum Sulphate.

Preparation.—This sulphate may be made by the process formerly official.

Take of Alum, Carbonate of Sodium, each, 4 oz. troy; Sulphuric Acid, 1 oz. troy, 150 gr.; Water, a sufficient quantity. Dissolve the salts separately, each in 6 fluidounces of boiling water, and pour the solution of the Alum gradually into that of the Carbonate of Sodium; then digest with a gentle heat until the evolution of carbonic acid ceases. Collect upon a filter the precipitate formed, and wash it with water, until the washings are no longer affected by chloride of barium. Next, with the aid of heat, dissolve the precipitate in the Sulphuric Acid, previously diluted with half a pint of Water, and, having filtered the solution, evaporate it until a pellicle begins to form. Then remove it to a water-bath, and continue the evaporation, with constant stirring, until a dry salt remains. Lastly, preserve this in a well-stoppered bottle.

Another method may be used: the hydroxide obtained by the process given on page 615 may be dissolved in diluted sulphuric acid, the solution evaporated, and the salt granulated.

Official Description.—A white, crystalline powder, or shining plates, or crystalline fragments; permanent in the air.

Odor, Taste, and Reaction.—Without odor; sweetish, and afterwards an astringent taste; acid reaction.

Solubility.—*Water.* In 1 part of water at 25° C. (77° F.), more soluble in boiling water.

Alcohol. Insoluble.

Tests for Identity.—When gradually heated to about 200° C. (392° F.), it loses its water of crystallization (45.7 percent. of its weight).

The aqueous solution of the salt yields, with barium chloride T.S., a white precipitate, insoluble in hydrochloric acid; and with potassium hydroxide T.S., a white, gelatinous precipitate which is soluble in an excess of the alkali, but which is again separated on the addition of a sufficient amount of ammonium chloride T.S.

Impurities and Tests for Impurities.—*Ammonia.* If 1 Gm. of Aluminum Sulphate be gently heated with 5 Cc. of potassium hydroxide T.S., the liquid should not evolve the odor of *ammonia.*

Limit of free acid. A filtered, aqueous solution of the salt (1 in 10) should not become more than faintly opalescent within five minutes after the addition of an equal volume of tenth-normal sodium thiosulphate V.S.

Heavy metals. The aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII). (The subsequent addition of ammonia water, as directed in this test, should be omitted.)

Limit of iron. The addition of 5 drops of potassium ferrocyanide T.S. to 20 Cc. of the aqueous solution of the salt (1 in 150) should not produce at once a blue coloration.

Uses.—Aluminum sulphate is antiseptic; it is rarely used internally.

Cerium. Ce; 139.2

Cerium is a metal occurring in *cerite*, *gadolinite*, etc.; it is of a chocolate-brown color, in masses; it takes fire more easily than magnesium; at ordinary temperatures it oxidizes in a moist atmosphere. Two oxides of cerium are known, Ce_2O_3, *cerous oxide*, and CeO_2, *ceric oxide*.

Test for Cerium Compounds

If sodium hypochlorite be added to a solution of a colorless cerous salt, a red precipitate separates; this dissolves in warm hydrochloric acid, and evolves chlorine.

Official Salt of Cerium

Official Name	Preparation
Cerii Oxalas	By precipitating cerium chloride with oxalic acid

Unofficial Salts of Cerium

Ceroso-cerii Oxidum, Ce_3O_4 Ceroso-ceric Oxide	By igniting cerium oxalate in an open vessel and then collecting the mass
Cerii Chloridum, $CeCl_2$ Cerium Chloride	By burning cerium in chlorine gas and then collecting the mass
Cerii Nitras, $CeNO_3 + 2H_2O$ Cerium Nitrate	By dissolving ceroso-ceric oxide in nitric acid in presence of alcohol or some other reducing substance
Cerii Oxidum, CeO Cerium Oxide	By heating cerium oxalate in a current of dry hydrogen perfectly free from air
Cerii Sulphas, $Ce_2(SO_4)_3$ Cerium Sulphate	By dissolving ceric oxide in sulphuric acid, and evaporating, then crystallizing

CERII OXALAS. U.S. Cerium Oxalate

Cerium Oxalate consists chiefly of a mixture of the oxalates of cerium, didymium, and lanthanum, and of other rare earths of this group.

Preparation.—This salt is made by decomposing the silicates in the powdered mineral containing the metal, with strong sulphuric acid, then heating the mass, and subsequently treating it with nitric acid and hydrogen sulphide to separate contaminating metals. Hydrochloric acid is now added in small quantity, and the cerium compounds are precipitated by oxalic acid. This oxalate is impure, containing lanthanum and didymium compounds; it is therefore mixed with magnesium carbonate, and the mixture heated to redness to decompose the oxalates; the residue is dissolved in a small quantity of nitric acid, and the solution added to water containing a little sulphuric acid; ceric sulphate is produced, which is dissolved in sulphuric acid, and sodium thiosulphate added to reduce it to cerous sulphate; this is collected and treated with oxalic acid, when cerium oxalate precipitates. The complication in the method of preparation of this salt is due to the presence of the two rare metals didymium and lanthanum, which can be separated only with difficulty.

Cerium oxalate as found in commerce is never pure, and the official definition and tests are therefore not very explicit.

Official Description.—A fine, white powder; permanent in the air.

Odor and Taste.—Without odor or taste.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Insoluble in ether, or in solutions of potassium or sodium hydroxide; insoluble in cold, but soluble in hot, diluted sulphuric or hydrochloric acid.

Tests for Identity.—When heated to redness it is decomposed, leaving a residue of reddish-brown ceric and other rare-earth oxides, constituting not less than 47 percent. of the salt.

On boiling the salt with potassium hydroxide T.S., an insoluble residue of white hydroxides is produced; if the filtrate from this residue be supersaturated with acetic acid, the addition of calcium chloride T.S. will produce a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid.

If the residue left after heating Cerium Oxalate be dissolved in concentrated sulphuric acid, and a small crystal of strychnine added, a deep blue color will appear, which will rapidly change to purple and then to red.

From the solution in diluted hydrochloric or sulphuric acid, potassium hydroxide T.S. precipitates white hydroxides, which do not redissolve in an excess of the reagent, and gradually turn yellow in contact with air. Ammonium carbonate T.S. precipitates from the same solution white cerous and other rare-earth carbonates, which are somewhat soluble in an excess of the reagent.

If 0.1 Gm. of Cerium Oxalate be dissolved in 1 Cc. of sulphuric acid, and 2 Cc. of potassium sulphate T.S. be added, small, colorless crystals of cerium and other rare-earth potassium sulphates will, after some time, be deposited.

Impurities and Tests for Impurities.—*Carbonates.* No effervescence should occur when the salt is dissolved in diluted hydrochloric acid.

Heavy metals. The solution of the salt (1 in 20) in diluted hydrochloric acid should not respond to the Time-Limit Test for *heavy metals*, omitting the addition of the ammonia water (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of the solution of the salt (1 in 10) in diluted hydrochloric acid should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No 17, Chap. LXII).
Aluminum. On boiling the salt with potassium hydroxide T.S. and filtering, no precipitate should be produced in the filtrate by the addition of either ammonium chloride T.S.
Zinc. Or ammonium sulphate T.S.

Uses—Cerium oxalate is a valuable remedy in controlling nausea. It is given in doses of one to ten grains (0.065 to 0.6 Gm.).

Cadmium. Cd; 111.6

This metal is associated with zinc in its ores. Although it enters into *no official preparations*, it is used to some extent in medicine, and hence merits a notice here. It is a white metal, resembling tin, but somewhat heavier and more tenacious. Like that metal, it crackles when bent. Its specific gravity is 8.7. It is little affected by the air, but when heated combines with an atom of oxygen, forming a reddish-brown or orange-colored oxide, CdO. It combines with chlorine, iodine, bromine, and sulphur.

Tests for Cadmium Salts

1. Hydrogen sulphide and ammonium sulphide produce precipitates of a yellow color (sulphide) when added to solutions of cadmium salts.

2. Sodium or potassium hydroxide produces, with cadmium salts, white precipitates (hydroxides), insoluble in excess. Ammonia water produces similar precipitates, soluble in excess.

3. Sodium or potassium carbonate produces white precipitates of cadmium carbonate, insoluble in excess.

Unofficial Compounds of Cadmium

Cadmii Bromidum, $CdBr_2$ Cadmium Bromide	By double decomposition between potassium bromide and cadmium sulphate
Cadmii Chloridum, $CdCl_2$ Cadmium Chloride	By treating cadmium or cadmium carbonate with hydrochloric acid
Cadmii Iodidum, CdI_2 Cadmium Iodide	By double decomposition between potassium iodide and cadmium sulphate
Cadmii Oxidum, CdO Cadmium Oxide	By igniting cadmium nitrate or carbonate
Cadmii Sulphidum, CdS Cadmium Sulphide	By passing hydrogen sulphide through a solution of cadmium chloride, nitrate, or sulphate
Cadmii Sulphas, $CdSO_4 + 4H_2O$ Cadmium Sulphate	By treating cadmium carbonate or oxide with diluted sulphuric acid

CHAPTER XLIV

MANGANESE, IRON, AND CHROMIUM

Mn ; 54.6. Fe ; 55.5. Cr. ; 51.7

THESE three metals form a group exhibiting some chemical and physical analogies. They unite with oxygen, producing basic oxides.

Manganese. Mn ; 54.6

Manganese is found, as a mineral, quite extensively in the state of black oxide, as *pyrolusite, braunite,* and *hausmannite.* The carbonate also is sometimes found. The metal is very hard and brittle ; when powdered, it decomposes water readily. With oxygen it forms five—possibly seven—compounds. The *monoxide,* MnO, is of a light green color, and is the oxide present in or corresponding to manganous salts. The *sesquioxide,* Mn_2O_3, is black or dark brown, when in the hydrated state ; the magnetic oxide, Mn_3O_4, is red ; the dioxide, MnO_2, is black ; and the permanganic oxide, Mn_2O_7, is, when in the free state, a very unstable dark reddish-brown liquid. The monoxide is a stable base, the sesquioxide feebly basic, and the dioxide when acted upon by acids yields manganous salts, while oxygen is evolved. The highest oxide is acid-forming, yielding permanganic acid, $HMnO_4$, the salts of which are known as permanganates. There exists also an acid, H_2MnO_4 (manganic), of which the salts formed are called manganates. The corresponding oxide, however, is not known.

Tests for Salts of Manganese

1. Ammonium sulphide, added to a solution of a manganese salt, produces a flesh-colored precipitate of manganese sulphide.

2. Potassium or sodium carbonate in solution produces white precipitates, which are insoluble in excess of solution of ammonium carbonate.

3. With the blowpipe, manganese gives with borax a bead having an amethystine color in the oxidizing flame, and a colorless bead in the deoxidizing flame.

4. If manganese be heated with sodium carbonate, *green* sodium manganate is produced. If this be added to water, it communicates a purplish-red color.

Official Salts of Manganese

Official Name	Preparation
Mangani Dioxidum Præcipitatum	Manganese dioxide, containing at least 88 percent. of pure oxide made by adding ammonia water and solution of hydrogen dioxide to a solution of manganese sulphate, collecting the precipitate, washing and drying
Hypophosphis	By reaction between manganous carbonate and calcium hypophosphite
Sulphas	Made by treating manganese dioxide with sulphuric acid
Potassii Permanganas	By heating manganese dioxide, potassium hydroxide, and potassium chlorate together

Unofficial Salts of Manganese

Mangani Arsenas, $MnHAsO_4$ Manganese Arsenate	By saturating a solution of arsenic acid with freshly precipitated manganese carbonate
Mangani Benzoas Manganese Benzoate	By adding to a solution of benzoic acid manganese carbonate as long as combination is effected
Mangani Carbonas, $MnCO_3$ Manganese Carbonate	By adding to a solution of manganese sulphate a solution of potassium carbonate, and collecting and drying the precipitate
Mangani Chloridum, $MnCl_2$ Manganese Chloride	By treating manganese dioxide with hydrochloric acid, purifying from iron salts, evaporating, and crystallizing
Mangani Citras Manganese Citrate	By digesting manganese carbonate with citric acid, and collecting the precipitate
Mangani Oxalas, $2\ MnC_2O_4 + 5H_2O$ Manganese Oxalate	By adding to a solution of manganese sulphate a solution of oxalic acid, and collecting the precipitate
Mangani Tartras Manganese Tartrate	By adding a solution of neutral potassium tartrate to a solution of manganous chloride, and, after the acid potassium tartrate has deposited, collecting the colorless crystals.

MANGANI DIOXIDUM PRÆCIPITATUM. U.S. Precipitated Manganese Dioxide

[To replace MANGANI DIOXIDUM, PHARM. 1890]

Chiefly Manganese Dioxide [$MnO_2 = 86.36$] with small amounts of other oxides of manganese, corresponding to not less than 80 percent. of Manganese Dioxide.

	Metric	Old form
* **Manganese Sulphate**	50 Gm.	2 oz. av.
Ammonia Water	250 Cc.	9 fl. oz. 153 min.
Solution of Hydrogen Dioxide	250 Cc.	9 fl. oz. 153 min.
Distilled Water, a sufficient quantity		

Dissolve the Manganese Sulphate in 1000 Cc. [old form 37 fl. oz.] of Distilled Water. Dilute the Ammonia Water with an equal volume of Distilled Water, and mix it with the Solution of Hydrogen Dioxide, which has also been diluted with an equal volume of Distilled Water. Pour the mixed solutions slowly, with constant stirring, into the solution of Manganese Sulphate. Allow the mixture to stand for one hour, stirring frequently. Then decant the supernatant clear liquid from the precipitate, and wash the latter repeatedly by affusion and decantation with hot Distilled Water, using 1000 Cc. [old form 37 fl. oz.] each time. Collect the precipitate on a plain filter, and continue the washing with hot Distilled Water until the washings no longer have an alkaline reaction upon red litmus paper, and produce no turbidity when mixed with barium chloride test solution. Allow the precipitate to drain, then dry it at 150° C. (302° F.).

Black oxide of manganese is frequently found in commerce of poor and variable quality; some pyrolusite from Nova Scotia was examined by the author a few years ago, however, which assayed 96 percent. of pure oxide. It is the safest rule to buy it only upon assay, and, when a good sample can be found, to secure a large quantity of it.

In order to secure a uniformly reliable product, the above process for its preparation has been introduced into the 8th Decennial Revision of the U. S. P.

Official Description.—A heavy, very fine, black powder; permanent in the air

Odor and Taste.—Odorless and tasteless.

Solubility.—*Water.* Insoluble.
Alcohol. Insoluble.

Tests for Identity.—It is not affected by concentrated sulphuric acid, but when heated with this acid it is converted into manganese sulphate, with the evolution of oxygen.

When heated with hydrochloric acid, it is converted into manganous chloride, with the evolution of chlorine. At a red heat Precipitated Manganese Dioxide gives off oxygen, and is converted into reddish-brown manganoso-manganic oxide (Mn_3O_4).

On intimately mixing 1 part of the Dioxide with 1 part of potassium hydroxide and 1 part of potassium chlorate, introducing the mass into a crucible, moistening with water, drying, and igniting, a dark fused mass is obtained which yields, with water, a green solution, changing to purplish-red on being boiled, or on the addition of diluted sulphuric acid.

Impurities and Tests for Impurities.—*Antimony sulphide and insoluble substances.* If to 1 Gm. of the Dioxide and 2 Gm. of oxalic acid, 20 Cc. of water be added, followed by 3 Cc. of sulphuric acid, and the mixture digested for several hours on a water-bath, complete solution should be effected.

Quantitative Test.—If 0.2 Gm. of Precipitated Manganese Dioxide be dissolved in a mixture of 50 Cc. of tenth-normal oxalic acid V.S. and 3 Cc. of sulphuric acid contained in a flask and heated on a water-bath, the resulting solution, after dilution with 100 Cc. of warm water, should require the addition of not more than 13 (12.95) Cc. of tenth-normal potassium permanganate V.S. to produce a slight pink tint (corresponding to not less than 80 percent. of pure Manganese Dioxide).

Uses.—Precipitated manganese dioxide is occasionally used internally, in doses of three to twenty grains (0.19 to 1.3 Gm.). The commercial manganese dioxide is principally used to form the salts of manganese.

MANGANI HYPOPHOSPHIS. U.S. Manganese Hypophosphite

$Mn(PH_2O_2)_2 + H_2O = 201.54$

It should contain not less than 97 percent. of pure Manganous Hypophosphite [$(PH_2O.O)_2Mn + H_2O$], and be kept in well-stoppered vials.

Official Description.—A pink crystalline powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless, and nearly tasteless. The aqueous solution (1 in 20) is acid to litmus paper, and yields, with ammonium sulphide T.S., a salmon-colored precipitate of maganese sulphide, soluble in acetic acid.

Solubility.—*Water.* Soluble in 66 parts at 25° C. (77° F.), and in 6 parts of boiling water.

Alcohol. Almost insoluble.

Tests for Identity.—When strongly heated in a dry test-tube, the salt evolves spontaneously inflammable hydrogen phosphide gas, and on complete ignition leaves a residue of manganous pyrophosphate.

Manganese Hypophosphite is readily oxidized by nitric acid and other oxidizing agents.

If a small quantity of an aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid, and mercuric chloride T.S. added in excess, a white precipitate of mercurous chloride will be produced, which, upon further addition of the acidulated solution, is reduced to metallic mercury.

Impurities and Tests for Impurities.—*Carbonate.* If to 0.5 Gm. of the salt 5 Cc. of acetic acid be added, no effervescence should occur.

Phosphate. If 0.25 Gm. of the salt be boiled with 10 Cc. of potassium hydroxide T.S., a light salmon-colored precipitate will be produced which gradually acquires a brown color on exposure to the air, and if the filtered liquid, after being slightly acidulated with hydrochloric acid and then rendered alkaline with ammonia water, be divided into two portions, one should yield no precipitate upon the addition of magnesia mixture T.S.

Calcium. The remaining portion should not be affected by ammonium oxalate T.S.

Arsenic. If 5 Cc. of the aqueous solution of the salt (1 in 10) be poured into an evaporating dish containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water, and evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—This salt has been introduced in the U. S. P. (8th Rev.) solely for use in compound syrup of hypophosphites. It may be given in the dose of three grains (0.2 Gm.).

MANGANI SULPHAS. U.S. Manganese Sulphate

$MnSO_4 + 4H_2O = 221.47$

It should contain not less than 99.5 percent. of pure Manganous Sulphate [$SO_2.O_2Mn + 4H_2O$], and should be kept in well-stoppered bottles.

Preparation.—This rose-colored salt is best made by Prof. Diehl's process, by heating manganese dioxide and charcoal together to redness in a covered crucible, until all of the charcoal is consumed, treating the residue, after cooling, with sulphuric acid, and evaporating to dryness, then returning the mixture to the covered crucible and again heating to redness; when cool, the residue is rubbed to powder, if necessary, and treated twice with eight parts of boiling water, the mixed liquors are filtered, evaporated until a pellicle forms, and set aside to crystallize. (See U. S. Dispensatory, p. 849.)

In this process it is important that the dish containing the liquid which is set aside to crystallize be removed from the fire as soon as a pellicle begins to form, to prevent the formation of an insoluble sulphate.

Official Description.—Colorless, or pale rose-colored, translucent, tetragonal prisms (crystallized at a temperature between 20° and 30° C. (68° and 86° F.), and containing 4 molecules, or 32.29 percent. of water of crystallization); slightly efflorescent in the air.

Odor, Taste, and Reaction.—Odorless, and having a slightly bitter and astringent taste. The aqueous solution (1 in 20) is neutral, or very slightly acid to litmus paper, and yields with ammonium sulphide T.S., a salmon-colored precipitate soluble in dilute acids; with potassium ferrocyanide T.S., a reddish-white precipitate; and with potassium ferricyanide T.S., a brown precipitate.

Solubility.—*Water.* In about 0.7 parts at 25° C. (77° F.), and in 0.53 part of boiling water.

Alcohol. Insoluble.

Tests for Identity.—With barium chloride T.S., it yields a white precipitate insoluble in hydrochloric acid.

If a fragment of Manganese Sulphate be mixed with a little sodium hydroxide and the mixture fused, it will yield a dark green mass, dissolving in water with a green color.

If 1 Gm. of the salt be gently ignited, in a porcelain crucible, it should lose not more than 0.323 Gm. of its weight (distinction from *Manganese Sulphate containing a larger amount of water of crystallization*).

Impurities and Tests for Impurities.—*Limit of iron.* The aqueous solution of the salt (1 in 100), to which a few drops of hydrochloric acid and a few drops of chlorine water have been added, should, after having been boiled, not be colored red by potassium sulphocyanate T.S.

Heavy metals. Another solution (1 in 20) should not respond to the Time-Limit Test for *heavy metals*, omitting the addition of ammonia water (see U. S. P. Test No. 121, Chap. LXII).

Salts of the alkalies, and of magnesium. If the manganese be completely precipitated from an aqueous solution of 3 Gm. of the salt by the addition of ammonium carbonate T.S., the filtrate, on evaporation and gentle ignition, should leave no weighable residue.

Zinc. A solution of 1 Gm., each, of the salt, and of sodium acetate, in 10 Cc. of water, to which a few drops of acetic acid have been added, should not be affected by hydrogen sulphide T.S.

Uses.—Manganese sulphate is used as a cholagogue and tonic, in doses of four to twenty grains (0.25 to 1.3 Gm.). It is also used as a purgative when given in doses of from one to two drachms (4 to 8 Gm.) and may be given dissolved in a flavored syrup.

POTASSII PERMANGANAS. U.S. Potassium Permanganate

$KMnO_4 = 156.98$

It should contain not less than 99 percent. of pure Potassium Permanganate [$MnO_3.OK$], and should be kept in glass-stoppered bottles, protected from light.

Potassium Permanganate, when in concentrated solution or in the dry condition, should not be brought in contact with organic or other readily oxidizable substances.

This is the most important official compound of manganese. It is considered under the potassium compounds (page 529).

Iron. Fe; 55.5

Iron, the most useful and abundant of the metals, is widely diffused in nature; it is found not only in the mineral kingdom, but in animal and vegetable products as well.

Iron is a hard, malleable, ductile, and tenacious metal, of a grayish-white color and fibrous texture, a slightly styptic taste, having a sensible odor when rubbed. Its specific gravity is 7.8. It is combustible, and, when heated to whiteness, burns in atmospheric air, and with brilliant scintillations in oxygen. At a red heat its surface is converted into black oxide, and at common temperatures, by the combined agency of air and moisture, it becomes covered with a reddish matter, called *rust*, which is hydrated ferric oxide. It combines with all the non-metallic elements except hydrogen and nitrogen, and with most of the metals. It forms three compounds with oxygen,—ferrous and ferric oxide, which, by their union, form the native magnetic oxide, and a teroxide possessing acid properties, called ferric acid.

Tests for Iron Salts

1. Potassium *ferrocyanide* produces a nearly white precipitate with a ferrous salt, which rapidly turns blue on exposure to the air; with a ferric salt it strikes a deep blue color (Prussian blue) at once.

2. Potassium *ferricyanide* produces a deep blue color (Turnbull's blue) at once with a ferrous salt, and a greenish or olive color with a ferric salt.

3. Tannin does not change the color of a solution of ferrous salt, provided it has not been oxidized; with a ferric salt a dark greenish-black precipitate (ink) is produced.

4. Ammonium sulphide produces a black precipitate (sulphide) with either a ferrous or a ferric salt.

5. Ammonia water precipitates from ferrous salts, ferrous hydroxide, a white precipitate turning green, then black, and finally a brown color; the same reagent precipitates brown ferric hydroxide from ferric salts.

Official Salts and Preparations of Iron

Official Name	Preparation
Ferrum	Metallic iron in the form of fine, bright, and non-elastic wire
Reductum	Made by passing hydrogen over iron carbonate
Ferri Carbonas Saccharatus	Double decomposition between ferrous sulphate and sodium bicarbonate; the precipitate is preserved with sugar
Massa Ferri Carbonatis	Double decomposition between ferrous sulphate and monohydrated sodium carbonate; the precipitate is preserved with sugar and honey
Mistura Ferri Composita	6 Gm. ferrous sulphate; 18 Gm. myrrh; 18 Gm. sugar; 8 Gm. potassium carbonate; 60 Cc. spirit of lavender; rose water sufficient to make 1000 Cc.
Pilulæ Ferri Carbonatis	16 Gm. granulated ferrous sulphate; 8 Gm. potassium carbonate; 4 Gm. sugar; 1 Gm. powdered tragacanth; 1 Gm. powdered althea; glycerin, water, to make 100 pills
Ferri Chloridum	By evaporating 100 Gm. of solution of ferric chloride to 40 Gm. and setting it aside to crystallize
Liquor Ferri Chloridi	By oxidizing solution of ferrous chloride with nitric acid
Tinctura Ferri Chloridi	350 Cc. of solution of ferric chloride with sufficient alcohol to make 1000 Cc.
Liquor Ferri et Ammonii Acetatis	40 Cc. tincture ferric chloride; 60 Cc. diluted acetic acid; 500 Cc. solution ammonium acetate; 120 Cc. aromatic elixir; 120 Cc. glycerin; sufficient water to make 1000 Cc.

Official Salts and Preparations of Iron—*Continued*

Official Name	Preparation
Ferri Citras	By evaporating and scaling a solution of ferric citrate
et Ammonii Citras	By adding ammonia water to solution of ferric citrate, evaporating, and scaling
Vinum Ferri	40 Gm. iron and ammonium citrate; 60 Cc. tincture of sweet orange peel; 100 Cc. syrup; sufficient white wine to make 1000 Cc.
Ferri et Quininæ Citras	By dissolving quinine (alkaloid) in a solution of ferric citrate, evaporating, and scaling
et Quininæ Citras Solubilis	By adding ammonia water to a solution of iron and quinine citrate, evaporating, and scaling
Vinum Ferri Amarum	50 Gm. soluble iron and quinine citrate; 60 Cc. tincture of sweet orange peel; 300 Cc. syrup; sufficient white wine to make 1000 Cc.
Ferri et Strychninæ Citras	By adding to a solution of iron and ammonium citrate, citric acid and strychnine, and scaling
et Ammonii Sulphas	By dissolving ammonium sulphate in solution of ferric sulphate, evaporating, and crystallizing
et Ammonii Tartras	By dissolving ferric hydroxide in a solution of acid ammonium tartrate, and scaling
et Potassii Tartras	By adding to ferric hydroxide, acid potassium tartrate and a trace of ammonia water, and scaling
Hydroxidum	By adding ammonia water to solution of ferric sulphate, and collecting and washing the precipitate
Hydroxidum cum Magnesii Oxido	By mixing solution of ferric sulphate with magnesia and water
Hypophosphis	Double decomposition between calcium hypophosphite and ferrous sulphate
Syrupus Ferri Iodidi	By adding solution of ferrous iodide to sugar (5 percent. Fe I)
Pilulæ Ferri Iodidi	4 Gm. reduced iron; 5 Gm. iodine; 4 Gm. glycyrrhiza; 4 Gm. sugar; 1 Gm. ext. glycyrrhiza; 1 Gm. acacia; water q. s. to make 100 pills
Ferri Phosphas Solubilis	By mixing solutions of ferric citrate and sodium phosphate, evaporating, and scaling
Pyrophosphas Solubilis	By mixing solutions of ferric citrate and sodium pyrophosphate, evaporating, and scaling
Glyceritum Ferri, Quininæ et Strychninæ Phosphatum	By dissolving in an acid solution of soluble ferric phosphate, quinine and strychnine, and adding glycerin
Syrupus Ferri, Quininæ et Strychninæ Phosphatum	By mixing 250 Cc. of glycerite of the phosphates of iron, quinine, and strychnine with 750 Cc. of syrup
Elixir Ferri, Quininæ et Strychninæ Phosphatum	By preparing a solution of soluble ferric phosphate, quinine, and strychnine and adding it to aromatic elixir
Ferri Sulphas	By treating iron with diluted sulphuric acid, evaporating, and crystallizing
Sulphas Exsiccatus	By exsiccating ferrous sulphate at a temperature not above 100° C. (212° F.)
Sulphas Granulatus	By cooling rapidly a hot, concentrated, aqueous solution of ferrous sulphate, stirring as crystallization occurs, collecting and drying the granulated salt
Pilulæ Aloes et Ferri	7 Gm. purified aloes; 7 Gm. exsiccated ferrous sulphate; 7 Gm. aromatic powder; confection of rose q. s. to make 100 pills
Liquor Ferri Subsulphatis	By heating ferrous sulphate in a mixture of sulphuric and nitric acids
Ferri Tersulphatis	By heating ferrous sulphate in a mixture of nitric and sulphuric acids, sulphuric acid being largely in excess

Unofficial Salts and Preparations of Iron

Ferri Acetas, $Fe(C_2H_3O_2)_3$ Ferric Acetate	By dissolving ferric hydroxide in acetic acid, evaporating, then crystallizing
Liquor Ferri Acetatis Solution of Ferric Acetate. U. S. P. 1890	By dissolving ferric hydroxide in glacial acetic acid
Ferri Arsenas, $3Fe(FeO)AsO_4 + 16H_2O$ Ferric Arsenate	By dissolving 1 oz. sodium arsenate and ¾ oz. sodium acetate in 8 oz. water, then dissolving 2 oz. ferrous sulphate in 10 fl. oz. water, mixing both solutions, collecting in precipitate, washing, and drying
Ferri Benzoas, $Fe(C_7H_5O_2)_3 + 3H_2O$ Ferric Benzoate	By adding to a solution of normal ferric sulphate a concentrated solution of sodium benzoate, collecting the precipitate, washing, and drying
Ferri Bromidum, $FeBr_2$ Ferrous Bromide	By adding 2 parts bromine to 1 part iron filings and 10 parts water, digesting until the liquid assumes a greenish color, then filtering and evaporating to dryness

Unofficial Salts and Preparations of Iron—*Continued*

Liquor Ferri Citratis Solution of Ferric Citrate	By dissolving ferric hydroxide in a solution of citric acid
Ferri et Sodii Pyrophosphas Iron and Sodium Pyrophosphate	By adding to a solution of 50 parts sodium pyrophosphate in 100 parts water sufficient ferric chloride in aqueous solution so that a permanent precipitate is not produced, then adding 250 parts alcohol and collecting the precipitate
Ferri Ferrocyanidum, $Fe_4(FeCN_6)_3$ Iron Ferrocyanide	By dissolving 4½ oz. potassium ferrocyanide in 1 pint water, adding the solution to 8 fl. oz. solution of normal ferric sulphate diluted previously with 8 fl. oz. water, stirring continually, collecting the precipitate, washing, and drying
Ferri Nitras, $Fe(NO_3)_3$ Ferric Nitrate	By concentrating a solution of ferric nitrate, filtering, and allowing to crystallize
Liquor Ferri Nitratis Solution of Ferric Nitrate. U. S. P. 1890	By dissolving ferric hydroxide in diluted nitric acid
Ferri Lactas, $Fe(C_3H_5O_3)_2 + 3H_2O$ Ferrous Lactate	By acting on iron with lactic acid and crystallizing the solution
Ferri Oxalas Ferrous Oxalate	By mixing solutions of ferrous sulphate and oxalic acid and collecting the precipitate
Ferri Oxidum Magneticum, Fe_3O_4 Magnetic Iron Oxide	By dissolving 2 oz. ferrous sulphate in 2 pints water and adding 5½ fl. oz. solution of normal ferric sulphate, then mixing this with 4 pints solution of sodium hydroxide, stirring well, boiling, letting it stand for 2 hours, occasionally stirring, collecting the precipitate, washing, and drying carefully
Ferri Oxidum Rubrum Red Oxide of Iron	By igniting ferrous sulphate in contact with air
Ferri Phosphas Albus, $Fe_22PO_4 + 4H_2O$ White Ferric Phosphate	By mixing 4 fl. oz. solution of normal ferric sulphate with a solution of 1 oz. sodium acetate, then adding solution of sodium phosphate, collecting the precipitate, washing, and drying
Ferri Salicylas Ferric Salicylate	By mixing a solution containing 24 grains of ferrous sulphate and 20 grains of sodium acetate in half a fluidounce of water with a solution made by dissolving 30 grains of sodium salicylate in half a fluidounce of water. Dose, a teaspoonful
Ferri Subcarbonas Ferric Oxyhydrate	By mixing solutions of 8 oz. ferrous sulphate and 9 oz. sodium carbonate, collecting the precipitate, washing, and drying without heat
Ferri Sulphidum, FeS Ferrous Sulphide	By mixing 3 parts iron filings with 2 parts sublimed sulphur, then placing in small portions the above mixture into a crucible heated to redness, and keeping covered after each addition
Ferri Valeras Ferric Valerate	By double decomposition between ferric sulphate and sodium valerate

FERRUM. U. S. Iron

$Fe = 55.5$

Metallic iron, in the form of fine, bright, and non-elastic wire.

Iron, when employed in pharmaceutical operations, should be of the purest kind ; hence the pharmacopœias generally direct it, when wanted in small masses, to be in the form of *iron wire*, which is necessarily made from the purest, because the softest and most ductile iron, and is readily cut into pieces. Such wire is very flexible and without elasticity.

The wire clippings and the ends of card teeth obtained from the manufacturers of cotton cards are frequently used in Philadelphia for making iron preparations. They are very convenient ; and it may be incidentally mentioned that they are sometimes used as a substitute for sand, in sand baths. Iron scraps and waste from steel pen factories are also used to make preparations of iron.

FERRUM REDUCTUM. U. S. Reduced Iron

Reduced Iron should contain not less than 90 percent. of pure metallic iron.

Preparation.—Reduced iron may be made by a process originally proposed by Prof. Procter, and afterwards made official in 1870:

Take of Subcarbonate of Iron 30 oz. troy. Wash the Subcarbonate thoroughly with water until no traces of sulphate of sodium are indicated by the appropriate tests, and calcine it in a shallow vessel until free from moisture. Then spread it upon a tray, made by bending an oblong piece of sheet-iron in the form of an incomplete cylinder, and introduce this into a wrought iron reduction tube, about four inches in diameter. Place the reduction tube in a charcoal furnace, and, by means of a self-regulating generator of hydrogen, pass through it a stream of that gas, previously purified by bubbling successively through solution of subacetate of lead, diluted with three times its volume of water, and through milk of lime, severally contained in four-pint bottles about one-third filled. Connect with the further extremity of the reduction tube a lead tube bent so as to dip into water. Make all the junctions airtight by appropriate lutes; and, when the hydrogen has passed long enough to fill the whole of the apparatus to the exclusion of atmospheric air, light the fire, and bring that part of the reduction tube, occupied by the Subcarbonate, to a dull-red heat, which must be kept up so long as the bubbles of hydrogen, breaking from the water covering the orifice of the lead tube, are accompanied by visible aqueous vapor. When the reduction is completed, remove the fire, and allow the whole to cool to the ordinary temperature, keeping up, during the refrigeration, a moderate current of hydrogen through the apparatus. Withdraw the product from the reduction tube, and, should any portion of it be black instead of iron-gray, separate such portion for use in a subsequent operation. Lastly, having powdered the Reduced Iron, keep it in a well-stoppered bottle. When thirty troyounces of Subcarbonate of Iron are operated on, the process occupies from five to eight hours.

The subcarbonate directed in the above formula is, more correctly, a ferric oxyhydrate, and the hydrogen combines with the oxygen to form water, metallic iron, in fine powder, being left.

$$\underset{\substack{\text{Ferric}\\\text{Oxide}}}{Fe_2O_3} + \underset{\text{Hydrogen}}{6H} = \underset{\text{Iron}}{2Fe} + \underset{\text{Water}}{3H_2O}$$

Official Description.—A very fine, grayish black, lustreless powder; permanent in dry air.

Odor, Taste, and Reaction.—Without odor or taste. If 1 Gm. of Reduced Iron be shaken with 5 Cc. of water, the liquid should not change the color of red litmus paper.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Test for Identity.—When ignited in contact with air, it glows and is converted into black ferrosoferric oxide.

Impurities and Tests for Impurities.—*Limit of sulphide.* One Gm. of Reduced Iron, when treated with 20 Cc. of diluted sulphuric acid, in a test-flask (see page 1028), causes the evolution of nearly odorless hydrogen gas, which should not affect, within five minutes, paper moistened with lead acetate T. S., and on applying a gentle heat, the Iron should dissolve in the acid without leaving more than 1 percent. of residue.

Arsenic. To 0.5 Gm. of Reduced Iron, contained in a small covered beaker, add 20 Cc. of diluted sulphuric acid; after the reaction has somewhat subsided, warm the liquid on a water-bath until the reaction ceases, then collect any minute undissolved residue of impure iron arsenide upon a very small filter, rinse the beaker with water, add the rinsings to the filter, and wash the residue with water until free from acid reaction. Transfer the residue to the beaker by rinsing it back, and, after adding about 0.25 Gm. of potassium chlorate and 5 Cc. of hydrochloric acid, evaporate the solution slowly to dryness on a water-bath. Dissolve the residue in sufficient water to measure 50 Cc., then add 5 Cc. of this solution to 5 Cc. of a saturated solution of sulphurous acid and heat the liquid on a water-bath for fifteen minutes, until all traces of sulphurous acid have been removed. The resulting solution should not respond to the Modified Gutzeit's test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Assay for Metallic Iron.—Introduce about 2.6 Gm. of iodine into a 100 Cc. flask and weigh accurately, then add 6 Cc. of water, 2 Gm. of potassium iodide, and 0.555 Gm. of Reduced Iron. Securely stopper the flask, and, after thoroughly mixing the contents by rotating the flask, set it aside for one hour. Then dilute the contents with sufficient distilled water to make the liquid measure exactly 100 Cc., mix well and to 25 Cc. of this solution add a few drops of starch T.S., followed by tenth-normal sodium thiosulphate V.S., added slowly with constant stirring, until the blue or greenish color has been discharged. Divide the weight of iodine taken, by 0.02518, and subtract from the quotient twice the number of Cc. of tenth-normal sodium thiosulphate V.S. used; the remainder represents the percentage of metallic iron present in the Reduced Iron, and this should not be less than 90 percent.

NOTE.—The percentage purity of the iodine employed should be accurately determined by a previous experiment, and in place of the 2.6 Gm. above directed, its equivalent in pure (100 percent.) iodine may be taken (see U. S. P. Test No. 137, Chap. LXII).

Uses.—Powder of iron, or reduced iron, is one of the best of the chalybeate tonics. It is generally given in pill form, in doses of one to six grains (0.065 to 0.38 Gm.). An elegant form of administering it is combined with chocolate in the form of lozenges.

FERRI CARBONAS SACCHARATUS. U. S. Saccharated Ferrous Carbonate

Saccharated Ferrous Carbonate should contain not less than 15 percent. of Ferrous Carbonate [$FeCO_3 = 115.05$], and should be kept in small, well-stoppered bottles.

	Metric	Old form
* **Ferrous Sulphate**	50 Gm.	5 oz. av.
Sodium Bicarbonate	35 Gm.	3½ oz. av.
Sugar, in fine powder,		
Distilled Water, each, a sufficient quantity,		
To make	100 Gm.	10 oz. av.

Dissolve the Ferrous Sulphate in 200 Cc. [old form 20 fl. oz.] of hot Distilled Water, and the Sodium Bicarbonate in 500 Cc. [old form 3 pints] of Distilled Water at a temperature not exceeding 50° C. (122° F.), and filter the solutions separately. To the solution of Sodium Bicarbonate contained in a flask having a capacity of about 1000 Cc. [old form 6 pints] add, gradually, the solution of Ferrous Sulphate, and mix thoroughly by rotating the flask. Fill the flask with boiling Distilled Water, cork it loosely, and set the mixture aside. When the precipitate has subsided, draw off the clear supernatant liquid by means of a siphon, and then fill the flask again with hot Distilled Water, and shake it. Again draw off the clear liquid, and repeat the washing with hot Distilled Water in the same manner until the decanted liquid gives merely a slight cloudiness with barium chloride T.S. Finally, drain the precipitate thoroughly on a muslin strainer, transfer it to a porcelain dish containing 80 Gm. [old form 8 oz. av.] of Sugar, and mix it intimately. Evaporate the mixture to dryness, by means of a water-bath, reduce it to powder, and mix intimately with it, if necessary, enough well-dried Sugar to make the final product weigh 100 Gm. [old form 10 oz. av.].

In this preparation ferrous carbonate is formed, sodium sulphate remaining in solution. Sodium bicarbonate is preferred because the evolution of carbonic acid during the decomposition measurably prevents oxidation; it would have been an improvement to use syrup in the solutions to protect them still further.

The object of boiling the water that is used in washing, is to expel the air, so that the ferrous carbonate may escape its oxidizing action; the evaporation of the mixture should be conducted as rapidly as possible, for the same reason.

$$\underset{\text{Ferrous Sulphate}}{FeSO_4} + \underset{\text{Sodium Bicarbonate}}{2NaHCO_3} = \underset{\text{Sodium Sulphate}}{Na_2SO_4} + \underset{\text{Ferrous Carbonate}}{FeCO_3} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon Dioxide}}{CO_2}$$

Official Description.—A greenish-brown powder, gradually becoming oxidized by contact with air.

Odor and Taste.—Without odor, and having at first a sweetish, afterwards a slightly ferruginous taste.

Solubility.—*Water.* Only partially soluble, but completely soluble upon the addition of hydrochloric acid, with copious evolution of carbon dioxide, forming a clear, greenish-yellow liquid.

Impurity and Test.—*Sulphate.* If 1 Gm. of Saccharated Ferrous Carbonate be dissolved in 5 Cc. of hydrochloric acid, and the solution diluted with water until it measures 50 Cc., portions of this solution will yield a blue precipitate with both potassium ferrocyanide T.S. and potassium ferricyanide T.S., but should not give more than a slight cloudiness with barium chloride T.S.

Quantitative Test.—If 1.15 Gm. of Saccharated Ferrous Carbonate be dissolved in 10 Cc. of diluted sulphuric acid (1 to 5) and the solution diluted with water to about 100 Cc., it should require not less than 15 Cc. of tenth-normal potassium dichromate V.S. for complete oxidation, potassium ferricyanide T.S. being used as indicator (corresponding to not less than 15 percent. of ferrous carbonate).

Uses.—Saccharated ferrous carbonate is used as a tonic, in doses of four to thirty grains (0.25 to 2 Gm.).

MASSA FERRI CARBONATIS. U.S. Mass of Ferrous Carbonate

[VALLET'S MASS]

	Metric	Old form
* **Ferrous Sulphate,** in clear crystals	100 Gm.	8 oz. av.
Monohydrated Sodium Carbonate	46 Gm.	3 oz. av. 5 dr.
Clarified Honey	38 Gm.	3 oz. av.
Sugar, in coarse powder	25 Gm.	2 oz. av.
Syrup,		
Distilled Water, each, a sufficient quantity,		
To make	100 Gm.	8 oz. av.

Dissolve the Ferrous Sulphate and the Monohydrated Sodium Carbonate, each separately, in 200 Cc. [old form 1 pint] of boiling Distilled Water, and, having added 20 Cc. [old form 1½ fl. oz.] of Syrup to the solution of the Iron salt, filter both solutions, and allow them to become cold. Introduce the solution of Monohydrated Sodium Carbonate into a bottle having a capacity of about 500 Cc. [old form 3 pints], and gradually add the solution of the Iron salt, rotating the flask constantly or frequently, until carbonic acid gas no longer escapes. Add a sufficient quantity of Distilled Water to fill the bottle; then cork it and set it aside, so that the Ferrous Carbonate may subside. Pour off the supernatant liquid, and, having mixed Syrup and Distilled Water in the proportion of one volume of Syrup to nineteen volumes of Distilled Water, wash the precipitate with the mixture by decantation until the washings no longer have a saline taste. Drain the precipitate on a muslin strainer, and express as much of the Water as possible. Lastly, mix the precipitate at once with the Honey and Sugar, and, by means of a water-bath, evaporate the mixture in a tared dish, with constant stirring, until it is reduced to 100 Gm. [old form 8 oz. av.].

This preparation consists of ferrous carbonate preserved from oxidation by contact with syrup and honey. The reaction is as follows:

$$\underset{\substack{\text{Ferrous}\\ \text{Sulphate}}}{FeSO_4} + \underset{\substack{\text{Sodium}\\ \text{Carbonate}}}{Na_2CO_3} = \underset{\substack{\text{Ferrous}\\ \text{Carbonate}}}{FeCO_3} + \underset{\substack{\text{Sodium}\\ \text{Sulphate}}}{Na_2SO_4}$$

Uses.—Mass of ferrous carbonate is widely known as *Vallet's mass;* it is a valuable chalybeate tonic, and is administered in pill form, in doses of four to fifteen grains (0.25 to 1 Gm.).

MISTURA FERRI COMPOSITA. U.S. Compound Iron Mixture

This mixture depends for its usefulness upon the ferrous carbonate produced by double decomposition between ferrous sulphate and potassium carbonate. The myrrh, sugar, spirit of lavender, and rose water are used as adjuvants and diluents (see page 305).

PILULÆ FERRI CARBONATIS. U.S. Pills of Ferrous Carbonate

Each pill contains $2\frac{1}{2}$ gr. of ferrous sulphate, $1\frac{1}{4}$ gr. of potassium carbonate, about $\frac{3}{4}$ gr. of sugar, with sufficient tragacanth, althæa, glycerin, and water to form a mass. Ferrous carbonate is produced through the reaction between the ferrous sulphate and the potassium carbonate.

FERRI CHLORIDUM. U.S. Ferric Chloride

[IRON PERCHLORIDE]

Ferric Chloride should contain not less than 22 percent. of metallic iron in the form of chloride.

	Metric	Old form
***Solution of Ferric Chloride**	**100 Gm.**	10 oz. av.
To make	**40 Gm.**	4 oz. av.

Evaporate the Solution of Ferric Chloride on a water-bath until it weighs 40 Gm. [old form 4 oz. av.]; then set it aside in a glass-covered vessel, until it forms a crystalline mass. Lastly, break the salt into pieces, and keep it in glass-stoppered bottles, protected from light.

Official Description.—Orange-yellow, crystalline pieces; very deliquescent in moist air.

Odor, Taste, and Reaction.—Odorless, or having a faint odor of hydrochloric acid; strongly styptic taste; acid reaction.

Solubility.—*Water.* Freely and completely soluble.

Alcohol. Freely and completely soluble.

Other solvents. Freely and completely soluble in a mixture of 1 part of ether and 3 parts of alcohol.

Tests for Identity.—At 35.5° C. (96° F.) the salt fuses to a reddish-brown liquid. When strongly heated, it decomposes, losing water and hydrochloric acid, while the anhydrous salt sublimes, leaving a residue of ferric oxide.

The dilute, aqueous solution of the salt shows an acid reaction with blue litmus paper, yields a brownish-red precipitate with ammonia water, a blue precipitate with potassium ferrocyanide T.S., and a white precipitate, insoluble in nitric acid, with silver nitrate T.S.

Impurities and Tests for Impurities.—*Heavy metals.* If 1 Gm. of the salt, dissolved in 25 Cc. of boiling water, be treated with an excess of ammonia water, the filtrate should be colorless, and, after acidulation with hydrochloric acid, 20 Cc. of the solution should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Limit of nitric acid. On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and an aqueous solution of the salt (1 in 10), the crystal should not become brown in color, nor should a brownish-black color be developed around it within five minutes.

Ferrous salt. If to a solution of the salt (1 in 50) a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced, which should not turn at once to a green or greenish-blue.

Quantitative Test.—If 1 Gm. of dry Ferric Chloride be dissolved in sufficient water to measure 100 Cc., then 55.5 Cc. of this solution, when measured into a glass-stoppered flask of the capacity of about 250 Cc., followed by 3 Cc. of hydrochloric acid, and 2 Gm. of potassium iodide, should, after securely stoppering the flask and heating for half an hour at 40° C. (104° F.), and cooling, require not less than 22 Cc. of tenth-normal sodium thiosulphate V.S. for complete decolorization (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—Ferric chloride is used externally as a styptic, and internally as a chalybeate tonic, in doses of one to five grains (0.065 to 0.3 Gm.).

LIQUOR FERRI CHLORIDI. U.S. Solution of Ferric Chloride

An aqueous solution of Ferric Chloride, which should contain not less than 29 percent. of the anhydrous salt [$FeCl_3 = 161.04$], corresponding to 10 percent. of metallic iron.

	Metric	Old form
* **Iron,** in the form of fine, bright wire, and cut into small pieces	**125 Gm.**	2 oz. av. 325 gr.
Hydrochloric Acid	**680 Gm.**	12 fl. oz. 3 fl. dr.
Nitric Acid,		
Distilled Water, each, a sufficient quantity,		
To make	**1000 Gm.**	1 pint

Introduce the Iron Wire into a flask having a capacity of about 2000 Cc. [old form 3 pints], pour upon it a mixture of 420 Gm. [old form 7 fl. oz. 5 fl. dr.] of Hydrochloric Acid and 250 Cc. [old form 5½ fl. oz.] of Distilled Water, and heat upon a water-bath for not less than one hour and fifteen minutes, or until effervescence ceases; then boil the liquid, filter it through paper, and, having rinsed the flask and Iron Wire with a little hot Distilled Water, pass the rinsings through the filter. To the filtered liquid add 220 Gm. [old form 4 fl. oz.] of Hydrochloric Acid, add the mixture slowly and gradually, in a stream, to 65 Gm. [old form 468 minims] of Nitric Acid contained in a capacious porcelain vessel, and warm gently. After effervescence ceases, apply heat, by means of a sand-bath, stirring occasionally, until the liquid is free from Nitric Acid. If the solution has acquired a black color, continue the addition of Nitric Acid, drop by drop, until red fumes are no longer evolved and the solution assumes a clear reddish-brown color. Finally, add the remaining 40 Gm. [old form 6 fl. dr.] of Hydrochloric Acid and enough Distilled Water to make the Solution weigh 1000 Gm., or measure [old form 1 pint].

In the first step of the process, ferrous chloride is produced; thus:

$$\underset{\text{Iron}}{Fe_2} + \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{4HCl} = \underset{\substack{\text{Ferrous}\\\text{Chloride}}}{(FeCl_2)_2} + \underset{\text{Hydrogen}}{4H}$$

Ferrous chloride is converted into ferric chloride by the addition of nitric and hydrochloric acids; thus:

$$\underset{\substack{\text{Ferrous}\\\text{Chloride}}}{6FeCl_2} + \underset{\substack{\text{Hydrochloric}\\\text{Acid}}}{6HCl} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{2HNO_3} = \underset{\substack{\text{Ferric}\\\text{Chloride}}}{6FeCl_3} + \underset{\substack{\text{Nitrogen}\\\text{Dioxide}}}{N_2O_2} + \underset{\text{Water}}{4H_2O}$$

If this solution, when finished, has a blackish color, it is due to incomplete oxidation, and the remedy is to heat it to boiling in a capacious dish, adding a few drops of nitric acid until the color changes to a clear ruby-red and effervescence ceases. If a brown precipitate is deposited upon dilution or standing, deficiency of hydrochloric acid is indicated, and the solution must be heated, and a few drops of the acid added until the precipitate is dissolved.

The strength of this solution was lowered in the U. S. P. (8th Rev.) so as to make the percentage of metallic iron to which it corresponds 10 percent., instead of 13 percent. This does not affect the strength of tincture of ferric chloride, as the proportion of the solution in the tincture was increased.

Official Description.—A reddish-brown liquid.

Odor, Taste, and Reaction.—Faint odor of hydrochloric acid; an acid, strongly styptic taste, and an acid reaction.

Specific Gravity.—From 1.280 to 1.290 at 25° C. (77° F.).

Tests for Identity.—The diluted Solution yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in nitric acid, with silver nitrate T.S.

Impurities and Tests for Impurities.—*Zinc or copper.* If the iron be completely precipitated from a portion of the Solution by an excess of ammonia water, the filtrate should be colorless, and should not yield a precipitate with hydrogen sulphide T.S.

Salts of the fixed alkalies. Nor should it leave a fixed residue on evaporation and gentle ignition.

Nitric acid. On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the solution (1 in 10), the crystal should not become colored brown, nor should a brownish-black color develop around it.

Ferrous salts. If to a diluted portion of the Solution (about 1 in 20) a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced, which should not at once turn green or greenish-blue.

Oxychloride. If to three drops of Solution of Ferric Chloride, 10 Cc. of tenth-normal sodium thiosulphate V.S. be added, and then slowly heated to boiling, no brownish-red precipitate of ferric hydroxide should separate.

Quantitative Test.—If 10 Gm. of the Solution be diluted to measure 100 Cc., and 11.1 Cc. of this be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 10 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch T.S., it should require not less than 20 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue or greenish color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 0.5 percent. of metallic iron).

Uses.—This solution is occasionally used as a hæmostatic; its principal use, however, is to form, by dilution with alcohol, the well-known tincture of ferric chloride. The dose is from one to two minims (0.06 to 0.12 Cc.).

TINCTURA FERRI CHLORIDI. U.S. Tincture of Ferric Chloride

This tincture is made by diluting 350 Cc. of solution of ferric chloride with 650 Cc. of alcohol, the mixture to stand in a closely covered vessel at least three months; it is then to be transferred to glass-stoppered bottles (see page 351). The object of allowing the mixture to stand three months before it is to be used is to permit the formation of ethyl chloride and other similar ethereal compounds, the result of the action of the free acid on the alcohol. These ethers are supposed to give to the tincture diuretic properties. If a brownish-red precipitate of ferric oxychloride takes place upon diluting the solution of ferric chloride, it shows that the solution has not been properly made, and is deficient in free hydrochloric acid (see above).

Official Description.—A bright, brownish liquid.

Odor, Taste, and Reaction.—Slightly ethereal odor; very astringent, styptic taste; acid reaction.

Specific Gravity.—About 1.005 at 25° C. (77° F.).

Tests for Identity.—The Tincture yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in nitric acid, with silver nitrate T.S.

After the Tincture has been exposed for some time to daylight, it yields a greenish or greenish-blue color with potassium ferricyanide T.S., showing the presence of some ferrous salt, due to reduction.

Impurities and Test for Impurities.—*Nitric acid.* On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Tincture (1 in 10), the crystal should not become colored brown, nor should there be a brownish-black zone developed around it.

Quantitative Test.—Evaporate 2.22 Gm. of the Tincture to dryness on a water bath, add 2 Cc. of hydrochloric acid and 5 Cc. of solution of hydrogen dioxide, and again evaporate the mixture to dryness; dissolve the residue in 10 Cc. of water, pour the solution into a glass-stoppered bottle having a capacity of about 100 Cc., rinsing the vessel with 10 Cc. more of water, add 1 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and keep the mixture for half an hour at a temperature of 40° C. (104° F.), then cool and add a little starch T.S.; it should require not less than 18.3 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue color of the liquid (each Cc. of the volumetric solution used indicating 0.25 percent. of metallic iron).

Uses.—Tincture of ferric chloride is undoubtedly the most important liquid iron preparation that is used; it is an efficient chalybeate, tonic, and styptic. The dose is from eight to thirty minims (0.5 to 2 Cc.), diluted with water; it should be sucked through a glass tube, to prevent injury to the teeth.

FERRI CITRAS. U.S. Ferric Citrate

It should contain Ferric Citrate corresponding in amount to not less than 16 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light.

Official Description.—Thin, transparent, garnet-red scales.

Odor, Taste, and Reaction.—Without odor, and having a slightly ferruginous taste.

Solubility.—*Water.* Slowly but completely at 25° C. (77° F.), and readily in hot water, but diminishing in solubility with age.

Alcohol. Insoluble.

Tests for Identity.—An aqueous solution of the salt is not precipitated, but rendered darker in color, by ammonia water.

With potassium ferrocyanide T.S. the aqueous solution yields a bluish-green color or precipitate, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid (difference from *iron and ammonium citrate*)

If Ferric Citrate be heated with potassium hydroxide T.S., it yields a brownish-red precipitate, without evolving ammonia.

If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually afford a white crystalline precipitate.

Impurities and Tests for Impurities.—*Tartrate.* Another portion of the acidulated and cooled liquid (see above), when allowed to stand for twenty-four hours, should not deposit a white crystalline precipitate.

Citrates or tartrates of the alkali metals. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper.

Quantitative Test.—If 0.555 Gm. of Ferric Citrate be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., with the aid of a gentle heat, and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 16 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—This salt is *very slowly* soluble in water, and hence is not largely used in making solutions. It is very useful in making pills, its slow solubility being an advantage in preventing the flattening which usually takes place when a more soluble form is used. The dose is four to twenty grains (0.25 to 1.3 Gm.).

FERRI ET AMMONII CITRAS. U.S. Iron and Ammonium Citrate

[AMMONIO-FERRIC CITRATE SOLUBLE FERRIC CITRATE]

It should contain Iron and Ammonium Citrate corresponding in amount to not less than 16 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light.

Preparation.—Iron and Ammonium Citrate may be made by the official process of 1890, in which a mixture of 100 Cc. of solution of ferric citrate and 40 Cc. of ammonia water were evaporated at a temperature not exceeding 60° C. (140° F.) to the consistence of syrup, and spread on glass plates to dry.

Prof. J. U. Lloyd modifies this process with advantage by using, instead of ammonia water, a definite quantity of ammonium citrate in solution (see U. S. Dispensatory, 18th edition, page 610).

Official Description.—Thin, transparent, garnet-red scales; deliquescent in moist air.

Odor, Taste, and Reaction.—Without odor, and having a saline, mildly ferruginous taste; neutral reaction.

Solubility.—*Water.* Readily and completely.

Alcohol. Insoluble.

Tests for Identity.—The aqueous solution is not precipitated, but rendered darker in color, by ammonia water.

With potassium ferrocyanide T.S. the solution does not afford a blue color or precipitate, unless it be acidulated with hydrochloric acid (difference from *ferric citrate*).

If Iron and Ammonium Citrate be heated with potassium hydroxide T.S., it yields a brownish-red precipitate, and ammonia is evolved.

If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually deposit a white, crystalline precipitate.

Impurities and Tests for Impurities.—*Tartrate.* Another portion of the acidulated and cooled liquid (see above), when allowed to stand for twenty-four hours, should not yield a white, crystalline precipitate.

Citrate or tartrates of the alkali metals. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction with red litmus paper.

Quantitative Test.—If 0.555 Gm. of the salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 16 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—Iron and ammonium citrate is a useful modification of ferric citrate, the object of adding the ammonia water being to make the salt more quickly soluble. The dose is four to twenty grains (0.25 to 1.3 Gm.).

LIQUOR FERRI CITRATIS. U.S. 1890 Solution of Ferric Citrate

An aqueous solution of Ferric Citrate, corresponding to about 7.5 percent. of metallic iron.

	Metric	Old form
Solution of Ferric Sulphate	1050 Gm.	10½ oz. av.
Citric Acid	300 Gm.	3 oz. av.
Ammonia Water	880 Cc.	8¾ fl. oz.
Water, a sufficient quantity,		
To make	1000 Gm.	10 oz. av.

Mix the Ammonia Water with 3000 Cc. [old form 30 fl. oz.] of cold Water, and the Solution of Ferric Sulphate with 10000 Cc. [old form 6 pints] of cold Water. Add the latter solution slowly to the diluted Ammonia Water, with constant stirring. Pour the mixture on a wet muslin strainer, and allow the liquid to run off and the precipitate to drain. Then remove the moist mass from the strainer, mix it well with 6000 Cc. [old form $3\frac{1}{2}$ pints] of cold Water, again pour it on the strainer, and let it drain. Repeat this washing with several successive portions of cold Water in the same manner, until the washings cease to produce more than a slight cloudiness with barium chloride test solution. Then allow the precipitate to drain completely, transfer it to a porcelain capsule, add the Citric Acid, and heat the mixture on a water-bath, to 60° C. (140° F.), stirring constantly, until the precipitate is dissolved. Lastly, filter the liquid, and evaporate it, at the above-mentioned temperature, until it weighs 1000 Gm. [old form 10 oz. av.].

In this preparation ferric hydroxide is precipitated, ammonium sulphate being washed out, and the former is then dissolved in citric acid and the solution brought to a definite strength.

$$\underset{\text{Ferric Sulphate}}{Fe_2 3SO_4} + \underset{\substack{\text{Ammonium}\\ \text{Hydroxide}}}{6NH_4HO} = \underset{\text{Ferric Hydroxide}}{2Fe(OH)_3} + \underset{\substack{\text{Ammonium}\\ \text{Sulphate}}}{3(NH_4)_2SO_4}$$

This solution was dropped at the last revision of the U. S. Pharmacopœia (8th Revision), but it is retained here as it furnishes a process for making ferric citrate. It is a dark brown liquid (sp. gr. about 1.250).

Uses.—This solution deserves to be known better and used oftener than it has been in the past. It keeps well, and much labor will be saved by the pharmacist if he will use it in all cases where an aqueous solution of ferric citrate is needed. It is of just *half* the strength of the scaled salt, and therefore the use of a double quantity of this solution will be found very convenient.

VINUM FERRI. U.S. Wine of Iron

This preparation is made by dissolving 40 Gm. of iron and ammonium citrate in a mixture of 100 Cc. of syrup, 60 Cc. of tincture of sweet orange peel, and sufficient white wine to make 1000 Cc. It is used as an agreeable chalybeate tonic, in doses of one to two fluidrachms (4 to 8 Cc.) (see page 369).

FERRI ET QUININÆ CITRAS. U.S. Iron and Quinine Citrate

It should contain not less than 11.5 percent. of dried quinine, and ferric citrate corresponding in amount to not less than 13.5 percent. of metallic iron. It should be kept in well-stoppered bottles, protected from light.

The process of the U. S. P. 1890 is appended, no process being given in the U. S. P. (8th Rev.).

	Metric	Old form
Ferric Citrate	85 Gm.	13 oz. av. 262 gr.
Quinine, dried at 100° C. (212° F.) to a constant weight	12 Gm.	1 oz. av. 400 gr.
Citric Acid	3 Gm.	210 grains
Distilled Water, a sufficient quantity,		
To make	100 Gm.	16 oz. av.

Dissolve the Ferric Citrate in 160 Cc. [old form 26 fl. oz.] of Distilled Water by heating on a water-bath at a temperature not exceeding 60° C. (140° F.). To this solution add the Quinine and Citric Acid, previously triturated with 20 Cc. [old form $3\frac{1}{4}$ fl. oz.] of Distilled Water, and stir constantly until the Quinine and Citric Acid are dissolved. Lastly, evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light.

This well known salt is simply a ferric citrate containing quinine in the proper quantity to make a good medicinal preparation. No symbolic formula is officially given to it, for the sufficient reason that it is not regarded as a definite chemical compound. It is often found deficient in quinine, and sometimes with a cheaper alkaloid substituted for it.

It frequently occurs in the market in light green scales. This color is due to the use of ammonia or ammonium citrate with the view of making the salt more soluble.

Iron and quinine citrate is not intended to be very soluble, the bitter taste being much less perceptible than when ammonia is combined with the citric acid. (See Ferri et Quininæ Citras Solubilis. page 636).

Official Description.—Thin, transparent scales, of a reddish-brown color; slowly deliquescent.

Odor, Taste, and Reaction.—Without odor, and having a bitter, mildly ferruginous taste. The aqueous solution of the salt shows an acid reaction with blue litmus paper.

Solubility.—*Water.* Slowly, but completely soluble in cold water, more readily soluble in hot water, partially soluble in alcohol. Its solubility is diminished by age.

Tests for Identity.—On the addition of a slight excess of ammonia water the color of the solution is deepened, and a white, curdy precipitate is produced.

The filtrate from this precipitate does not afford a blue color with potassium ferrocyanide T.S., unless it be acidulated with hydrochloric acid.

Another portion of the filtrate, heated with an excess of potassium hydroxide T.S., deposits a brownish-red precipitate.

If an aqueous solution of the salt (1 in 10) be deprived of its iron and quinine by boiling with an excess of potassium hydroxide T.S., and the filtrate slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, gradually deposits a white, crystalline precipitate.

Impurities and Tests for Impurities.—*Tartrate.* Another portion of the acidulated and cooled liquid, when allowed to stand for some time, should not deposit a white, crystalline precipitate.

Citrates or tartrates of the alkali metals. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper.

Assay.—*For the quinine.* Introduce 1.11 Gm. of Iron and Quinine Citrate into a dish, and, with the aid of a gentle heat, dissolve it in 20 Cc. of water. Transfer the solution, together with the rinsings of the dish, to a separator, allow the liquid to become cold, then add 5 Cc. of ammonia water and 10 Cc. of chloroform, and shake the separator for one minute. Allow the liquids to separate, draw off the chloroformic layer, and shake the residuary liquid a second and a third time with portions of 10 Cc. each of chloroform. Allow the combined chloroformic solutions to evaporate spontaneously in a tared dish, and dry the residue at 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.1276 Gm. (corresponding to at least 11.5 percent. of dried quinine), and should conform to the reactions and tests under *Quinina.*

For the iron. Heat the aqueous liquid, from which the quinine has been removed in the manner just described, on a water-bath, until the odor of chloroform and of ammonia have disappeared, allow it to cool, and dilute it with water to the volume of 50 Cc. Transfer 25 Cc. of the liquid to a glass-stoppered flask having the capacity of about 100 Cc., add 3 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and, after securely closing the flask, allow the mixture to stand for half an hour at 40° C. (104° F.). After it has been allowed to cool, it should require not less than 13.5 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—This is a valuable tonic combination, and is particularly useful in making pills, because of its slow solubility (see Ferri Citras). To supply the demand for a more popular salt, the soluble iron and quinine citrate was made official. The dose of the salt is from four to ten grains (0.25 to 0.6 Gm.).

FERRI ET QUININÆ CITRAS SOLUBILIS. U.S. Soluble Iron and Quinine Citrate

It should contain not less than 11.5 percent. of dried quinine, and ferric citrate corresponding in amount to not less than 13.5 percent. of metallic iron. It should be kept in well-stoppered bottles, protected from light.

The process of the U.S.P. 1890 is appended, no process being given for this scaled salt in the U.S.P. (8th Rev.).

	Metric	Old form
Ferric Citrate	**85 Gm.**	13 oz. av. 262 gr.
Quinine, dried at 100° C. (212° F.) to a constant weight	**12 Gm.**	1 oz. av. 400 gr.
Citric Acid	**3 Gm.**	210 grains
Ammonia Water,		
Distilled Water, each, a sufficient quantity,		
To make	**100 Gm.**	16 oz. av.

Dissolve the Ferric Citrate in 160 Cc. [old form 26 fl. oz.] of Distilled Water, by heating on a water bath at a temperature not exceeding 60° C. (140° F.). To this solution add the Quinine and Citric Acid previously triturated with 20 Cc. [old form $3\frac{1}{2}$ fl. oz.] of Distilled Water, and stir constantly until the Quinine and Citric Acid are dissolved. Then add gradually, and with constant stirring, 50 Cc. [old form 8 fl. oz.], or a sufficient quantity, of Ammonia Water, so that, after the addition of each portion of the latter, the precipitated Quinine will be redissolved and the liquid acquire a greenish-yellow tint. Lastly, evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stoppered bottles, protected from light.

Official Description.—Thin, transparent scales, of a greenish, golden-yellow color; deliquescent.

Odor, Taste, and Reaction.—Without odor, and having a bitter, mildly ferruginous taste; slightly acid reaction.

Solubility.—*Water.* Rapidly and completely soluble in cold water.

Alcohol. Partially soluble.

Tests for Identity.—On the addition of a slight excess of ammonia water the color of the liquid is deepened, and a white, curdy precipitate is produced.

With potassium ferrocyanide T.S. a portion of the filtrate from this precipitate does not yield a blue color or precipitate, unless it be acidulated with hydrochloric acid.

When heated with potassium hydroxide T.S., the salt affords a brownish-red precipitate, and ammonia is evolved.

If an aqueous solution of the salt (1 in 10) be deprived of its iron and quinine by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually deposit a white, crystalline precipitate.

Impurities and Tests for Impurities.—*Tartrate.* Another portion of the acidulated and cooled liquid, when allowed to stand for twenty-four hours, should not give a white, crystalline precipitate.

Citrates or tartrates of the alkali metals. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper.

Assay.—Soluble Iron and Quinine Citrate, when assayed for Quinine and Iron by the method described under *Ferri et Quininæ Citras*, should respond to the same requirements as the latter.

Uses.—This is the soluble form of iron and quinine citrate, and is preferred by pharmacists when solutions are needed quickly. It differs from the salt considered on page 634 only in containing ammonia. The dose is the same.

VINUM FERRI AMARUM. U.S. Bitter Wine of Iron

This wine is made by dissolving 50 Gm. of soluble iron and quinine citrate in 500 Cc. of white wine, and adding 60 Cc. of tincture of sweet orange-peel, 300 Cc. of syrup, and sufficient white wine to make 1000 Cc. (see page 369). It is used as a mild ferruginous tonic, in doses of two to four teaspoonfuls (8 to 16 Cc.).

FERRI ET STRYCHNINÆ CITRAS. U.S. Iron and Strychnine Citrate

It should contain not less than 0.9 nor more than 1 percent. of strychnine, and ferric citrate corresponding in amount to not less than 16 percent. of metallic iron. It should be kept in well-stoppered bottles, protected from light.

No process was given in the U. S. P. (8th Rev.) for this salt ; the process of the U. S. P. 1890 is appended.

	Metric	Old form
Iron and Ammonium Citrate	98 Gm.	490 grains
Strychnine	1 Gm.	5 grains
Citric Acid	1 Gm.	5 grains
Distilled Water	120 Cc.	11 fl. dr.
To make	100 Gm.	500 grains

Dissolve the Iron and Ammonium Citrate in 100 Cc. [old form 9 fl. dr.] of Distilled Water, and the Strychnine, together with the Citric Acid, in 20 Cc. [old form 2 fl. dr.] of Distilled Water. Mix the two solutions, evaporate the mixture by means of a water-bath at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light. This salt contains 1 percent. of strychnine.

Official Description.—Thin, transparent scales, varying in color from garnet-red to yellowish-brown ; deliquescent in moist air.

Odor, Taste, and Reaction.—Without odor ; bitter, slightly ferruginous taste ; slightly acid reaction.

Solubility.—*Water.* Readily and completely soluble.

Alcohol. Partially soluble.

Tests for Identity.—The aqueous solution of Iron and Strychnine Citrate is not immediately precipitated, but rendered darker in color, by ammonia water.

With potassium ferrocyanide T.S. the aqueous solution does not yield a blue color or precipitate, unless it be acidulated with hydrochloric acid.

On heating with potassium hydroxide T.S., the salt affords a brownish-red precipitate, evolving ammonia.

If an aqueous solution of the salt (1 in 10) be deprived of its iron and strychnine by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually deposit a white, crystalline precipitate.

Impurities and Tests for Impurities.—*Tartrate.* Another portion of the acidulated and cooled liquid, when allowed to stand for twenty-four hours, should not deposit a white, crystalline precipitate.

Citrates or tartrates of the alkali metals. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction with red litmus paper.

Assay.—*For the strychnine.* Dissolve 4.11 Gm. of Iron and Strychnine Citrate, in a separator, in 15 Cc. of water, add 5 Cc. of ammonia water and 10 Cc. of Chloroform, and shake the separator for one minute. Allow the liquids to separate, draw off the chloroformic layer, and shake the residuary liquid a second and a third time with portions of 10 Cc. each of chloroform. Allow the combined chloroformic liquids to evaporate spontaneously in a tared dish, and dry the residue at 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.04 (0.0399) Gm., nor more than 0.0444 Gm. (corresponding to not less than 0.9 nor more than 1 percent. of strychnine), and should respond to the reactions and tests given under *Strychnina.*

For the iron. Heat the aqueous liquid, from which the strychnine has been removed in the manner just described, on a water-bath, until the odors of chloroform and of ammonia have disappeared, allow it to cool, and dilute it with water to the volume of 100 Cc. Transfer 25 Cc. of the liquid to a glass-stoppered flask having the capacity of about 100 Cc., add 4 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and, after securely closing the flask, allow the mixture to stand for half an hour at 40° C. (104° F.). After it has been allowed to cool, it should require not less than 32 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of tenth-normal sodium thiosulphate V.S. indicating one-half percent. of metallic iron).

Uses.—This salt is used as a bitter ferruginous tonic, in doses of two to five grains (0.12 to 0.3 Gm.).

GLYCERITUM FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U.S. Glycerite of the Phosphates of Iron, Quinine and Strychnine

This glycerite is made by dissolving 80 Gm. of soluble ferric phosphate, 104 Gm. of quinine, and 0.8 Gm. of strychnine in 200 Cc. of phosphoric acid, 500 Cc. of glycerin, and sufficient water to make 1000 Cc. (see page 308).

It was introduced into the present Pharmacopœia and is used as a stock solution, from which the Syrup of Iron, Quinine, and Strychnine Phosphates may be readily made extemporaneously by adding to it three parts of syrup. The glycerite is more permanent, not darkening or precipitating as readily as the syrup.

ELIXIR FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U.S. Elixir of the Phosphates of Iron, Quinine and Strychnine

This elixir is prepared by dissolving 8.75 Gm. of quinine and 0.275 Gm. of strychnine in 60 Cc. of alcohol, and adding 2 Cc. of phosphoric acid, 350 Cc. of aromatic elixir, a solution of ammonium acetate, then enough aromatic elixir to measure 880 Cc., and finally 120 Cc. of a solution containing 17.5 Gm. of soluble ferric phosphate (see page 318).

SYRUPUS FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U.S. Syrup of the Phosphates of Iron, Quinine and Strychnine

[EASTON'S SYRUP]

This is made by adding 250 Cc. of the glycerite (see above) to sufficient syrup to make 1000 Cc. On keeping, it gradually deposits a precipitate which contains a portion of the alkaloids, it should therefore only be made as wanted. The dose is one or two teaspoonfuls (4 to 8 Cc.).

FERRI ET AMMONII SULPHAS. U.S Ferric Ammonium Sulphate

$FeNH_4(SO_4)_2 + 12H_2O = 478.69$

[AMMONIO-FERRIC ALUM AMMONIO-FERRIC SULPHATE IRON AMMONIUM ALUM]

It should contain, in the uneffloresced condition, 99.5 percent. of pure Ferric Ammonium Sulphate, and not less than 11.5 percent. of metallic iron. It should be kept in well-stoppered bottles, protected from light.

Preparation.—Ammonio-ferric alum may be made by the process formerly official:

Take of Solution of Tersulphate of Iron 2 pints, Sulphate of Ammonium 4½ oz. troy. Heat the Solution of Tersulphate of Iron to the boiling point, add the Sulphate of Ammonium, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air.

$$\underset{\substack{\text{Ferric}\\\text{Sulphate}}}{Fe_23SO_4} + \underset{\substack{\text{Ammonium}\\\text{Sulphate}}}{(NH_4)_2SO_4} = \underset{\substack{\text{Ammonio-ferric}\\\text{Sulphate}}}{2FeNH_4(SO_4)_2}$$

It is well to choose the cold winter weather to prepare this salt, if it is possible to make a choice, as handsome crystals may then be obtained with little labor. This compound is not very stable, melting oftentimes in hot summer weather in its water of crystallization.

Official Description.—Pale violet, octahedral crystals; efflorescent on exposure to the air.

Odor, Taste, and Reaction.—Without odor, and having an acid, styptic taste; an acid reaction.

Solubility.—*Water.* In 2.7 parts at 25° C. (77° F.), and in 0.8 part of boiling water. *Alcohol.* Insoluble.

Tests for Identity.—When strongly heated, the crystals fuse, lose their water of crystallization, expand, and finally leave a pale brown residue.

The aqueous solution of the salt yields with potassium ferrocyanide T.S. a blue precipitate, and with barium chloride T.S. a white precipitate insoluble in hydrochloric acid.

With potassium hydroxide T.S. Ferric Ammonium Sulphate yields a brownish-red precipitate, and if the mixture be heated, ammonia gas is evolved.

Impurities and Tests for Impurities.—*Aluminum.* If the iron be wholly precipitated from a solution of the salt by treating it with an excess of potassium hydroxide T.S., the resulting filtrate, when neutralized with hydrochloric acid, and then mixed with ammonia water, should not yield a white, gelatinous precipitate.

Chlorides. The addition of 3 Cc. of nitric acid to 30 Cc. of a solution of the salt (1 in 20), followed by a few drops of silver nitrate T.S., should not produce any turbidity.

Quantitative Test.—If 0.555 Gm. of the uneffloresced crystals of the salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 11.5 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—Iron alum is used as a styptic in saturated solution. It partakes more of the characteristics of an alum than of an iron salt. The dose is eight grains (0.5 Gm.).

FERRI ET AMMONII TARTRAS. U.S. Iron and Ammonium Tartrate

[AMMONIO-FERRIC TARTRATE]

It should contain Iron and Ammonium Tartrate corresponding in amount to not less than 13 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light.

A process for making this salt will be found in the third edition of this work on page 673. No process is given in the U. S. P. (8th Rev.). Theoretically, this salt is supposed to have the following composition: $2(FeO)NH_4.C_4H_4O_6 + 3H_2O$. The formula indicates a double tartrate, in which the two basylous hydrogen atoms have been substituted by the iron and ammonium radical. The scaled salts are, however, not definite compounds.

The object in this process is to form a compound in which ferric hydroxide is made soluble by acid ammonium tartrate, and the double salt, iron and ammonium tartrate, is produced.

Official Description.—Thin, transparent scales, varying in color from garnet-red to reddish-brown; slightly deliquescent in the air.

Odor, Taste, and Reaction.—Without odor; sweetish, slightly ferruginous taste; acid reaction.

Solubility.—*Water.* Very soluble.
Alcohol. Insoluble.

Tests for Identity.—An aqueous solution of Iron and Ammonium Tartrate is not precipitated, but rendered darker in color, by ammonia water.

With potassium ferrocyanide T.S. the solution does not yield a blue color or precipitate, unless it be acidulated with hydrochloric acid.

If Iron and Ammonium Tartrate be heated with potassium hydroxide T.S., it yields a brownish-red precipitate, and ammonia is evolved.

If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., the filtrate, when slightly acidulated with acetic acid, will gradually deposit a white, crystalline precipitate.

Impurities and Tests for Impurities.—*Citrates or tartrates of the alkali metals.* When strongly heated, the salt chars, emits fumes having the odor of burning sugar, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper.

Quantitative Test.—If 0.555 Gm. of the dry salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 13 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—This preparation is a mild chalybeate, the dose being four to thirty grains (0.25 to 2 Gm.).

FERRI ET POTASSII TARTRAS. U. S. Iron and Potassium Tartrate

[Potassio-Ferric Tartrate]

It should contain Iron and Potassium Tartrate corresponding in amount to not less than 15 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light.

No process is given in the U. S. P (8th Rev.) for this scaled salt; the process of the U. S. P. 1890, will be found in the third edition of this work, page 674. The hydrogen in the acid potassium tartrate in this compound is replaced by iron, so that a double salt like potassium and sodium tartrate is produced.

Official Description.—Thin, transparent scales, varying in color from garnet-red to reddish-brown; slightly deliquescent in the air.

Odor, Taste, and Reaction.—Without odor, and having a sweetish, ferruginous taste; neutral reaction.

Solubility.—*Water.* Very soluble.
Alcohol. Insoluble.

Tests for Identity.—When strongly heated, the salt chars, emits fumes having an odor resembling that of burning sugar, and finally leaves a dark brown residue, having a strongly alkaline reaction, and effervescing with acids (distinction from *iron and ammonium tartrate*).

An aqueous solution of Iron and Potassium Tartrate is not precipitated, but rendered darker in color, by ammonia water.

With potassium ferrocyanide T.S. the solution does not afford a blue color or precipitate, unless it be acidulated with hydrochloric acid.

When heated with potassium hydroxide T.S., the salt yields a brownish-red precipitate.

If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., the filtrate, when slightly acidulated with acetic acid, will gradually deposit a white, crystalline precipitate.

Quantitative Test.—If 0.555 Gm. of the dry salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 15 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—This is a mild ferruginous tonic, and is given in doses of four to thirty grains (0.25 to 2 Gm.).

The French use this salt by making it into an olive shaped ball, to which a loop of string is attached; a lead pencil or any convenient stick is run through the loop, and the ball suspended over a glass containing wine or water, at such a height as to dip into the liquid, so as to dissolve the necessary quantity ; the liquid is soon impregnated with the iron salt, and a second dose is prepared like the first by refilling the glass. This form is called "*Boule de Mars,*" and furnishes a ready method of obtaining a mild chalybeate draught.

FERRI HYDROXIDUM. U.S. Ferric Hydroxide

$Fe(OH)_3 = 106.14$

[FERRI OXIDUM HYDRATUM, PHARM. 1890 FERRIC HYDRATE HYDRATED OXIDE OF IRON]

	Metric	Old form
* **Solution of Ferric Sulphate**	**100 Cc.**	10 fl. oz.
Ammonia Water	**138 Cc.**	13¾ fl. oz.
Water, a sufficient quantity		

To the Ammonia Water, previously diluted with 500 Cc. [old form 3 pints] of cold Water, add, with constant stirring, the Solution of Ferric Sulphate, previously diluted with 1000 Cc. [old form 6 pints] of cold Water. As soon as the precipitate has subsided, draw off the clear liquid by means of a siphon, then mix the precipitate intimately with about 1000 Cc. [old form 6 pints] of cold Water, again draw off the clear liquid after subsidence of the precipitate, and repeat this operation, until a portion of the decanted liquid gives not more than a slight cloudiness with barium chloride test solution. Finally, transfer the precipitate to a wet muslin strainer, and, after it has drained, mix it with sufficient cold Water to make the mixture weigh 300 Gm. [old form 30 oz. av.].

Ferric Hydroxide, thus prepared, is a brownish-red magma, wholly soluble in hydrochoric acid without effervescence.

When Ferric Hydroxide is to be made in haste, for use as an antidote, the washing may be performed more quickly, though less perfectly, by transferring the precipitate at once to a wet muslin strainer, pressing forcibly with the hands, until no more liquid passes, and then adding enough Water to make the whole weigh about 300 Gm. [old form 30 oz. av.].

NOTE.—The ingredients for preparing Ferric Hydroxide as an antidote should always be kept on hand in bottles containing, respectively, 200 Cc. [old form 6 fl. oz.] of the Solution of Ferric Sulphate, and 276 Cc. [old form 8¼ fl. oz.] of Ammonia Water.

The reaction is as follows :

$$\underset{\text{Ferric Sulphate}}{Fe_2 3SO_4} + \underset{\text{Ammonium Hydroxide}}{6NH_4HO} = \underset{\text{Ferric Hydroxide}}{2Fe(OH)_3} + \underset{\text{Ammonium Sulphate}}{3(NH_4)_2SO_4}$$

Ammonia water is preferred as the precipitant, because an excess is easily detected by the odor, and the salt formed is readily washed out.

Uses.—This compound is used as the basis in preparing several iron salts, citrate, tartrate, etc., and also as the antidote to poisoning by arsenic. For the latter purpose it should be administered freely. It acts by producing insoluble ferrous arsenate.

$$\underset{\text{Ferric Hydroxide}}{4Fe(OH)_3} + \underset{\text{Arsenic Trioxide}}{As_2O_3} = \underset{\text{Ferrous Arsenate}}{Fe_3(AsO_4)_2} + \underset{\text{Ferrous Hydroxide}}{Fe(HO)_2} + \underset{\text{Water}}{5H_2O}$$

It should never be kept on hand, as it decomposes even when kept under water; the ingredients should always be kept already weighed out, placed in suitable bottles, *and in an accessible and well known place in the store*, so that if wanted quickly for an antidote it can be made without the unnecessary loss of a moment's time.

FERRI HYDROXIDUM CUM MAGNESII OXIDO. U.S. Ferric Hydroxide with Magnesium Oxide

[FERRI OXIDUM HYDRATUM CUM MAGNESIA, PHARM. 1890 ARSENIC ANTIDOTE FERRIC HYDRATE WITH MAGNESIA]

	Metric	Old form
* **Solution of Ferric Sulphate**	**40 Cc.**	1 fl. oz 3 fl. dr.
Magnesium Oxide	**10 Gm.**	154 grains
Water, a sufficient quantity		

Mix the Solution of Ferric Sulphate with 125 Cc. [old form $3\frac{3}{4}$ fl. oz.] of Water, and keep the liquid in a large, well-stoppered bottle. Rub the Magnesium Oxide with cold Water to a smooth and thin mixture, transfer this to a bottle capable of holding about 1000 Cc. [old form 2 pints], and fill it with Water to about three-fourths of its capacity. When the preparation is wanted for use, shake the Magnesium Oxide mixture to a homogeneous, thin magma, add it gradually to the diluted Solution of Ferric Sulphate, and shake them together until a uniform, smooth mixture results.

NOTE.—For the rapid preparation of this antidote to arsenical poisoning, the diluted Solution of Ferric Sulphate, and the mixture of Magnesium Oxide with Water, should always be kept on hand, in separate bottles, ready for immediate use.

Uses.—This preparation furnishes a ready and efficient antidote against arsenic poisoning. Ferric hydroxide is produced when the mixture of magnesium oxide is added to the diluted solution of ferric tersulphate, and, as the magnesium oxide is in excess and acidity thus prevented, no harm can result from not separating the by-products of the reaction. It contains in addition magnesium sulphate and hydroxide. It has been shown that no soluble compound with arsenic is formed when it is used as an antidote; the presence of the magnesium salts, from a therapeutical point of view, is not objectionable, and it is preferred to ferric hydroxide.

FERRI HYPOPHOSPHIS. U. S. Ferric Hypophosphite

$Fe(PH_2O_2)_3 = 249.09$

It should contain not less than 98 percent. of pure Ferric Hypophosphite $[(PH_2O.O)_3Fe]$, and should be kept in well-stoppered bottles.

Preparation.—This is among the hypophosphites brought into notice in consequence of their recommendation by Dr. Churchill in the treatment of phthisis, in which they were thought to be useful by the introduction of phosphorus into the system. This particular salt may be considered preferable to others when a marked condition of anæmia indicates a deficiency of iron in the tissues. It may be made by the action of hypophosphorous acid on ferrous carbonate formed by precipitation from ferrous sulphate; but, as some difficulty has been found in obtaining this acid perfectly pure, preference has been given to the plan of double decomposition. This salt may be made by causing ferrous sulphate and calcium hypophosphite to react on each other in molecular proportions represented by 480 grains of crystallized ferrous sulphate and 326 grains of commercial hypophosphite,—in the latter an allowance of 10 percent. being made for impurities ordinarily found in that salt. These quantities will yield 320 grains of ferric hypophosphite, and the reaction will be represented by the following formula :

$$\underset{\substack{\text{Calcium}\\\text{Hypophosphite}}}{Ca(H_2PO_2)_2} + \underset{\substack{\text{Ferrous}\\\text{Sulphate}}}{FeSO_4} = \underset{\substack{\text{Calcium}\\\text{Sulphate}}}{CaSO_4} + \underset{\substack{\text{Ferrous}\\\text{Hypophosphite}}}{Fe(H_2PO_2)_2}$$

Calcium sulphate is precipitated, and ferrous hypophosphite is held in solution. In this condition the salt is a ferrous compound ; but on evaporation the ferrous salt becomes ferric, and acquires the properties detailed in the Pharmacopœia.

Official Description.—A white, or grayish-white powder ; permanent in the air.

Odor and Taste.—Odorless and nearly tasteless.

Solubility.—*Water.* In 2300 parts at 25° C. (77° F.), and in 1200 parts of boiling water ; more readily in the presence of hypophosphorous acid, or in a warm, concentrated solution of an alkali citrate, forming with the latter a green solution.

Tests for Identity.—When strongly heated in a dry test-tube, the salt evolves spontaneously inflammable hydrogen phosphide gas, and, on complete ignition, leaves a residue of ferric pyrophosphate.

Ferric Hypophosphite is readily oxidized by nitric acid or other oxidizing agents.

Impurities and Tests for Impurities.—*Carbonate.* If to 1 Gm. of the salt 10 Cc. of acetic acid be added, no effervescence should occur.

If the mixture be subsequently heated to boiling, the filtrate should respond to the following tests :

The addition of a few drops of silver nitrate T.S. to a portion of the filtrate should, upon warming, cause a brown to black coloration or precipitate. If another portion of the filtrate be added drop by drop to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed upon gently heating.

Calcium. Another portion of the cold filtrate should afford no turbidity with ammonium oxalate T.S.

Phosphate. If 0.5 Gm. of the salt be boiled with 10 Cc. of potassium hydroxide T.S., a reddish-brown precipitate will be produced ; and if to the filtrate from the latter, slightly acidulated with hydrochloric acid, magnesia mixture T.S. be added, and subsequently an excess of ammonia water, no crystalline precipitate should be produced.

Heavy metals. If 1 Gm. of the salt be dissolved in about 25 Cc. of boiling water by the aid of sufficient hydrochloric acid, added drop by drop, then a slight excess of ammonia water added, the filtrate from the reddish-brown precipitate should be colorless, and, after acidulating with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Uses.—Ferric hypophosphite is given in anæmia and in cases of defective nerve nutrition ; it is administered in the form of pills, powders, or syrup. The dose is from three to ten grains (0.2 to 0.6 Gm.).

SYRUPUS FERRI IODIDI. U.S. Syrup of Ferrous Iodide

A syrupy liquid containing about 5 percent., by weight, of Ferrous Iodide [$FeI_2 = 307.30$], or about 6.74 Gm. in 100 Cc.

This syrup is prepared by forming a solution of ferrous iodide by acting on iron wire with iodine in the presence of water ; the green solution of ferrous iodide is then protected by its addition to sugar, and the syrup is poured into small, well-stoppered bottles which are exposed to daylight. A small amount of diluted hypophosphorous acid is added to aid in its preservation. The object of exposing the syrup to daylight is to prevent the separation of free iodine, to which the irritant action is due, the syrup being prone to decomposition and discoloration from this separation; when iodine is diffused through water and is exposed to light, colorless hydriodic acid is formed, and this is measurably protected from change through the intervention of the syrup. (See Syrupus Acidi Hydriodici, page 290.)

Official Description.—A transparent, pale green, or yellowish green liquid.
Taste and Reaction.—Sweet, strongly ferruginous taste, and an acid reaction.
Specific Gravity.—About 1.349 at 25° C. (77° F.).
Test for Identity.—On adding a few drops of potassium ferricyanide T.S. to a small portion of the diluted Syrup a blue precipitate will be produced.
Impurity and Test.—*Free iodine.* If mixed with a little starch T.S., and afterwards with a few drops of chlorine water, the syrup will acquire a deep blue color. This color should not be produced in the Syrup by starch T.S. alone.
Quantitative Test.—If 10 Gm. of Syrup of Ferrous Iodide be diluted with distilled water to measure 100 Cc., and 15.4 (15.36) Cc. of the solution be mixed with 15 Cc. of water, 6 Cc. of tenth-normal silver nitrate V.S., and 2 Cc. each of diluted nitric acid and ferric ammonium sulphate T.S., then, after thoroughly shaking the mixture, not more than 1 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 1 percent. of Ferrous Iodide).

Uses.—The dose of this syrup is from ten to thirty minims (0.6 to 2 Cc.); it should be largely diluted, and sucked through a glass tube, to protect the teeth from injury.

PILULÆ FERRI IODIDI. U.S. Pills of Ferrous Iodide

The liability to decomposition of ferrous iodide has led to various forms of administration which will present it unaltered. The official pills of ferrous iodide are directed to be coated with an ethereal solution of tolu to preserve them from change. The pills contain ferrous iodide, sugar, extract of glycyrrhiza, glycyrrhiza, and acacia. There is in each pill nearly one grain of ferrous iodide. Ferrous iodide is a valuable salt in diseases attended with anæmia which require the use of an alterative. The dose is one or two pills. (See Part V.)

FERRI PHOSPHAS SOLUBILIS. U.S. Soluble Ferric Phosphate

It should contain Ferric Phosphate corresponding in amount to not less than 12 percent. of metallic iron, and should be kept in amber-colored, well-stoppered bottles, protected from light.

No process is given in the U. S. P. (8th Rev.) for this scaled salt; the process of the U. S. P. 1890 is appended.

	Metric	Old form
Ferric Citrate	50 Gm.	10 oz. av.
Sodium Phosphate, uneffloresced	55 Gm.	11 oz. av.
Distilled Water	100 Cc.	19 fl. oz.

Dissolve the Ferric Citrate in the Distilled Water by heating on a water bath. To this solution add the Sodium Phosphate, and stir constantly until it is dissolved. Evaporate the solution, on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

This scaled salt is very different from the insoluble slate-colored powder of iron phosphate formerly official. It is not a definite chemical compound, but is sometimes termed sodio-ferric citro-phosphate. It greatly resembles the official ferric pyrophosphate.

Official Description.—Thin, bright green, transparent scales. The salt is permanent in dry air when excluded from light, but when unprotected soon becomes dark and discolored.

Odor, Taste, and Reaction.—Without odor, and having an acidulous, slightly saline taste; slightly acid reaction.

Solubility.—*Water.* Freely and completely soluble.

Alcohol. Insoluble.

Tests for Identity.—The addition of ammonia water to the aqueous solution of the salt produces a reddish-brown color.

If soluble Ferric Phosphate be boiled with potassium hydroxide T.S., it affords a brownish-red precipitate without evolving ammonia.

Dissolve 0.1 Gm. of the salt in 2 Cc. of warm water, add 5 Cc. of potassium hydroxide T.S., boil and filter. Neutralize the filtrate with hydrochloric acid, add 2 Cc. of magnesia mixture T.S. and ammonia water in slight excess. A white, crystalline precipitate is produced, which, if well washed on a filter, is turned yellow by silver nitrate T.S.

To 1 Gm. of the salt dissolved in 10 Cc. of water, add 15 Cc. or a slight excess of boiling potassium hydroxide T.S., and, after thoroughly mixing, filter. The filtrate, after strongly acidulating with hydrochloric acid and adding 10 Cc. of magnesia mixture T.S., followed by a slight excess of ammonia water, will afford an abundant, white, crystalline precipitate.

Quantitative Test.—If 0.555 Gm. of the salt be dissolved in 10 Cc. of water, in a glass-stoppered flask having a capacity of about 100 Cc., and 2 Cc. of hydrochloric acid and 40 Cc. of water added, and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 12 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid (each Cc. of tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—This is a mild and safe ferruginous tonic. It is given in doses of four to ten grains (0.2 to 0.6 Gm.).

FERRI PYROPHOSPHAS SOLUBILIS. U.S. Soluble Ferric Pyrophosphate

It should contain Ferric Pyrophosphate corresponding in amount to not less than 10 percent. of metallic iron, and should be kept in amber-colored, well-stoppered bottles, protected from light.

No process is given for this scaled salt in the U. S. P. (8th Rev.); the process of the U. S. P. 1890 is appended.

	Metric	Old form
Ferric Citrate	50 Gm.	8 oz. av.
Sodium Pyrophosphate, uneffloresced	50 Gm.	8 oz. av.
Distilled Water	100 Cc.	16 fl. oz.

Dissolve the Ferric Citrate in the Distilled Water, by heating on a water-bath. To this solution add the Sodium Pyrophosphate, and stir constantly until it is dissolved. Evaporate the solution, on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

This compound is a mixture of several salts,—sodio-ferric pyrophosphate, sodio-ferric citrate, and ferric citrate. It differs from the salt official in 1870, which was the insoluble ferric pyrophosphate, $Fe_43P_2O_7$, dissolved in solution of ammonium citrate; the ammonium salt is less stable than the sodium compound, being slowly decomposed on exposure to the air, and the process yielded an unsatisfactory product.

Official Description.—Thin, apple-green, transparent scales. The salt is permanent in dry air, when excluded from light, but when unprotected, soon becomes discolored.

Odor, Taste, and Reaction.—Without odor; acidulous, slightly saline taste; slightly acid reaction.

Solubility.—*Water.* Freely and completely soluble.

Alcohol. Insoluble.

Tests for Identity.—If Soluble Ferric Pyrophosphate be boiled with potassium hydroxide T.S., it affords a brownish-red precipitate without evolving the odor of ammonia.

If 0.1 Gm. of the salt be fused with 0.1 Gm. each of potassium nitrate and sodium carbonate, and the residue boiled with 10 Cc. of distilled water and filtered, the filtrate, after being rendered nearly, but not quite, neutral with highly diluted nitric acid, should yield a yellow precipitate upon the addition of silver nitrate T.S.

Quantitative Test.—If 0.555 Gm. of the salt be dissolved in 10 Cc. of water, in a glass-stoppered flask having a capacity of about 100 Cc. and 8 Cc. of hydrochloric acid and 40 Cc. of water added, and if, after the addition of 2 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 10 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron).

Uses.—This is one of the best of the mild ferruginous preparations. It is very largely used on account of its solubility and the ease with which it can be administered either in pills or in solution. The dose is two to five grains (0.12 to 0.3 Gm.).

FERRI SULPHAS. U.S. Ferrous Sulphate

$FeSO_4 + 7H_2O = 276.01$

[IRON PROTOSULPHATE]

It should contain not less than 99.5 percent. of pure Ferrous Sulphate [$SO_2.O_2Fe + 7H_2O$] ; the crystals should not be effloresced, and should be kept in well-stoppered bottles.

Preparation.—This salt is rarely made by the pharmacist, because the commercial article is sold at a very low price. The following is a formerly official British process :

Take of Iron Wire, 4 oz. av. ; Sulphuric Acid, 4 fl. oz. [Imperial measure] ; Distilled Water, 1½ pints [Imp. meas.]. Pour the Water on the Iron placed in a porcelain dish, add the Sulphuric Acid, and, when the disengagement of gas has nearly ceased, boil for ten minutes. Filter now through paper, and, after the lapse of twenty-four hours, separate the crystals which have been deposited from the solution. Let these be dried on filtering paper placed on porous bricks, and be preserved in a stoppered bottle.

The salt is a by-product in the manufacture of hydrogen, the following being the reaction :

$$\underset{\text{Iron}}{Fe_2} + \underset{\substack{\text{Sulphuric}\\ \text{Acid}}}{2H_2SO_4} = \underset{\substack{\text{Ferrous}\\ \text{Sulphate}}}{2FeSO_4} + \underset{\text{Hydrogen}}{4H}$$

Official Description.—Large, pale bluish-green, monoclinic prisms ; efflorescent in dry air. On exposure to moist air, the crystals rapidly oxidize, and become coated with brownish-yellow, basic ferric sulphate.

Odor, Taste, and Reaction.—Without odor ; saline, styptic taste ; acid reaction.

Solubility.—*Water.* In 0.9 part at 25° C. (77° F.), and in 0.3 part of boiling water.

Alcohol. Insoluble.

Tests for Identity.—When slowly heated to 115° C. (239° F.), the crystals disintegrate, and lose 38.87 percent. of their weight (6 molecules of water of crystallization).

The aqueous solution of the salt, even when highly diluted, gives with potassium ferricyanide T.S. a blue color or precipitate, and with barium chloride T.S. a white precipitate insoluble in hydrochloric acid.

Impurities and Tests for Impurities.—*Heavy metals.* If 1 Gm. of the salt be dissolved in about 25 Cc. of water, containing 1 Cc. of diluted sulphuric acid, the solution heated to boiling, oxidized with nitric acid, and then mixed with a slight excess of ammonia water, the filtrate from the reddish-brown precipitate produced should be colorless, and, after acidulating with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Salts of the alkali metals. If another portion of the salt be oxidized and precipitated as directed above, the filtrate, on evaporation to dryness and ignition, should not leave any weighable residue.

Free acid. If 1 Gm. of Ferrous Sulphate, in small fragments, be agitated during four or five minutes with 10 Cc. of alcohol, the filtrate should not redden moistened blue litmus paper.

Quantitative Test.—If 1.38 Gm. of the salt, in uneffloresced crystals, be dissolved in about 25 Cc. of diluted sulphuric acid, not less than 49.75 Cc. of tenth-normal potassium permanganate V.S. should be required to impart to the liquid a permanent pink color (each Cc. of the tenth-normal potassium permanganate V.S. indicating 2 percent. of crystallized Ferrous Sulphate).

Uses.—This is a very astringent iron salt. When used internally, the exsiccated or granulated salt is preferred. The impure ferrous sulphate, called *copperas*,[1] is used as a disinfectant. The dose of the sulphate is one to three grains (0.065 to 0.2 Gm.).

FERRI SULPHAS EXSICCATUS. U.S. Exsiccated Ferrous Sulphate

[DRIED FERROUS SULPHATE]

	Metric	Old form
* **Ferrous Sulphate,** in coarse powder	100 Gm.	25 oz. av.

Allow the salt to effloresce at a temperature of about 40° C. (104° F.), in dry air, and then heat it in a porcelain dish, on a water-bath, constantly stirring, until the product weighs from 64 to 65 Gm. [old form 16 oz. av.]. Lastly, reduce the residue to a fine powder, and transfer it at once to perfectly dry, well-stoppered bottles.

A grayish-white powder, slowly but completely soluble in water, and conforming to the reactions and tests given under *Ferri Sulphas*.

This process does not deprive the ferrous sulphate of all of its water of crystallization, about 15 percent. being retained. One hundred parts of crystallized sulphate yield about 64 percent. of the exsiccated salt.

Uses.—Exsiccated ferrous sulphate is a grayish-white powder, and is principally used in making pills, the crystallized sulphate being unfitted for the purpose on account of the large proportion of water that it contains. Five grains of the crystals are represented by three grains of the exsiccated sulphate. It is used in the official pills of aloes and iron.

FERRI SULPHAS GRANULATUS. U.S. Granulated Ferrous Sulphate

$FeSO_4 + 7H_2O = 276.01$

[FERRI SULPHAS PRECIPITATUS, U. S. 1880 PRECIPITATED FERROUS SULPHATE]

	Metric	Old form
* **Ferrous Sulphate,** in coarse powder	100 Gm.	4 oz. av.
Distilled Water	100 Cc.	4 fl. oz.
Diluted Sulphuric Acid	5 Cc.	1½ fl. dr.
Alcohol	25 Cc.	1 fl. oz.

Dissolve the Ferrous Sulphate in the Distilled Water previously heated to boiling, add the Diluted Sulphuric Acid, and filter the solution while hot. Evaporate the solution immediately in a tared porcelain dish, on a sand-bath, until it weighs 150 Gm. [old form 6 oz. av.], and then cool it quickly, with constant stirring. Transfer the product to a glass funnel stopped with a plug of purified cotton, and, when it has thoroughly drained, pour upon it the Alcohol. When this has also drained, spread the crystalline powder on bibu-

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[1] This unfortunate synonym, "*copperas*," has led to a great many errors, through the impression that this salt must contain copper. It is often confounded with the poisonous salt copper sulphate, or blue vitriol, and they have been substituted for each other.

lous paper, dry it quickly at the ordinary temperature, and transfer it at once to perfectly dry, well-stoppered bottles.

Granulated Ferrous Sulphate is a very pale bluish-green, crystalline powder, which should conform in every respect to the reactions and tests given under *Ferri Sulphas.*

Ferrous sulphate is insoluble in alcohol; hence, if a strong aqueous solution be poured into alcohol, it is precipitated in the form of a granular crystalline powder, and this method was used in the U. S. P. 1880 for preparing this salt. The processes of the U. S. P. 1890 and U. S. P. (8th Rev.) differ from that formerly official in that the sulphate is not precipitated but granulated, and subsequently washed with alcohol to free it from impurities.

Uses.—Granulated ferrous sulphate should be used in preference to the large crystals at the prescription counter; the soluble impurities are washed out by the alcohol. It is much less liable to oxidation and change than the ordinary crystallized sulphate.

LIQUOR FERRI ET AMMONII ACETATIS. U.S. Solution of Iron and Ammonium Acetate

[BASHAM'S MIXTURE]

	Metric	Old form
* **Tincture of Ferric Chloride**	40 Cc.	4 fl. dr.
Diluted Acetic Acid	60 Cc.	6 fl. dr.
Solution of Ammonium Acetate	500 Cc.	6¼ fl. oz.
Aromatic Elixir	120 Cc.	1½ fl. oz.
Glycerin	120 Cc.	1½ fl. oz.
Water, a sufficient quantity,		
To make	1000 Cc.	12½ fl. oz.

To the Solution of Ammonium Acetate (which should not be alkaline) add, successively, the Diluted Acetic Acid, the Tincture of Ferric Chloride, the Aromatic Elixir, and the Glycerin, and, lastly, enough Water to make the product measure 1000 Cc. [old form 12½ fl. oz.].

This preparation should be freshly made when wanted.

This solution was improved in the U. S. P. 1890 by the addition of glycerin, and in the 8th Decennial Revision, by doubling the strength of the important ingredients. It is not intended to be a permanent preparation, and in time will decompose. Some pharmacists prefer to keep all the ingredients mixed together in a shop bottle, except the tincture of ferric chloride, and, when called for, add the proper quantity of the tincture to the quantity to be dispensed. In this way time is saved, and a fresh preparation always furnished.

This is a mild ferruginous solution, of very pleasant taste, and is often known as Basham's mixture. It is given in doses of two fluidrachms to one-half fluidounce (8 to 16 Cc.).

LIQUOR FERRI SUBSULPHATIS. U.S. Solution of Ferric Subsulphate

[MONSEL'S SOLUTION SOLUTION OF BASIC FERRIC SULPHATE]

An aqueous solution of variable chemical composition, containing an amount of basic ferric sulphate corresponding to not less than 13.57 percent. of metallic iron.

	Metric	Old form
* **Ferrous Sulphate,** in clear crystals	675 Gm.	16 oz. av. 628 gr.
Sulphuric Acid	65 Gm.	7 fl. dr.
Nitric Acid,		
Distilled Water, each, a sufficient quantity,		
To make	1000 Gm.	1 pint

Add the Sulphuric Acid to 500 Cc. [old form 7 fl oz.] of Distilled Water in a capacious porcelain dish, heat the mixture to nearly 100° C. (212° F.), then add 70 Gm. [old form 1 fl. oz. 100 min.] of Nitric Acid, and mix well. Divide the Ferrous Sulphate, coarsely powdered, into four equal portions, and add these portions, one at a time, to the hot liquid, stirring after each addition until effervescence ceases. If, after the Ferrous Sulphate has been dissolved, the solution is of a black color, add Nitric Acid, a few drops at a time, with heating and stirring, until it no longer causes red fumes to be evolved; then boil the Solution until it assumes a ruby red color and is free from nitric acid. Lastly, add enough Distilled Water to make the product weigh 1000 Gm. [or measure, old form, 1 pint]. Filter, if necessary. Keep it in well-stoppered bottles, in a moderately warm place (not under 22° C. or 71.6° F.), protected from light.

This solution sometimes crystallizes, forming a semisolid, whitish mass. When this occurs, the application of a gentle heat to the bottle will restore the liquid condition.

NOTE.—Solution of Ferric Subsulphate is to be dispensed when Solution of Persulphate of Iron has been prescribed by the physician.

When ferrous sulphate is added to a hot mixture of nitric and sulphuric acids, a copious evolution of reddish-yellow vapors of nitrogen tetroxide takes place, and the iron assumes a blackish tint, due to the formation of a compound of the ferrous sulphate with the nitric oxide. This black color disappears under the influence of heat, and, when effervescence ceases, the dark reddish-brown liquid is left which is widely known as *Monsel's Solution.*

Official Description.—A dark reddish-brown liquid.

Odor, Taste, and Reaction.—Odorless or nearly so; acid, strongly styptic taste; acid reaction.

Specific Gravity.—About 1.548 at 25° C. (77° F.).

Solubility.—*Water.* Miscible in all proportions, without decomposition.

Alcohol. Miscible in all proportions, without decomposition.

Tests for Identity.—The diluted Solution yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in hydrochloric acid, with barium chloride T.S.

On slowly mixing 2 volumes of the Solution with 1 volume of concentrated sulphuric acid, in a beaker, a semi-solid white mass should separate on standing (difference from *tersulphate*).

Impurities and Tests for Impurities.—*Nitric acid.* On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Solution (about 1 in 10), the crystal should not become brown, nor should a brownish-black color develop around it.

Ferrous salt. If to a diluted portion of the Solution (1 in 20), a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced; it should not at once turn green or greenish-blue.

Quantitative Test.—If 10 Gm. of the Solution be diluted to measure 100 Cc., and 11.1 Cc. of this be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), with 10 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at the temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch T.S., it should require not less than 27.2 (27.15) Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue or greenish color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 0.5 percent. of metallic iron).

Uses.—This preparation is probably the most valuable official styptic solution. It is less irritating than the solution of ferric sulphate, owing to the smaller proportion of sulphuric acid. It is used externally in stopping hemorrhages, and internally in doses of three to six minims (0.2 to 0.4 Cc.), largely diluted with water.

LIQUOR FERRI TERSULPHATIS. U. S. Solution of Ferric Sulphate

An aqueous solution, which should contain about 36 percent. of normal Ferric Sulphate [$Fe_2(SO_2.O_2)_3 = 397.05$], corresponding to not less than 10 percent. of metallic iron.

	Metric	Old form
* **Ferrous Sulphate,** in clear crystals	500 Gm.	11 oz. av. 418 gr.
Sulphuric Acid	96 Gm.	1 fl. oz. 103 min.
Nitric Acid,		
Distilled Water, each, a sufficient quantity,		
To make	1000 Gm.	1 pint

Add the Sulphuric Acid to about 250 Cc. [old form 3¾ fl. oz.] of Distilled Water in a capacious porcelain dish, heat the mixture to nearly 100° C. (212° F.), then add 56 Gm. [old form 7 fl. dr.] of Nitric Acid, and mix well. Divide the Ferrous Sulphate, coarsely powdered, into four equal portions, and add these portions, one at a time, to the hot liquid, stirring after each addition until effervescence ceases. When all of the Ferrous Sulphate is dissolved, if the solution has acquired a black color, add Nitric Acid, a few drops at a time, heating and stirring until it no longer causes red fumes to be evolved, and the Solution assumes a clear reddish-brown color; then boil the liquid until it is free from nitric acid. Lastly, add enough Distilled Water to make the product weigh 1000 Gm. [or measure, old form, 1 pint]. Filter, if necessary.

This solution differs from the solution of ferric subsulphate merely in containing a larger proportion of sulphuric acid. It has the sp. gr. 1.432, and is a solution of the *true* persulphate $Fe_2(SO_4)_3$, or normal ferric sulphate. The strength of this solution was increased in the U. S. P. (8th Rev.). The U. S. P. 1890 contained an amount of metallic iron corresponding to 8 percent.; the present Pharmacopœia contains 10 percent. Solution of persulphate of iron is the name under which Monsel's solution is erroneously prescribed. The latter is a solution of a subsalt, $Fe_4O(SO_4)_5$. The reaction for solution of ferric sulphate is as follows:

$$\underset{\substack{\text{Ferrous}\\\text{Sulphate}}}{6FeSO_4} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{3H_2SO_4} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{2HNO_3} = \underset{\substack{\text{Ferric}\\\text{Sulphate}}}{3Fe_23SO_4} + \underset{\substack{\text{Nitrogen}\\\text{Dioxide}}}{2NO} + \underset{\text{Water}}{4H_2O}$$

Official Description.—A dark reddish-brown liquid.

Odor, Taste, and Reaction.—Almost odorless; acid, strongly styptic taste; acid reaction.

Specific Gravity.—From 1.430 to 1.450 at 25° C. (77° F.).

Solubility.—Miscible with water and alcohol, in all proportions, without decomposition.

Tests for Identity.—The diluted Solution yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in hydrochloric acid, with barium chloride T.S.

On slowly mixing 2 volumes of the Solution with 1 volume of concentrated sulphuric acid, in a beaker, no solid white mass should separate on standing (difference from *subsulphate*).

Impurities and Tests for Impurities.—*Nitric acid.* On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Solution (about 1 in 10), the crystal should not become brown, nor should a brownish-black color develop around it.

Ferrous salt. If to a small portion of the Solution, diluted with about 10 volumes of water, a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced, without a tinge of green or greenish-blue.

Quantitative Test.—If 1.11 Gm. of the Solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch T.S., it should require not less than 20 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue or greenish color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 0.5 percent. of metallic iron).

Uses.—This solution is largely used in pharmacy for preparing ferric hydroxide by precipitation with ammonia water. From this many of the iron salts and solutions are made. It is not used medicinally to any extent, the solution of the subsulphate being preferred.

Chromium. Cr; 51.7

Chromium occurs in nature as chrome-iron ore, deposits of which are found in Southeastern Pennsylvania. This metal is brittle, of a grayish-white color, and very hard, being capable of scratching glass. It forms five compounds with oxygen: 1. Monoxide, or *Chromous oxide*, CrO. 2. *Trichromic tetroxide*, Cr_3O_4. 3. Sesquioxide, or *chromic oxide*, Cr_2O_3. 4. Dioxide, CrO_2. 5. *Chromium trioxide*, CrO_3. The latter alone and its salts are of pharmaceutical interest.

Tests for Chromium Salts

1. Ammonium sulphide precipitates from solutions of chromium salts a greenish precipitate of chromic hydroxide.

2. Sodium or potassium hydroxide also produces a precipitate of chromic hydroxide, soluble in excess.

3. Soluble lead salts produce yellow precipitates of lead chromate (chrome yellow).

Official Salts containing Chromium

Official Name	Preparation
Chromii Trioxidum	Made by decomposing potassium dichromate with sulphuric acid
Potassii Dichromas	Made by removing one-half of the potassium from potassium chromate with sulphuric acid, evaporating and crystallizing (see page 524)

Unofficial Salts of Chromium

Chromii Bromidum, Cr_2Br_6 Chromium Bromide	By passing bromine vapor over an ignited mixture of chromic oxide with charcoal and starch paste
Chromii Dichloridum, $CrCl_2$ Chromium Dichloride	By passing dry chlorine gas over a red-hot mixture of charcoal and chromic oxide
Chromii Fluoridum, Cr_2Fl_6 Chromium Fluoride	By treating chromic oxide, dried, but not ignited, with excess of hydrofluoric acid, and heating the dried mass very strongly in a platinum crucible
Chromii Iodidum, Cr_2I_6 Chromium Iodide	By treating silver chromate with hydriodic acid and alcohol
Chromii Sulphas, $Cr_2(SO_4)_3 + 5H_2O$ Chromium Sulphate (Green)	By dissolving chromic oxide in strong sulphuric acid at a temperature between 50° and 60° C.

CHROMII TRIOXIDUM. U.S. Chromium Trioxide

CrO_3 = 99.34

[Acidum Chromicum, Pharm. 1890 Chromic Acid Chromic Anhydride]

It should contain not less than 90 percent. of pure Chromium Trioxide (chromic acid anhydride). It should be kept in glass-stoppered bottles, and great caution should be observed to avoid bringing it in contact with organic substances, such as cork, tannic acid, sugar, alcohol, collodion, etc., as serious accidents are liable to result.

Preparation.—Chromium trioxide, or, as it is usually called, chromic acid, is readily obtained by mixing one hundred measures of a cold saturated solution of potassium dichromate with one hundred and fifty measures of sulphuric acid, and allowing the mixture to cool. The sulphuric acid unites with the potassium, and sets free the chromium trioxide, which is deposited in crystals. The mother liquor having been poured off, these are transferred to a glass funnel, and the mother liquor displaced by nitric acid; they are then placed upon a tile or a clean, dry pressed brick to drain, covered with a glass bell jar.

$$\underset{\substack{\text{Potassium}\\\text{Dichromate}}}{K_2Cr_2O_7} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{2H_2SO_4} = \underset{\substack{\text{Chromium}\\\text{Trioxide}}}{2CrO_3} + \underset{\substack{\text{Acid Potassium}\\\text{Sulphate}}}{2KHSO_4} + \underset{\text{Water}}{H_2O}$$

Official Description.—Small, needle-shaped crystals or rhombic prisms, of a dark purplish-red color and metallic lustre; destructive to animal and vegetable tissues; deliquescent in moist air.

Odor.—Odorless.

Solubility.—*Water.* Very soluble, forming an orange-red solution.

Other solvents. When brought in contact with alcohol, ether, glycerin, and other organic solvents, decomposition takes place, sometimes with dangerous violence.

Tests for Identity.—When Chromium Trioxide is heated, its color darkens, and finally becomes black, but it is restored on cooling. At 192° to 193° C. (377.6° to 379.4° F.) it fuses to a reddish-brown liquid, which, on cooling, forms a dark red, brittle mass (often enclosing cavities filled with crystals), furnishing a scarlet powder. Above 250° C. (482° F.) it begins to decompose into green chromic oxide and free oxygen, and, after protracted heating, leaves a residue of pure chromic oxide, which should yield nothing soluble in water.

When warmed with hydrochloric acid, chlorine is evolved.

Impurity and Test.—*Sulphuric acid.* A solution of 1 Gm. of Chromium Trioxide in 100 Cc. of water, previously acidulated with a few Cc. of hydrochloric acid, should not be rendered turbid on the addition of 1 Cc. of barium chloride T.S.

Quantitative Test.—If 1 Gm. of Chromium Trioxide be dissolved in 100 Cc. of water, then 8.3 Cc. (8.28 Cc.) of this solution, when measured into a glass-stoppered bottle (of about 200 Cc. capacity), mixed with 2 Cc. of hydrochloric acid and about 1 Gm. of potassium iodide, after securely closing and shaking for a few minutes, should require, after diluting with 100 Cc. of water and adding 5 Cc. of starch T.S., not less than 22.5 Cc. of tenth-normal sodium thiosulphate V.S. to change the deep blue color to a light green (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 4 percent. of pure Chromium Trioxide).

Uses.—Chromium trioxide is a powerful caustic and antiseptic; it parts with its combined oxygen with great facility. It is a very effective caustic in destroying warty growths. It is not used internally.

POTASSII DICHROMAS. U.S. Potassium Dichromate

For a description of this official chromium salt, see page 524.

CHAPTER XLV

NICKEL, COBALT, AND TIN

Ni ; 58.3. Co ; 58.56. Sn ; 118.1

None of these metals nor any of their compounds are considered of sufficient medicinal importance to give them a place in the U. S. Pharmacopœia. Their salts are sometimes used medicinally, and several are among the official reagents. Two of the metals, nickel and tin, are important in many respects, particularly in the arts.

Nickel. Ni ; 58.3

This metal is found in magnetic pyrites in Pennsylvania ; also as arsenic or *kupfernickel* in Germany and Sweden, and as a silicate in New Caledonia. Its specific gravity is 8.9. It is a white, malleable metal, and forms with copper a valuable alloy, known as German silver. This alloy is also used for making coins. Salts of nickel are very largely employed in electroplating, and some of them have come into use as medicines ; the Latin name of the metal is *Niccolum.*

Tests for Compounds of Nickel

1. Ammonium sulphide produces with a solution of a nickel salt a black precipitate (sulphide), insoluble in diluted hydrochloric acid, but soluble in hot nitric acid.

2. Potassium or sodium hydroxide produces with nickel salts pale green precipitates of hydroxide insoluble in an excess.

3. Potassium cyanide produces a green precipitate with a solution of a nickel salt, soluble in an excess, but reprecipitated by hydrochloric acid.

Unofficial Salts of Nickel

Niccoli Bromidum, $NiBr_2$ Nickel Bromide	By dissolving nickel carbonate in hydrobromic acid, concentrating, then crystallizing
Niccoli Carbonas, $NiCO_3$ Nickel Carbonate	By heating nickel chloride with an alkaline carbonate in sealed tubes and collecting the powder
Niccoli Chloridum, $NiCl_2$ Nickel Chloride	By heating nickel filings to low redness in a stream of chlorine
Niccoli Cyanidum, $Ni(CN)_2$ Nickel Cyanide	By adding to a solution of potassium cyanide a solution of any nickel salt in slight excess and collecting the precipitate
Niccoli Sulphas, $NiSO_4+7H_2O$ Nickel Sulphate	By dissolving pure nickel carbonate in diluted sulphuric acid, concentrating the solution, then crystallizing

Cobalt. Co ; 58.56

This metal is usually found associated with arsenical ores. It is white, tough, and brittle, unalterable in the air, and strongly magnetic. Sp. gr. 8.5. It forms two classes of salts, cobaltous and cobaltic, in this respect resembling iron. The native ore *skutterudite*, $CoAs_3$, and other cobalt minerals containing arsenic, are often sold in commerce under the name of *flystone*. It is used as a fly-poison by breaking it into small fragments and mixing them with sweetened water. The *chloride* and *sulphocyanate* have been used to make *ba-*

rometer paper, by dipping ordinary white paper into a solution and drying it; when dry the color is blue, but an increase of moisture in the air changes the color to pink. Salts of cobalt are used to give glass a blue color.

Cobalt forms no official salts, and none of the unofficial salts are of pharmaceutical interest.

Tests for Salts of Cobalt

1. Ammonium sulphide produces in a solution of a cobaltous salt a black precipitate (sulphide), insoluble in diluted hydrochloric acid.

2. Solution of potassium hydroxide produces with a solution of a cobaltous salt a blue precipitate, changing by heat first to a violet and subsequently to a red color.

3. Potassium cyanide produces a yellowish-brown precipitate, soluble in an excess; the clear solution after being boiled does not afford a precipitate with hydrochloric acid (difference from nickel salts).

Tin. Sn; 118.1

The sulphide and oxide are the forms in which tin is usually found. Tin is a valuable white metal, of a silvery color, which, when bent, emits a peculiar crackling sound, termed the "cry of tin." Its specific gravity is 7.25. It forms two classes of compounds, called *stannous* and *stannic* salts. These are not used to any extent in medicine or pharmacy, but are of great importance in the arts.

Tests for Compounds of Tin

1. Potassium or sodium hydroxide produces in a solution of a salt of tin a white precipitate (hydroxide), soluble in an excess.

2. Ammonia water produces a white precipitate (hydroxide) with a solution of a stannous salt, nearly insoluble in an excess. The same reagent with a stannic salt produces a similar white precipitate (hydroxide), slightly soluble in an excess.

3. Ammonia sulphide produces in solutions of stannous salts a brownish-black precipitate, soluble in an excess (if an excess of sulphur be present in the reagent). The yellow sulphide is precipitated from this solution on the addition of an acid. Ammonium sulphide with stannic salts produces a yellow precipitate, soluble in an excess.

4. Mercuric chloride in contact with stannous salts is reduced to mercurous chloride or metallic mercury; no change occurs when it is added to stannic salts.

Unofficial Salts of Tin

Stanni Chloridum, $SnCl_2 + 2H_2O$ Stannous Chloride (tin salt)	By dissolving tin in hot hydrochloric acid
Stanni Sulphidum, SnS Stannous Sulphide	By passing hydrogen sulphide gas into a solution of stannic chloride
Sodii Stannas, Na_2SnO_3 Sodium Stannate	By boiling tin ore with solution of sodium hydroxide
Acidum Stannicum, $SnO_2 + 2H_2O$ Stannic Acid	By precipitating a solution of an alkaline stannate with an acid
Acidum Metastannicum, $5SnO_2 + 10H_2O$ Metastannic Acid	By acting on tin with nitric acid

CHAPTER XLVI

LEAD, COPPER, SILVER, AND MERCURY

Pb; 205.35. Cu; 63.1. Ag; 107.12. Hg; 198.5

THIS group embraces four well known metals, which furnish compounds of great value as medicines. They are allied to one another chemically, although they differ greatly in their physical properties.

Lead. Pb; 205.35

Lead is obtained from the native sulphide, *galena*, by roasting in a reverberatory furnace. It is often associated with silver. It is a heavy, soft, bluish metal, with a specific gravity of 11.37. Lead forms five compounds with oxygen: 1. Suboxide, Pb_2O. 2. Monoxide, PbO. 3. Sesquioxide, Pb_2O_3. 4. Dioxide, PbO_2. 5. Triplumbic tetroxide, Pb_3O_4.

Tests for Compounds of Lead

1. Hydrogen sulphide or ammonium sulphide precipitates the insoluble black sulphide from salts of lead.
2. Sulphuric acid or a sulphate causes the precipitation of the white sulphate, insoluble in nitric acid.
3. The alkaline carbonates (sodium, potassium, and ammonium) precipitate lead carbonate, insoluble in an excess.

Poisonous Properties of Lead and its Compounds

Pure water dissolves appreciable quantities of lead through the formation of a slightly soluble hydroxide or carbonate. If traces of sulphates or chlorides be present in the water, an insoluble coating is formed on the surface of the metal, which protects it from further decomposition. Lead pipes and lead tanks for containing drinking water should be used with care (see U. S. Dispensatory, 18th edition, page 1059).

Official Salts and Preparations of Lead

Official Name	Preparation
Plumbi Acetas	Made by treating lead oxide with acetic acid, evaporating, and crystallizing
Liquor Plumbi Subacetatis	By boiling aqueous solution of lead acetate with lead oxide
Plumbi Subacetatis Dilutus	By diluting 40 Gm. of solution of lead subacetate with 960 Gm. of distilled water
Ceratum Plumbi Subacetatis	By mixing 20 Gm. of solution of lead subacetate, 20 Gm. of wool-fat, 20 Gm. of paraffin, 38 Gm. of white petrolatum, and 2 Gm. of camphor
Plumbi Iodidum	By double decomposition between lead nitrate and potassium iodide
Nitras	By treating lead oxide with diluted nitric acid, evaporating, and crystallizing
Oxidum	By roasting lead ore in reverberatory furnaces
Unguentum Diachylon	By diluting lead plaster with olive oil and adding a little oil of lavender
Emplastrum Plumbi	By mixing solutions of castile soap and lead acetate, collecting and washing precipitate

Unofficial Salts and Preparations of Lead

Plumbi Bromidum, $PbBr_2$ Lead Bromide	By making separate solutions of lead acetate and potassium bromide, mixing them, and collecting the precipitate
Plumbi Carbonas, $(PbCo_3)_2Pb(OH)_2$ Lead Carbonate	By acting on metallic lead with fumes of acetic acid and decaying matter
Plumbi Chloridum, $PbCl_2$ Lead Chloride	By dissolving lead acetate in water and adding hydrochloric acid, then collecting the precipitate
Plumbi Chloris, $Pb(ClO_2)_2$ Lead Chlorite	By making separate solutions of lead nitrate and neutral calcium chlorite, mixing them, and collecting the precipitate
Plumbi Chromas, $PbCrO_4$ Lead Chromate	By making separate solutions of lead nitrate and potassium dichromate, mixing them, and collecting the precipitate
Plumbi Dioxidum, PbO_2 Lead Dioxide	By treating red lead with diluted nitric acid and collecting the insoluble powder
Plumbi Hydroxidum Lead Hydroxide	By mixing solutions of lead acetate and sodium hydroxide and collecting the precipitate
Plumbi Oxidum Rubrum, Pb_3O_4 Red Lead Oxide	By heating massicot to near 450° C. (840° F.); it gradually combines with the oxygen of the air, which converts it into red lead
Plumbi Saccharas Lead Saccharate	By saturating a solution of saccharic acid in water with freshly precipitated lead carbonate gradually added
Plumbi Sulphas, $PbSO_4$ Lead Sulphate	By dissolving lead nitrate in water and adding sulphuric acid, then collecting the precipitate
Plumbi Tannas Lead Tannate	By adding a solution of tannin to one of lead acetate and collecting the precipitate

PLUMBI ACETAS. U.S. Lead Acetate

$$Pb(C_2H_3O_2)_2 + 3H_2O = 376.15$$

[SUGAR OF LEAD]

It should contain not less than 99.5 percent. of pure Lead Acetate $[(CH_3.COO)_2Pb + 3H_2O]$, and should be kept in well-stoppered bottles.

Preparation.—This important salt is made by adding lead oxide to acetic acid and gently heating the mixture until combination takes place.

$$\underset{\text{Lead Oxide}}{PbO} + \underset{\text{Acetic Acid}}{2HC_2H_3O_2} = \underset{\text{Lead Acetate}}{Pb(C_2H_3O_2)_2} + \underset{\text{Water}}{H_2O}$$

The commercial salt is unfit for pharmaceutical uses; it is not expected to be pure, and usually contains both carbonate and oxide. The official salt is thus described:

Official Description.—Colorless, shining, transparent, monoclinic prisms or plates, or heavy, white, crystalline masses, or granular crystals. Efflorescent, and absorbing carbon dioxide on exposure to the air.

Odor, Taste, and Reaction.—Faintly acetous odor; sweetish, astringent, afterwards metallic taste; neutral or slightly alkaline reaction.

Solubility.—*Water.* In 2 parts at 25° C. (77° F.); in 0.5 part of boiling water.

Alcohol. In 30 parts at 25° C. (77° F.); in 1 part of boiling alcohol.

Tests for Identity.—When heated to 40° C. (104° F.), the salt loses its water of crystallization (14.26 percent.). When heated rapidly to 75° C. (167° F.) it fuses in its water of crystallization, and at a higher temperature is converted into a pulverulent basic salt which fuses at about 280° C. (536° F.) with continued loss of acetic acid, finally decomposing with the evolution of carbon dioxide and acetone, leaving a residue of finely divided metallic lead mixed with oxide and carbonate.

On heating the salt with sulphuric acid, vapors of acetic acid are evolved.

The aqueous solution of Lead Acetate has a neutral or slightly alkaline reaction, and yields a black precipitate with hydrogen sulphide T.S., a yellow one with potassium iodide T.S., and a white one with diluted sulphuric acid.

Impurities and Tests for Impurities.—*Limit of carbonate.* A solution of the salt (1 in 10), prepared with water which has been recently boiled, should be clear, or only slightly opalescent.

Iron and copper. The above solution should yield, with potassium ferrocyanide T.S., a pure white precipitate.

Limit of zinc and iron. If to the aqueous solution of the salt (1 in 10), hydrochloric acid be added until no further precipitate is produced, the remainder of the lead removed from the filtrate by hydrogen sulphide, and the liquid filtered, a portion of the second filtrate should not, upon the addition of ammonia water, yield more than a slight precipitate.

Limit of salts of the alkali metals, and those of magnesium, calcium, zinc and iron. If another portion of the filtrate be evaporated to dryness, it should not leave more than a slight residue after gentle ignition.

Uses.—Lead acetate is a valuable astringent and sedative; it is used both internally and externally. The dose is from one to three grains (0.065 to 0.2 Gm.). Its solution in water is turbid, due to the formation of a trace of carbonate through the carbonic acid present in the water; diluted acetic acid dissolves this precipitate.

LIQUOR PLUMBI SUBACETATIS. U.S. Solution of Lead Subacetate

[GOULARD'S EXTRACT]

An aqueous liquid, which should contain in solution not less than 25 percent of Lead Subacetate [approximately $Pb_2O(CH_3.COO)_2 = 543.74$].

	Metric	Old form
* **Lead Acetate**	180 Gm.	3 oz. av. 313 gr.
Lead Oxide	110 Gm.	2 oz. av. 18 gr.
Distilled Water, a sufficient quantity,		
To make	1000 Gm.	1 pint

To the finely powdered Lead Oxide contained in a porcelain dish, of about 1000 Cc. [old form 2 pints] capacity, add slowly and in portions, with constant stirring, the Lead Acetate which has been previously dissolved in 700 Cc. [old form 11½ fl. oz.] of boiling Distilled Water, and boil the liquid for half an hour, with occasional stirring. Finally, when cool, filter the Solution, and add sufficient Distilled Water, which has been previously boiled and cooled, to make the finished product weigh 1000 Gm. [or measure, old form, 1 pint]. Keep the Solution in well-stoppered bottles.

The object of this process is to furnish a concentrated solution of a lead compound containing a small proportion of acetic acid. The "subacetate" is not a definite salt, but as found in the official solution it is a mixture of oxyacetates, produced by boiling the normal acetate in water in contact with the oxide.

$$\underset{\text{Lead Oxide}}{3PbO} + \underset{\text{Lead Acetate}}{3Pb(C_2H_3O_2)_2} = \underbrace{Pb_3O(C_2H_3O_2)_4 + Pb_3O_2(C_2H_3O_2)_2}_{\text{Lead Oxyacetates}}$$

Official Description.—A clear, colorless liquid. On exposure to the air it absorbs carbon dioxide, which causes the formation of a white precipitate.

Odor, Taste, and Reaction.—Odorless; sweetish, astringent taste; alkaline reaction.

Specific Gravity.—About 1.235 at 25° C. (77° F.).

Tests for Identity.—When Solution of Lead Subacetate is added to a solution of acacia, it produces a dense, white precipitate (distinction from *normal lead acetate*).

In other respects the Solution conforms to the reactions and tests for an aqueous solution of lead acetate given under *Plumbi Acetas*.

Quantitative Test.—If 10 Gm. of the Solution be diluted with distilled water, which has been previously boiled and cooled, to measure 100 Cc., and 13.6 (13.594) Cc. of this be added to 35 Cc. of tenth-normal oxalic acid V.S., contained in a graduated cylinder, and, after thoroughly shaking, the mixture be diluted with distilled water to measure 50 Cc., and again well shaken, then, after the precipitate has settled, 10 Cc. of the clear solution, after diluting with about 50 Cc. of water and adding 5 Cc. of sulphuric acid, should require not more than 2 Cc. of tenth-normal potassium permanganate V.S. to produce a permanent pink tint (each Cc. of tenth-normal oxalic acid V.S. required for the precipitation of the 13.6 Cc. of the diluted Solution, corresponding to 1 percent. of Lead Subacetate).

Uses.—This solution, which is frequently termed *Goulard's Extract*, is sedative and astringent; it is employed externally as an application to inflamed surfaces.

LIQUOR PLUMBI SUBACETATIS DILUTUS. U.S. Diluted Solution of Lead Subacetate

[LEAD WATER]

An aqueous liquid, which should contain about 1 percent. of Lead Subacetate.

	Metric	Old form
* **Solution of Lead Subacetate**	**40 Gm.**	1 fl. oz. 20 min.
Distilled Water, a sufficient quantity,		
To make	**1000 Gm.**	2 pints

Mix the Solution of Lead Subacetate with enough Distilled Water, previously boiled and cooled, to make the product weigh 1000 Gm. [old form 2 pints]. Keep the Solution in well-stoppered bottles.

This solution will be opalescent, through the formation of a trace of carbonate, if the distilled water used has not been recently boiled and cooled, the object of which is to deprive the water of carbonic acid gas. The addition of a few drops of acetic acid clears the solution by dissolving the precipitate; but, as many serious errors have occurred through the internal use by patients of *lead* water in mistake for *lime* water, it is a good practice to dispense lead water in a slightly opalescent condition and lime water always as a transparent liquid, and, as an additional safeguard, to use blue poison bottles for the lead water.

Uses.—Lead water is used as a soothing application to inflamed surfaces.

CERATUM PLUMBI SUBACETATIS. U.S. Cerate of Lead Subacetate

[GOULARD'S CERATE]

This cerate is made by mixing 20 Gm. of solution of lead subacetate with 20 Gm. of melted wool-fat, and then adding 38 Gm. of white petrolatum and 20 Gm. of paraffin melted together, and in which 2 Gm. of camphor has been dissolved, mix the whole thoroughly as it cools. It possesses the sedative and astringent properties of the lead solution. It may be prevented from assuming a yellow color by the addition of a trace of acetic acid. (See Part V.)

PLUMBI IODIDUM. U.S. Lead Iodide

$PbI_2 = 457.15$

It should contain not less than 99 percent. of pure Lead Iodide, and should be kept in well-stoppered bottles, protected from light.

Preparation.—This Iodide may be made by a formerly official British process:

Take of Nitrate of Lead, Iodide of Potassium, each, 4 oz. av.; Distilled Water, a sufficiency. Dissolve the Nitrate of Lead, by the aid of heat, in a pint and a half, and the Iodide of Potassium in half a pint, of the Water, and mix the solutions. Collect the precipitate on a filter, wash it with Distilled Water, and dry it at a gentle heat.

This is an instance of double decomposition, lead iodide and potassium nitrate being formed. The nitrate is preferred to the acetate, because lead iodide is more soluble in solution of potassium acetate than in that of potassium nitrate.

$$\underset{\text{Potassium Iodide}}{2KI} + \underset{\text{Lead Nitrate}}{Pb2NO_3} = \underset{\text{Lead Iodide}}{PbI_2} + \underset{\text{Potassium Nitrate}}{2KNO_3}$$

Official Description.—A heavy, bright yellow powder; permanent in the air.
Odor and Taste.—Odorless and tasteless.
Solubility.—*Water.* In about 1300 parts at 25° C. (77° F.), and in about 200 parts of boiling water, separating from the latter solution on cooling in brilliant, golden-yellow crystalline laminæ.
Alcohol. Very slightly soluble.
Other solvents. Soluble, without color, in solutions of the fixed alkalies, in concentrated solutions of the alkali acetates, of potassium iodide, and of sodium thiosulphate, and in a hot solution of ammonium chloride.
Test for Identity.—When moderately heated, the salt fuses to a thick, reddish-brown liquid, which congeals, on cooling, to a yellow, crystalline mass. At a higher temperature it is decomposed, with the evolution of violet vapors of iodine, leaving a lemon-yellow residue of lead oxyiodide.
Impurities and Tests for Impurities.—*Chromate and other insoluble foreign salts.* If 1 Gm. of the salt be triturated with 2 Gm. of ammonium chloride and 2 Cc. of water, a nearly white mixture will result. If this be transferred to a test-tube, and heated in a water-bath for a few minutes, a clear and almost colorless solution should be formed. On cooling this solution, a solid mass of nearly colorless, fine, silky crystals will be produced, and on adding water or diluted sulphuric acid to this mass, yellow Lead Iodide will separate.
Limit of nitrate. Add 0.1 Gm. of the salt to 5 Cc. of water, and heat the mixture until it boils; cool the liquid and filter it into a test-tube of about 40 Cc. capacity, then add 5 Cc. of potassium hydroxide T.S. and about 0.2 Gm. of aluminum wire, insert in the upper portion of the test-tube a pledget of purified cotton, and over the mouth, place a piece of moistened red litmus paper; then if the tube be heated on a water-bath for fifteen minutes, no blue coloration of the paper should be discernible.
Acetate. If 1 Gm. of Lead Iodide be boiled for a few minutes with 20 Cc. of water, the mixture then cooled and filtered, and the lead removed from the filtrate by hydrogen sulphide, a portion of the second filtrate, after boiling to drive off hydrogen sulphide and carefully neutralizing with ammonia water, should not be colored red by a drop of ferric chloride T.S.
Soluble foreign salts. Another portion of this filtrate, if evaporated to dryness, should leave no residue.

Uses.—Lead iodide may be given internally in doses of one to three grains (0.065 to 0.2 Gm.). It is principally used externally in the form of a 10 percent. ointment.

PLUMBI NITRAS. U.S. Lead Nitrate

$Pb(NO_3)_2 = 328.49$

It should contain not less than 99.5 percent. of pure Lead Nitrate [$(NO_2.O)_2Pb$], and should be kept in well-closed vessels.

Preparation.—This salt may be easily made by adding lead oxide to equal parts of nitric acid and water, heating the mixture until solution is effected, and, after filtering, evaporating the solution of lead nitrate and crystallizing.

Official Description.—Colorless, transparent, octahedral crystals, when obtained by the spontaneous evaporation of cold solutions, or white, nearly opaque crystals, when formed by the cooling of hot solutions; permanent in the air.
Odor, Taste, and Reaction.—Odorless; sweetish, astringent, afterwards metallic taste; acid reaction.
Solubility.—*Water.* In 1.85 parts at 25° C. (77° F.); in 0.75 part of boiling water.
Alcohol. Almost insoluble.
Tests for Identity.—When strongly heated, the salt decrepitates, emits nitrous vapors, and finally leaves a residue of lead oxide.
It yields a black precipitate with hydrogen sulphide T.S., a yellow one with potassium iodide T.S., and a white one with diluted sulphuric acid.

Impurities and Tests for Impurities.—*Copper and iron.* The aqueous solution of the salt (1 in 10) should give, with potassium ferrocyanide T.S., a pure white precipitate.

Limit of zinc and iron. If hydrochloric acid be added to the aqueous solution of the salt (1 in 10) until no further precipitate is produced, and the remainder of the lead be removed from the filtrate by hydrogen sulphide, a portion of the second filtrate should not yield more than a slight precipitate upon the addition of ammonia water.

Limit of salts of the alkalies and those of magnesium, calcium, zinc, and iron. Another portion of this filtrate, when evaporated to dryness, should not leave more than a slight residue after gentle ignition.

Uses.—Lead nitrate is used in solution principally as an external application to excoriated surfaces.

PLUMBI OXIDUM. U.S. Lead Oxide

$PbO = 221.23$

[LITHARGE]

It should contain not less than 96 percent. of pure Lead Oxide, and should be kept in well-closed vessels.

Preparation.—Litharge is lead oxide which has been rendered semicrystalline by incomplete fusion. Almost all the litharge of commerce is obtained as a secondary product in the process for extracting silver from argentiferous galenas. After extracting the lead from the ore, the alloy is calcined in the open air, whereby the lead becomes oxidized, and by fusion passes into the state of litharge, while the silver remains unchanged.

Red lead is a higher oxide, Pb_3O_4; 683.04, and is made by sprinkling hot litharge with water, powdering and drying it, and then heating it out of contact with air. Litharge is officially described as follows:

Official Description.—A heavy, yellowish or reddish-yellow powder, or minute scales. On exposure to the air it slowly absorbs moisture and carbon dioxide.

Odor, Taste, and Reaction.—Odorless and tasteless; faintly alkaline reaction.

Solubility.—*Water.* Almost insoluble.

Alcohol. Insoluble.

Other solvents. In acetic or diluted nitric acid and in warm solutions of the fixed alkali hydroxides.

Tests for Identity.—When heated, the Oxide assumes a brownish-red color, becoming yellow again on cooling; it fuses at a red heat. When heated in contact with charcoal, it is reduced to metallic lead.

The solution in diluted nitric acid, which should be colorless, when nearly neutralized by ammonia water yields with hydrogen sulphide T.S. a black precipitate, with potassium iodide T.S. a yellow one, and with diluted sulphuric acid a white precipitate, the latter two being soluble in a strong solution of sodium hydroxide.

Impurities and Tests for Impurities.—*Limit of silicates, barium sulphate, etc.* Lead Oxide should be soluble in diluted nitric acid, with but little effervescence (limit of *carbonate*), and without the development of the odor of nitrous acid (absence of *lead*), leaving not more than a trifling residue.

Limit of copper. If from the solution in diluted nitric acid the lead be precipitated by sulphuric acid, the filtrate, after the addition of an excess of ammonia water, should not assume more than a slight bluish tint.

Limit of iron. Nor should the above solution yield more than traces of a reddish-brown precipitate

More than 4 percent. of insoluble impurities. If 5 Gm. of the Oxide contained in a small flask be shaken with 5 Cc. of water, then 20 Cc. of acetic acid added, and the mixture boiled for a few minutes and filtered, the insoluble residue, when well washed and dried, should not weigh more than 0.2 Gm.

Limit of soluble impurities. If, to the mixed filtrate and washings obtained in the last test, hydrochloric acid be added until no further precipitate be produced, the remainder of the lead removed from the filtrate by hydrogen sulphide, and the liquid filtered, the second filtrate, upon evaporation to dryness, should not yield a residue weighing more than 0.050 Gm.

Limit of carbonate and of moisture. When strongly heated in a porcelain crucible, the Oxide should not lose more than 4 percent. of its weight.

Uses.—Lead Oxide is used by manufacturers in making lead plaster, but in the U. S. P. (8th Rev.) the process of making lead plaster was changed (see below).

EMPLASTRUM PLUMBI. U. S. Lead Plaster

[Diachylon Plaster]

This compound of lead is now officially made by adding a solution of lead acetate to a solution of castile soap, whereby lead oleo-palmitate is precipitated and sodium acetate remains in solution. The precipitate is thoroughly washed, by kneading with warm water, and formed into cylindrical rolls. (See Part V.)

The official process in the U. S. P. 1890, and which has long been in use, consists of boiling lead oxide with olive oil and water, whereby the lead enters into combination with the fatty acids of the oil. (See Glycerinum.) It is used as the basis of many plasters.

UNGUENTUM DIACHYLON. U.S. Diachylon Ointment

This ointment is simply lead plaster diluted with olive oil to the consistence of an ointment and slightly perfumed with oil of lavender flowers. (See Unguenta.) It is used externally in several skin diseases.

Copper. Cu ; 63.1

Copper is found naturally in its metallic condition, also as a sulphide or oxide, and as a sulphate, carbonate, phosphate, or arsenate. It is a brilliant metal, of a red color, having a specific gravity of 8.92 to 8.95. It forms two oxides : 1. Red cuprous oxide, Cu_2O. 2. Black cupric oxide, CuO.

Tests for Compounds of Copper

1. Hydrogen sulphide or ammonium sulphide produces a black precipitate of cupric sulphide.
2. Ammonia water produces in concentrated solutions of copper salts a pale blue precipitate of cupric hydroxide, in dilute solutions a deep blue coloration.
3. Potassium ferrocyanide produces a reddish-brown precipitate of cupric ferrocyanide.
4. A bright surface of metallic iron or zinc immersed in an acidulated solution of a copper salt is coated with metallic copper.
5. Copper salts color the flame of an alcohol lamp or Bunsen burner green.

Official Salt of Copper

Official Name	Preparation
Cupri Sulphas	By treating copper with diluted sulphuric acid, evaporating the solution, and crystallizing

Unofficial Salts of Copper

Cupri Acetas, $Cu(C_2H_3O_2)_2 + H_2O$ Copper Acetate	By treating copper with acetic acid and purifying the product by crystallization
Cupri Arsenas, $Cu_3As_2O_8 + 4H_2O$ Copper Arsenate	By adding a solution of copper sulphate to a solution of disodic arsenate, and collecting and drying the precipitate
Cupri Bromidum, $CuBr_2$ Copper Bromide	By evaporating a solution of cupric oxide in aqueous hydrobromic acid, and fusing the residue at a gentle heat

Unofficial Salts of Copper—*Continued*

Cupri Citras Copper Citrate	By heating a solution of cupric acetate with citric acid and setting aside to crystallize
Cupri Nitras, $Cu(NO_3)_2$ Copper Nitrate	By dissolving metallic copper in nitric acid and concentrating the solution, then crystallizing
Cupri Oxidum, CuO Copper Oxide	By continued ignition of copper in contact with air
Cupri Subacetas, $Cu(HO)_2.Cu(C_2H_3O_2)_2$ Verdigris	Made by acting on sheets of copper with acetic acid
Cupri Tartras Copper Tartrate	By adding a solution of neutral potassium tartrate to a solution of cupric sulphate and collecting the precipitate

CUPRI SULPHAS. U.S. Copper Sulphate

$$CuSO_4 + 5H_2O = 247.85$$

It should contain not less than 99.5 percent. of pure Copper Sulphate [$SO_2.O_2Cu + 5H_2O$].

Preparation.—This salt is economically made by acting on scrap copper with diluted sulphuric acid, heating, evaporating the solution, and crystallizing.

Official Description.—Large, transparent, deep blue, triclinic crystals; slowly efflorescent in dry air.

Odor, Taste, and Reaction.—Odorless; nauseous, metallic taste. The aqueous solution (1 in 20) has a blue color, and shows an acid reaction with blue litmus paper.

Solubility.—*Water.* Soluble in about 2.2 parts at 25° C. (77° F.), and in 0.5 part of boiling water.

Alcohol. In 400 parts at 25° C. (77° F.).

Other solvents. In 3.5 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—When heated to 30° C. (86° F.), the salt loses 2 of its 5 molecules of water (14.43 percent.), and is converted into a pale blue, amorphous powder. Two more molecules of water are lost at 100° C. (212° F.), while the fifth is retained until 200° C. (392° F.) is reached, when a white, anhydrous powder remains (63.9 percent. of the original weight). At a still higher temperature, sulphur dioxide and oxygen are given off, and a residue of black cupric oxide is left.

If a drop of the solution be placed upon a bright piece of iron, a red film of metallic copper will be produced.

With potassium ferrocyanide T.S. the solution yields a deep reddish-brown precipitate.

Barium chloride T.S. produces in the solution a white precipitate, insoluble in hydrochloric acid.

If ammonia water be added to the solution, drop by drop, a pale blue precipitate of cupric hydroxide is formed, which redissolves in an excess of ammonia water, forming a deep azure-blue solution.

Impurities and Tests for Impurities.—*Limit of iron, aluminum, etc.* If hydrogen sulphide gas be passed through 10 Cc. of the aqueous solution of the salt (1 in 20), to which 1 Cc. of diluted hydrochloric acid has been added, until all of the copper is precipitated as sulphide, one-half of the colorless filtrate should not be colored or rendered turbid upon the addition of ammonia water, nor should the remaining portion of the filtrate yield, upon evaporation and ignition, a weighable residue.

Heavy metals. If the aqueous solution of the salt (1 in 20) be heated to boiling with an excess of sodium hydroxide T.S., until all of the copper has been converted into black cupric oxide, it will yield a colorless filtrate, which, after acidulation with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Uses.—Copper sulphate, called commercially *blue vitriol*, is used internally as an emetic, in doses of four grains (0.25 Gm.); as an astringent or tonic, from one-fifth to one-half grain (0.01 to 0.03 Gm.) is given. It is used as an injection in gonorrhœa and other diseases, and also as a stimulant wash, and in substance as an escharotic.

Silver. Ag; 107.12

Silver is found in the metallic state, but usually as a sulphide, and associated with lead sulphide, or *galena*.

Silver is a brilliant white metal, very malleable and ductile, having a specific gravity of 10.4 to 10.5. It forms but one oxide, Ag_2O.

Tests for Silver Salts

1. Hydrochloric acid or any soluble chloride produces with a soluble salt of silver a characteristic, curdy, white precipitate of silver chloride, which is insoluble in hot nitric acid, but soluble in ammonia water.

2. Hydrogen sulphide or ammonium sulphide produces a black precipitate of silver sulphide.

3. Caustic alkalies produce a brown precipitate of silver oxide.

Official Salts and Preparations of Silver

Official Name	Preparation
Argenti Cyanidum	By passing hydrocyanic acid gas into solution of silver nitrate
Nitras	By treating metallic silver with nitric acid, evaporating the solution, and crystallizing
Nitras Fusus	By fusing and moulding silver nitrate
Nitras Mitigatus	By fusing together 30 parts of silver nitrate and 60 parts potassium nitrate
Oxidum	By precipitating solution of silver nitrate with solution of potassium hydroxide

Unofficial Salts of Silver

Argenti Acetas, $AgC_2H_3O_2$ Silver Acetate	By adding a solution of silver nitrate to a solution of sodium acetate, then collecting and drying the precipitate
Argenti Bromidum, AgBr Silver Bromide	By adding to a solution of silver nitrate a solution of potassium bromide, then collecting and drying the precipitate
Argenti Chloridum, AgCl Silver Chloride	By adding to a solution of silver nitrate hydrochloric acid as long as a precipitate is produced, then collecting and drying the precipitate
Argenti Chromas, Ag_2CrO_4 Silver Chromate	By adding a solution of neutral potassium chromate to a solution of silver nitrate, then collecting and drying the precipitate
Argenti Iodidum, AgI Silver Iodide	By double decomposition between potassium iodide and silver nitrate
Argenti Lactas, $AgC_3H_5O_3 + H_2O$ Silver Lactate	By boiling silver carbonate with lactic acid, and collecting and drying the precipitate
Argenti Oxalas, $Ag_2C_2O_4$ Silver Oxalate	By adding a solution of oxalic acid to a solution of silver nitrate, and collecting and drying the precipitate
Argenti Phosphas, Ag_3PO_4 Silver Phosphate	By adding a solution of silver nitrate to a solution of sodium phosphate, and collecting and drying the precipitate
Argenti Sulphas, Ag_2SO_4 Silver Sulphate	By adding a solution of silver nitrate to a solution of sodium sulphate, and collecting and drying the precipitate

ARGENTI CYANIDUM. U.S. *Silver Cyanide*

$AgCN = 132.96$

It should contain not less than 99.9 percent. of pure Silver Cyanide, corresponding to 80.48 percent. of metallic silver. It should be kept in dark amber-colored vials, protected from light.

Preparation.—Silver cyanide is easily prepared by passing hydrocyanic acid gas into a solution of silver nitrate, or by mixing solutions of potassium cyanide and silver nitrate.

$$\underset{\substack{\text{Silver}\\\text{Nitrate}}}{AgNO_3} + \underset{\substack{\text{Potassium}\\\text{Cyanide}}}{KCN} = \underset{\substack{\text{Silver}\\\text{Cyanide}}}{AgCN} + \underset{\substack{\text{Potassium}\\\text{Nitrate}}}{KNO_3}$$

Official Description.—A white powder, permanent in dry air, but gradually turning brown on exposure to light.

Odor and Taste.—Without odor or taste.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Insoluble in cold nitric acid; soluble in boiling nitric acid with evolution of hydrocyanic acid; also soluble in ammonia water, sodium thiosulphate T.S., and potassium cyanide T.S.

Quantitative Test.—When heated in a porcelain crucible the salt fuses, gives off cyanogen gas, and, on ignition, leaves a residue of metallic silver amounting to 80.48 percent of its original weight.

Uses.—This salt was made official to use in the extemporaneous preparation of hydrocyanic acid. (See Acidum Hydrocyanicum Dilutum.)

ARGENTI NITRAS. U.S. Silver Nitrate

$AgNO_3 = 168.69$

It should contain not less than 99.9 percent. of pure Silver Nitrate, and should be kept in dark amber-colored vials, protected from light.

Preparation.—This valuable salt may be made by a former official process:

Take of Silver, in small pieces, 2 oz. troy; Nitric Acid, 2½ oz. troy; Distilled Water, a sufficient quantity. Mix the Acid with a fluidounce of Distilled Water in a porcelain capsule, add the Silver to the mixture, cover it with an inverted glass funnel, resting within the edge of the capsule, and apply a gentle heat until the metal is dissolved, and red vapors cease to be produced; then remove the funnel, and, increasing the heat, evaporate the solution to dryness. Melt the dry mass, and continue the heat, stirring constantly with a glass rod, until free nitric acid is entirely dissipated. Dissolve the melted salt, when cold, in six fluidounces of Distilled Water, allow the insoluble matter to subside, and decant the clear solution. Mix the residue with a fluidounce of Distilled Water, filter through paper, and, having added the filtrate to the decanted solution, evaporate the liquid until a pellicle begins to form, and set it aside in a warm place to crystallize. Lastly, drain the crystals in a glass funnel until dry, and preserve them in a well-stoppered bottle. By evaporating the mother water, more crystals may be obtained.

The silver employed is usually coin, and this always contains copper; hence, copper nitrate is present, which is known by the bluish color of the solution. By evaporating the solution and fusing the residue the copper salt is decomposed and the insoluble copper oxide produced; by solution and filtration this is separated, and the purified solution of silver nitrate is evaporated and crystallized.

$$\underset{\text{Silver}}{Ag_3} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{4HNO_3} = \underset{\substack{\text{Silver}\\\text{Nitrate}}}{3AgNO_3} + \underset{\substack{\text{Nitrogen}\\\text{Monoxide}}}{NO} + \underset{\text{Water}}{2H_2O}$$

Official Description.—Colorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light in the presence of organic matter.

Odor, Taste, and Reaction.—Without odor, but having a bitter, caustic, and strongly metallic taste; neutral reaction.

Solubility.—*Water.* In 0.54 part at 25° C. (77° F.); in 0.1 part of boiling water.

Alcohol. In 24 parts at 25° C. (77° F.); in 5 parts boiling Alcohol.

Tests for Identity.—When heated in a porcelain crucible to about 200° C. (392° F.), the salt melts, forming a faintly yellow liquid, which, on cooling, congeals to a pure white, crystalline mass. At a higher temperature it is gradually decomposed with evolution of nitrous vapors.

Impurities and Tests for Impurities.—*Copper.* An aqueous solution of the salt yields, with hydrochloric acid, a white precipitate, which is readily dissolved by ammonia water, the liquid not acquiring a blue color.

Lead. If 5 Cc. of an aqueous solution of the salt (1 in 10) be mixed with 20 Cc. of hot diluted sulphuric acid, and heated to boiling, no turbidity should be perceptible, and upon standing, no white precipitate should be deposited.

Limit of foreign salts. If a portion of an aqueous solution (1 in 10) be completely precipitated by hydrochloric acid, filtered, and the filtrate evaporated to dryness, not more than 0.1 per cent. of residue should remain.

Quantitative Test.—If 0.5 Gm. of Silver Nitrate, dissolved in 10 Cc. of distilled water, be well mixed with 30 Cc. of tenth-normal sodium chloride V.S. and 3 drops of potassium chromate T.S., not more than 0.4 Cc. of tenth-normal silver nitrate V.S. should be required to impart to the liquid a permanent red color.

Uses.—Silver nitrate is used externally as a caustic and escharotic; internally, it is given in gastritis and diarrhœa, in doses of one-fifth to one-half grain (0.01 to 0.03 Gm.).

ARGENTI NITRAS FUSUS. U.S. Moulded Silver Nitrate

[Fused Silver Nitrate Lunar Caustic Toughened Caustic]

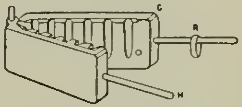
It should contain not less than 94.8 percent. of pure Silver Nitrate.

	Metric	Old form
* **Silver Nitrate**	**100 Gm.**	1 oz. av.
Hydrochloric Acid	**4 Gm.**	16 minims

To the Silver Nitrate, contained in a porcelain dish, add the Hydrochloric Acid, and melt the mixture at as low a temperature as possible. Stir well, and pour the melted mass into suitable moulds. It should be kept in dark amber-colored vials, protected from light.

When pure fused silver nitrate is cooled, the mass is very brittle, but the addition of hydrochloric acid produces sufficient silver chloride to toughen it, so that the cast cones or sticks will not break so easily. In order to keep the sticks from becoming discolored during the casting process, it is advisable to add a little diluted nitric acid (1 in 5) occasionally to the melted nitrate, and carefully prevent the mass from becoming overheated. Fig. 445 illustrates the silver moulds used in moulding the cones.

Fig. 445



Caustic cone mould

Official Description.—A white, hard solid, generally in the form of pencils or cones of a fibrous fracture, becoming gray or grayish-black on exposure to light in the presence of organic matter.

Odor, Taste, and Reaction.—Odorless; bitter, caustic, and strongly metallic taste; neutral reaction.

Solubility.—*Water.* Soluble, with the exception of about 5 percent. of silver chloride, in 0.54 part at 25° C. (77° F.); in 0.1 part of boiling water. The portion left undissolved by water should be completely soluble in ammonia water.

Alcohol. In 24 parts at 25° C. (77° F.); in 5 parts of boiling alcohol.

Tests for Identity.—A clear, aqueous solution of Moulded Silver Nitrate, decanted from the insoluble portion, should be neutral to litmus paper, and should respond to the tests of identity and purity stated under *Argenti Nitras.*

Quantitative Test.—If 0.5 Gm. of Moulded Silver Nitrate, dissolved as completely as possible in 10 Cc. of water, be thoroughly mixed with 30 Cc. of tenth-normal sodium chloride V.S. and 3 drops of potassium chromate T.S., not more than 1.9 Cc. of tenth-normal silver nitrate V.S. should be required to impart to the liquid a permanent red color.

Uses.—Moulded silver nitrate is used as an escharotic; a good caustic holder may be made from a glass stirring rod of the same diameter as the cone by joining it to the cone with a short length of rubber tubing. The cone may be protected from the action of the air by slipping over it another short length of rubber tubing, having a very short piece of glass rod in the other end as a stopper.

Death has resulted more than once through the careless use of silver nitrate in cauterizing the throat, the cone having slipped out of the fingers and then been swallowed by the patient.

ARGENTI NITRAS MITIGATUS. U.S. Mitigated Silver Nitrate

[ARGENTI NITRAS DILUTUS, PHARM. 1890 DILUTED SILVER NITRATE MITIGATED CAUSTIC]

It should contain not less than 33.3 percent. of pure Silver Nitrate.

	Metric	Old form
* **Silver Nitrate**	**30 Gm.**	1 oz. av.
Potassium Nitrate	**60 Gm.**	2 oz. av.

Melt the salts together in a porcelain crucible, at as low a temperature as possible, stirring the melted mass well until it flows smoothly. Then pour it into suitable moulds. It should be kept in dark amber-colored vials, protected from light.

Official Description.—A white, hard solid, generally in the form of pencils or cones of a finely granular fracture, becoming gray or grayish-black on exposure to light in the presence of organic matter.

Odor, Taste, and Reaction.—Odorless; caustic, metallic taste; neutral reaction.

Solubility.—Each of its constituents retains the solubility in water and in alcohol stated respectively under *Argenti Nitras* and *Potassii Nitras*.

Tests for Identity.—An aqueous solution of Mitigated Silver Nitrate yields with a slight excess of hydrochloric acid a white precipitate, which is readily soluble in ammonia water. The filtrate from this precipitate, when evaporated to dryness, yields a white residue which is completely soluble in water, and this solution, when concentrated, affords a white, crystalline precipitate with sodium bitartrate T.S.

If 1 drop of diphenylamine T.S. be mixed with 5 Cc. of an aqueous solution of the salt in a test-tube, and sulphuric acid be carefully poured in, so as to form a separate layer, a blue color will appear at the line of contact.

Impurities and Test.—*Copper.* If to an aqueous solution of Mitigated Silver Nitrate a slight excess of ammonia water be added, it should neither assume a blue color.

Lead and bismuth. Nor show any turbidity.

Quantitative Test.—If 1 Gm. of Mitigated Silver Nitrate, dissolved in 10 Cc. of water, be well mixed with 20 Cc. of tenth-normal sodium chloride V.S. and 3 drops of potassium chromate T.S., not more than 0.3 Cc. of tenth-normal silver nitrate V.S. should be required to impart to the liquid a permanent red color.

Uses.—The object of this preparation is to provide a fused silver nitrate, which may often be useful where the undiluted caustic might prove too severe in its action. This preparation is used only externally. It is similar in its action to the moulded nitrate, but less energetic.

ARGENTI OXIDUM. U.S. Silver Oxide

$Ag_2O = 230.12$

It should contain 99.8 percent. of pure Silver Oxide, corresponding to not less than 92.9 percent. of pure metallic silver, and should be kept in dark amber-colored vials. Silver Oxide should not be triturated with readily oxidizable or combustible substances, and should not be brought in contact with ammonia.

Preparation.—This salt may be made by a former official process: Take of Nitrate of Silver, 4 oz. troy; Distilled Water, half a pint; Solution of Potassa, $1\frac{1}{2}$ pints, or a sufficient quantity. Dissolve the Nitrate of Silver in the Water, and to the solution add Solution of Potassa so long as it produces a precipitate. Wash this repeatedly with water until the washings are nearly tasteless. Lastly, dry the precipitate and keep it in a well-stoppered bottle protected from the light.

$$\underset{\substack{\text{Silver}\\\text{Nitrate}}}{2AgNO_3} + \underset{\substack{\text{Potassium}\\\text{Hydroxide}}}{2KHO} = \underset{\substack{\text{Silver}\\\text{Oxide}}}{Ag_2O} + \underset{\substack{\text{Potassium}\\\text{Nitrate.}}}{2KNO_3} + \underset{\text{Water}}{H_2O}$$

Official Description.—A heavy, dark brownish-black powder, liable to reduction by exposure to light.

Odor, Taste, and Reaction.—Odorless; metallic taste; alkaline reaction.

Solubility.—*Water.* Very slightly. *Alcohol.* Insoluble.

Tests for Identity.—When heated in a porcelain crucible to about 250° to 300° C. (482° to 572° F.), it is rapidly decomposed, with the evolution of oxygen, leaving a residue of metallic silver. The solution of the Oxide in nitric acid should be colorless, and should respond to the reactions and tests stated under *Argenti Nitras.*

Impurity and Test for Impurity.—*Carbonate.* It is readily soluble in nitric acid without effervescence.

Limit of Chloride.—If 0.2 Gm. of the Oxide be dissolved in a mixture of 1 Cc. of nitric acid and 2 Cc. of distilled water, 10 Cc. of ammonia water added, and the liquid diluted to 60 Cc., then 10 Cc. of this solution should not immediately become cloudy upon the addition of 1 Cc. of nitric acid.

Quantitative Test.—If 0.5 Gm. of the Oxide be ignited in a porcelain crucible, it should yield not less than 0.464 Gm. of pure metallic silver.

Uses.—Silver oxide is used as a substitute for silver nitrate, being much less caustic than the latter, and better suited for internal use. It is owing to the facility with which it parts with its oxygen that silver oxide should not be triturated with readily oxidizable or combustible substances, and should not be brought in contact with ammonia. The dose is one grain (0.065 Gm.).

Gelatin capsules are well fitted for dispensing this compound. With most excipients decomposition ensues, and the pills have been known to explode with some violence.

Mercury. Hg; 198.5

Mercury, or quicksilver, is found most abundantly as sulphide, or *cinnabar;* the principal mines are in Spain and California. It is a brilliant, silver-white metal, liquid above —40° C. (—40° F.), and having the specific gravity 13.5584. Mercury forms two series of compounds,—*mercurous,* and *mercuric.* It is used more largely in medicine in the metallic state than any other element.

Tests for Compounds of Mercury

1. Ammonium sulphide or hydrogen sulphide, in excess, produces a black precipitate (sulphide) in solutions of salts of mercury.
2. Potassium iodide produces with mercurous salts a green precipitate of mercurous iodide, or with mercuric salts a red precipitate of mercuric iodide, soluble in excess.
3. With hydrochloric acid or soluble chlorides a white precipitate of mercurous chloride is produced with mercurous salts, while with mercuric salts no precipitation occurs.
4. A plate of copper or a solution of stannous chloride, in excess, precipitates the metal from its soluble combinations.

Official Preparations of Mercury

Preparations of the Metal

Official Name	Preparation
Hydrargyrum cum Creta	By extinguishing 38 Gm. of mercury with 10 Gm. of clarified honey and 57 Gm. of prepared chalk
Emplastrum Hydrargyri	By extinguishing 30 Gm. of mercury with 1 Gm. of oleate of mercury, and incorporating with 10 Gm. of hydrous wool-fat and sufficient melted lead plaster to make 100 Gm.
Massa Hydrargyri	By extinguishing 33 percent. of mercury with honey of rose and glycerin, and then adding powdered glycyrrhiza and powdered althea
Unguentum Hydrargyri	By extinguishing 500 Gm. of mercury with 20 Gm. of oleate of mercury, then adding sufficient melted benzoinated lard and prepared suet to make 1000 Gm.
Hydrargyri Dilutum	By mixing 670 Gm. of mercurial ointment with 330 Gm. of petrolatum

Salts of Mercury and their Preparations

Hydrargyrum Ammoniatum	By precipitating solution of mercuric chloride with ammonia water
Unguentum Hydrargyri Ammoniati	By incorporating 10 Gm. of ammoniated mercury with 50 Gm. of white petrolatum and 40 Gm. of hydrous wool-fat
Hydrargyri Chloridum Corrosivum	By subliming mercuric sulphate with sodium chloride
Chloridum Mite	By subliming mercuric sulphate and mercury with sodium chloride
Iodidum Rubrum	By double decomposition between mercuric chloride and potassium iodide
Iodidum Flavum	By precipitating an acid solution of mercurous nitrate with potassium iodide
Oxidum Flavum	By precipitating solution of mercurous chloride with sodium hydroxide
Unguentum Hydrargyri Oxidi Flavi	By incorporating 10 Gm. of yellow mercuric oxide, after trituration with 10 Gm. of water, with 40 Gm. of hydrous wool-fat and 40 Gm. of petrolatum
Oleatum Hydrargyri	By dissolving 25 Gm. of yellow mercuric oxide in 75 Gm. of oleic acid
Hydrargyri Oxidum Rubrum	By decomposing mercuric nitrate by heat
Unguentum Hydrargyri Oxidi Rubri	By incorporating 10 Gm. of red mercuric oxide, after trituration with 10 Gm. of water, with 40 Gm. of hydrous wool-fat and 40 Gm. of petrolatum
Liquor Hydrargyri Nitratis	By dissolving 40 Gm. of red mercuric oxide in 45 Gm. of nitric acid and 15 Gm. of water
Unguentum Hydrargyri Nitratis	By treating lard with nitric acid, and then incorporating a solution of mercuric nitrate

Unofficial Salts of Mercury

Hydrargyri Acetas Mercuric Acetate	By dissolving mercuric oxide in acetic acid, filtering, concentrating, and crystallizing
Hydrargyri Arsenas Mercuric Arsenate	By adding a solution of arsenic acid to a solution of mercuric nitrate, and collecting the precipitate
Hydrargyri Bromidum, $HgBr_2$ Mercuric Bromide	By dissolving mercuric oxide in hot aqueous hydrobromic acid, filtering and concentrating, then crystallizing
Hydrargyri Carbonas, Hg_2CO_3 Mercurous Carbonate	By precipitating a solution of mercurous nitrate with acid potassium carbonate
Hydrargyri Chloras, $Hg(ClO_3)_2 + H_2O$ Mercuric Chlorate	By dissolving mercuric oxide in warm chloric acid, filtering and concentrating, then crystallizing
Hydrargyri Chromas, $HgCrO_4$ Mercuric Chromate	By boiling equal parts of chromium trioxide and yellow mercuric oxide in water, and collecting crystals
Hydrargyri Cyanidum, $Hg(CN)_2$ Mercuric Cyanide	By passing hydrocyanic acid into a vessel containing mercuric oxide with water
Hydrargyri Lactas, $(Hg_2)_2(C_3H_5O_3)_2 + 2H_2O$ Mercurous Lactate	By mixing boiling solutions of sodium lactate and mercurous nitrate, and collecting the precipitate
Hydrargyri Subsulphas Flavus, $Hg(HgO)_2SO_4$ Yellow Mercuric Subsulphate	By adding mercuric sulphate to boiling water
Hydrargyri Sulphidum Nigrum, HgS Black Mercuric Sulphide Ethiops Mineral	By rubbing together equal parts of mercury and sulphur
Hydrargyri Sulphidum Rubrum, HgS Red Mercuric Sulphide Vermilion	By fusing and subliming mercury and sulphur
Hydrargyri Nitras, $Hg_2(NO_3)_2 + 2H_2O$ Mercurous Nitrate	By mixing 4 parts mercury, 3 parts nitric acid, 1 part water, and after twenty-four hours collecting the crystals
Hydrargyri Sulphas, $HgSO_4$ Mercuric Sulphate	By heating 10 oz. mercury with 6 fl. oz. sulphuric acid, in a porcelain vessel, and stirring constantly until a white salt is obtained

HYDRARGYRUM. U.S. Mercury

$Hg = 198.50$

[QUICKSILVER]

It should contain not less than 99.9 percent. of pure metallic Mercury, and should be kept in strong, well-stoppered bottles.

Mercury for pharmaceutical uses should be pure. To separate mechanical impurities, moisture, or small quantities of oxide, mercury may be filtered by collecting it in a sound piece of chamois leather and, gathering the corners together, forcibly squeezing the particles through the pores of the leather. But distillation is preferable in most cases to purify the metal effectually, which may be accomplished by a process formerly official in the British Pharmacopœia, as follows:

Take of Mercury, 3 pounds [avoirdupois]; Hydrochloric Acid, 3 fluidrachms; Distilled Water, a sufficiency. Place the Mercury in a glass retort or iron bottle, and, applying heat, cause two pounds and a half of the metal to distil over into a flask employed as a receiver. Boil on this for five minutes the Hydrochloric Acid diluted with 9 fluidrachms of Distilled Water, and having, by repeated affusions of Distilled Water and decantations, removed every trace of acid, let the mercury be transferred to a porcelain capsule, and dried first by filtering paper, and finally on a water-bath.

Official Description.—A shining, silver-white metal.

Odor, Taste, and Reaction.—Odorless; tasteless.

Specific Gravity.—13.535 at 25° C. (77° F.).

Solubility.—Insoluble in the ordinary solvents, also in concentrated hydrochloric acid, and, at ordinary temperatures, in sulphuric acid; but it dissolves in the latter when boiled with it, and is readily and completely soluble in nitric acid.

Tests for Identity.—It is liquid at ordinary temperatures and easily divisible into spherical globules; but when cooled to —39.38° C. (—38.88° F.), it forms a ductile, malleable mass.

At ordinary temperatures it volatilizes very slowly, more rapidly as the temperature increases, and at 357.25° C. (675.05° F.) it boils and is completely volatilized, yielding a colorless, very poisonous vapor, and no appreciable residue.

When globules of Mercury are dropped upon white paper, they should roll about freely, retaining their globular form, and leaving no streaks or traces.

It should be perfectly dry and present a bright surface even after agitation in contact with air.

Impurity and Test.—*More than slight traces of foreign metals.* On boiling 5 Gm. of Mercury with 5 Cc. of water and 4.5 Gm. of sodium thiosulphate, in a test-tube, for about one minute, the Mercury should not lose its lustre, and should not acquire more than a slightly yellowish shade.

Uses.—When mercury is administered in a finely divided condition, as in blue mass, or in mercury with chalk, it exerts an action upon the liver, which is termed alterative. This action is possessed by some of its salts.

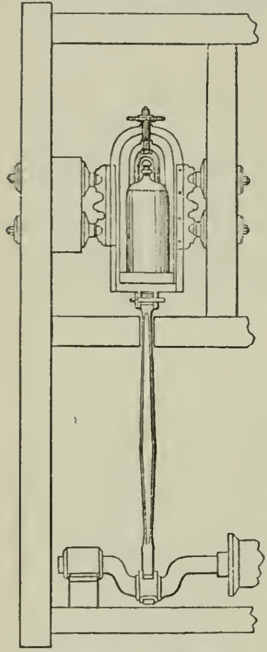
MASSA HYDRARGYRI. U. S. Mass of Mercury

	Metric	Old form
* **Mercury**	33 Gm.	5 oz. av. 122 gr.
Glycyrrhiza, in No. 60 powder	10 Gm.	1 oz. av. 263 gr.
Althæa, in No. 60 powder	15 Gm.	2 oz. av. 175 gr.
Glycerin	9 Gm.	1 oz. av. 193 gr.
Honey of Rose	33 Gm.	5 oz. av. 122 gr.
To make	100 Gm.	16 oz. av.

Triturate the Mercury with the Honey of Rose until it is extinguished and globules of Mercury are no longer visible under a lens magnifying ten diameters. Add the Glycerin, then the Glycyrrhiza and Althaea gradually, and continue the trituration until the mass is homogeneous. Keep the product in well-closed containers. (For tests see Part V.)

By using this formula the pharmacist is enabled to make blue mass extemporaneously with very little labor. The mass should not be *forcibly pressed,* or the globules of mercury will run together, and will grow larger instead of smaller.

Fig. 446



Squibb's mercurial shaker

Uses.—The object of this preparation is to furnish mercury in a finely divided condition. It is given in small doses to produce salivation, and in doses of three to ten grains (0.2 to 0.6 Gm.) as an alterative or purgative.

Fig. 446 illustrates the mercurial shaker invented by Dr. Squibb. It consists of a stout wooden frame to which is attached a metal cage for holding a strong glass gallon bottle; this is held in place by a cup-shaped screw clamp which rests on a cloth collar placed around the top of the bottle above the shoulder; the sides of the cage move in guides which are bolted to the wooden frame. A vertical shaft operated by the horizontal shaft at the bottom communicates an "up and down" motion to the bottle, and, when speeded properly, the mercury and a mixture containing honey in the bottle is thrown from the top to the bottom rapidly, and the mercury is thus quickly extinguished. The mixture is afterwards incorporated with the powders, placed in a large vessel, and the mass is finished. In making mercurial ointment, the mercury is placed in the bottle holding the lard, and both are shaken together; the mixture is afterwards mixed with the melted suet. This process of extinguishing mercury is termed "succussion."

HYDRARGYRUM CUM CRETA. U.S. Mercury with Chalk

[Gray Powder]

	Metric	Old form
* **Mercury**	38 Gm.	166 grains
Clarified Honey	10 Gm.	44 grains
Prepared Chalk	57 Gm.	248 grains
Water, a sufficient quantity,		
To make	100 Gm.	1 oz. av.

Weigh the Mercury and Clarified Honey successively into a strong bottle of the capacity of 100 Cc. [old form 1 fl. oz.], and add 2 Cc. [old form 10 minims] of Water. Cork the bottle, and shake it for about half an hour at a time, until the aggregate time of shaking reaches ten hours, or until the globules of Mercury are no longer visible under a lens magnifying *four diameters.* The shaking may be more conveniently performed by mechanical means. Rub the Prepared Chalk with Water, in a mortar, to a thick, creamy paste, and, having added the contents of the bottle, washing the last portions in with a little Water, triturate the whole to a uniform mixture.

Finally, dry the mixture, first between ample layers of bibulous paper, and afterwards in a dish at the ordinary temperature, until it weighs 100 Gm. [old form 1 oz. av.]. Then reduce it to a uniform powder, without trituration, and keep it in well-stoppered bottles, protected from light.

The intention here is to furnish mercury in a finely divided condition in the form of a powder. The above process is a very tedious one. In Matter's process, fifty-three grains of powdered acacia are mixed with fifty-three grains of chalk, enough water added to form a thin paste, and one hundred and sixty-seven grains of mercury added and triturated until extinguished. One hundred and sixty-five grains of chalk are made into a paste with water, and added to it, and the water evaporated from the mixture in a water-bath ; it is rubbed to powder when dry.

Official Description.—A light gray, rather damp powder, free from grittiness.

Odor and Taste.—Without odor ; slightly sweetish taste.

Impurities and Tests for Impurities.—*Limit of mercurous oxide.* If a portion of the powder be digested with warm acetic acid, the chalk is dissolved with effervescence, leaving a residue of finely divided mercury. The filtrate should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid.

Limit of mercuric oxide. If 0.1 Gm. of the powder be digested with 20 Cc. of warm diluted hydrochloric acid, the filtrate should not be affected by hydrogen sulphide T.S.

Uses.—Mercury with chalk is a mild mercurial, frequently given to children. It should be free from mercurous or mercuric oxide ; through exposure to air old specimens frequently contain both. The dose is four to ten grains (0.25 to 0.6 Gm.).

UNGUENTUM HYDRARGYRI. U.S. Mercurial Ointment

This ointment is made by extinguishing 500 Gm. of mercury with 20 Gm. of oleate of mercury ; the mixture is then incorporated with 250 Gm. of benzoinated lard and 230 Gm. of prepared suet, melted together. (See Unguenta.) The object of this process is to furnish finely divided mercury in a convenient form for external administration. The ointment is largely used, and the extemporaneous process furnishes a satisfactory preparation.

UNGUENTUM HYDRARGYRI DILUTUM. U.S. Blue Ointment

This ointment is made by mixing 670 Gm. of mercurial ointment with 330 Gm. of petrolatum, thus producing a 33⅓ percent. mercurial ointment. A demand for a weaker mercurial preparation for external use has warranted the introduction of this diluted ointment into the U. S. Pharmacopœia (8th Revision). Its properties are the same as the official mercurial ointment, although less active. (See Unguenta.)

EMPLASTRUM HYDRARGYRI. U.S. Mercurial Plaster

This plaster contains 30 Gm. of finely divided mercury extinguished in 1 Gm. of oleate of mercury and incorporated with 10 Gm. of hydrous wool-fat and 59 Gm. of melted lead plaster, the whole being thoroughly mixed while cooling. (See Emplastra.) Its uses are the same as those of the ointment, metallic mercury in a finely divided condition being present in both, the only difference being in the form of the preparations.

HYDRARGYRUM AMMONIATUM. U.S. Ammoniated Mercury

$HgNH_2Cl = 249.61$

[WHITE PRECIPITATE]

It should contain not less than 78 percent. nor more than 80 percent. of metallic mercury.

	Metric	Old form
* **Corrosive Mercuric Chloride,** in powder	**100 Gm.**	1 oz. av.
Ammonia Water,		
Distilled Water, each, a sufficient quantity		

Dissolve the Corrosive Mercuric Chloride in 2000 Cc. [old form 20 fl. oz.] of warm Distilled Water, filter the solution, and allow it to cool. Pour the filtered liquid gradually, and with constant stirring, into 150 Cc. [old form 1½ fl. oz.] of Ammonia Water, taking care that the latter shall remain in slight excess. Collect the precipitate on a filter, and, when the liquid has drained from it as much as possible, wash it with a mixture of 400 Cc. [old form 4 fl. oz.] of Distilled Water and 20 Cc. [old form 1½ fl. dr.] of Ammonia Water. Finally, dry the precipitate between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.), and keep it in well-stoppered bottles, protected from light.

In this process the ammonium of one-half of the ammonium chloride, which is formed upon mixing the solutions, has two of its hydrogen atoms replaced by one atom of bivalent mercury, NH_4Cl becoming NH_2HgCl.

$$\underset{\text{Mercuric Chloride}}{HgCl_2} + \underset{\text{Water of Ammonia}}{2NH_4HO} = \underset{\text{Ammonium Chloride}}{NH_4Cl} + \underset{\text{Mercurammonium Chloride}}{NH_2HgCl} + \underset{\text{Water}}{2H_2O}$$

Official Description.—White, pulverulent pieces, or a white, amorphous powder; permanent in the air.

Odor and Taste.—Without odor; earthy, afterwards styptic and metallic taste.

Solubility.—Insoluble in water or in alcohol. By prolonged washing with water it is gradually decomposed, assuming a yellow color, and becoming converted into a basic salt. Readily soluble in warm hydrochloric, nitric, or acetic acid, and in a cold solution of ammonium carbonate. Also completely soluble in a cold solution of sodium thiosulphate, with the evolution of ammonia; when this solution is heated for a short time, red mercuric sulphide is separated, which, on protracted boiling, turns black.

Tests for Identity.—At a temperature below a red heat Ammoniated Mercury is decomposed without fusion, and at a red heat it is wholly volatilized.

When heated with potassium hydroxide T.S., the salt turns yellow, and evolves vapor of ammonia.

The solution of the salt in diluted nitric acid gives with potassium iodide T.S. a red precipitate, and with silver nitrate T.S. a white precipitate.

Impurities and Tests for Impurities.—*Carbonate.* The salt should be soluble in hydrochloric acid without effervescence.

Mercurous salt. And without leaving a residue.

Foreign salts, metals, and arsenic. The solution of 0.5 Gm. of Ammoniated Mercury in 2 Cc. of hydrochloric acid diluted with water to 25 Cc. should not respond to the tests for *foreign salts, metals*, and *arsenic*, as described under *Hydrargyri Chloridum Mite.*

Uses.—This compound of mercury is not used internally; it is applied externally in the form of ointment.

UNGUENTUM HYDRARGYRI AMMONIATI. U.S. Ointment of Ammoniated Mercury

This ointment is made by incorporating 10 Gm. of ammoniated mercury with 50 Gm. of white petrolatum and 40 Gm. of hydrous wool-fat. It is a valuable application in certain forms of eczema and psoriasis and other skin diseases. (See Unguenta.)

HYDRARGYRI CHLORIDUM CORROSIVUM. U.S. Corrosive Mercuric Chloride

$HgCl_2 = 268.86$

[BICHLORIDE OF MERCURY CORROSIVE SUBLIMATE MERCURIC CHLORIDE]

It should contain not less than 99.5 percent. of pure Mercuric Chloride, and be kept in well-stoppered bottles.

Preparation.—This important mercuric salt may be made by the former official process, as follows:

Take of Mercury, 24 oz; Sulphuric Acid, 36 oz.; Chloride of Sodium, 18 oz. Boil the Mercury with the Sulphuric Acid, by means of a sand-bath, until a dry white mass is left. Rub this, when cold, with the Chloride of Sodium in an earthenware mortar; then sublime with a gradually increasing heat.

By boiling sulphuric acid in excess with mercury to dryness a white salt (mercuric sulphate) is formed, according to the reaction:

$$\underset{\text{Sulphuric Acid}}{2H_2SO_4} + \underset{\text{Mercury}}{Hg} = \underset{\text{Mercuric Sulphate}}{HgSO_4} + \underset{\text{Sulphurous Acid}}{SO_2} + \underset{\text{Water}}{2H_2O}$$

When this is mixed with sodium chloride, and the mixture exposed to a subliming heat, decomposition takes place, according to the reaction:

$$\underset{\text{Mercuric Sulphate}}{HgSO_4} + \underset{\text{Sodium Chloride}}{(NaCl)_2} = \underset{\text{Sodium Sulphate}}{Na_2SO_4} + \underset{\text{Mercuric Chloride}}{HgCl_2}$$

The mercuric chloride thus formed sublimes, and the sodium sulphate remains behind.

This chloride is always sublimed in masses, to distinguish it from mercurous chloride, or calomel, which is in powder.

Official Description.—Heavy, colorless, rhombic crystals, or crystalline masses; permanent in the air.

Odor, Taste, and Reaction.—Odorless; acrid and persistent metallic taste. The aqueous solution reddens blue litmus paper, but becomes neutral to litmus paper upon the addition of sodium chloride.

Solubility.—*Water.* When in fine powder, it is soluble in 13 parts at 25° C. (77° F.), and in 2 parts of boiling water.

Alcohol. When in fine powder, soluble in three parts of alcohol at 25° C. (77° F.), and in 1.2 parts of boiling alcohol.

Other solvents. When in fine powder, soluble in about 14 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—If 1 Gm. of finely powdered Mercuric Chloride be dissolved in 10 Cc. of alcohol or 20 Cc. of water, it should leave not more than 0.005 Gm. of residue.

It fuses at 265° C. (509° F.) to a colorless liquid, and at about 300° C. (572° F.) it volatilizes in dense, white vapors, leaving no appreciable residue.

With ammonia water the aqueous solution of the salt yields a white precipitate; with an excess of hydrogen sulphide a black one; with potassium iodide T.S. a red one, soluble in an excess of the reagent; and with silver nitrate T.S. a white precipitate, insoluble in nitric acid.

Impurities and Tests for Impurities.—*Foreign salts.* If to 0.5 Gm. of Mercuric Chloride, dissolved in 20 Cc. of water, 5 Cc. of hydrochloric acid be added, and the solution be completely saturated with hydrogen sulphide, allowed to stand for several hours in a well-corked flask until the precipitate has subsided, and then filtered, the filtrate should be colorless and leave no weighable residue upon evaporation.

Arsenic. If the precipitate obtained in the preceding test, after washing with about 100 Cc. of water and draining, be rinsed into a beaker with about 20 Cc. of water, and then 5 Cc. of stronger ammonia water added, and if after covering and digesting the mixture for about 15 minutes on a bath of boiling water, it be rinsed upon a filter and washed with a little water, the filtrate and washings after evaporating to dryness, moistening with 6 drops of nitric acid, and again drying, should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of foreign metals. If the precipitated sulphide remaining upon the filter be treated with diluted nitric acid (1 in 4), warmed, and then filtered, the filtrate should leave no weighable residue upon evaporation and gentle ignition.

Uses.—Pharmaceutically, mercuric chloride is used in several preparations to furnish the mercury in the compounds. Medicinally, as an alterative, it is one of the most valuable internal remedies in syphilis and chronic rheumatism, the dose being one-twentieth of a grain (0.003 Gm.). Externally, it is used as a stimulant and escharotic. Recently it has been very extensively employed in antiseptic surgery. It is undoubtedly the most powerful antiseptic available, the only serious disadvantage being the necessity for great care on account of its poisonous properties. The antidote to poisoning by corrosive sublimate is the free use of white of egg, milk, or other albuminous liquids, followed by an emetic.

HYDRARGYRI CHLORIDUM MITE. U.S. Mild Mercurous Chloride

$HgCl = 233.68$

[CALOMEL MERCUROUS CHLORIDE PROTOCHLORIDE OF MERCURY SUBCHLORIDE OF MERCURY]

It should contain not less than 99.5 percent. of pure Mercurous Chloride, and be kept in dark amber-colored bottles.

Preparation.—The former official process may be used to prepare mercurous chloride, as follows:

Take of Mercury, 48 oz.; Sulphuric Acid, 36 oz.; Chloride of Sodium, 18 oz.; Distilled Water, a sufficient quantity. Boil, by means of a sand bath, 24 oz. of the Mercury with the Sulphuric Acid, until a dry, white mass is left. Rub this, when cold, with the remainder of the Mercury, in an earthenware mortar, until they are thoroughly mixed. Then add the Chloride of Sodium, and, having rubbed it with the other ingredients until globules of Mercury cease to be visible, sublime the mixture into a large chamber so that the sublimate may fall in powder. Wash the sublimed matter with boiling Distilled Water, until the washings afford no precipitate with water of ammonia, and dry it.

In this preparation mercuric sulphate is first made; this is then triturated with a quantity of mercury equal to that used in forming it; mercurous sulphate is produced, and when this is mixed with sodium chloride and sublimed, mercurous chloride is produced as a fine white sublimate, and sodium sulphate remains behind.

$$\underset{\substack{\text{Sulphuric}\\\text{Acid}}}{2H_2SO_4} + \underset{\text{Mercury}}{Hg} = \underset{\substack{\text{Mercuric}\\\text{Sulphate}}}{HgSO_4} + \underset{\substack{\text{Sulphurous}\\\text{Acid}}}{SO_2} + \underset{\text{Water}}{2H_2O}$$

$$\underset{\substack{\text{Mercuric}\\\text{Sulphate}}}{HgSO_4} + \underset{\text{Mercury}}{Hg} = \underset{\substack{\text{Mercurous}\\\text{Sulphate}}}{Hg_2SO_4}$$

$$\underset{\substack{\text{Mercurous}\\\text{Sulphate}}}{Hg_2SO_4} + \underset{\substack{\text{Sodium}\\\text{Chloride}}}{2NaCl} = \underset{\substack{\text{Mercurous}\\\text{Chloride}}}{2HgCl} + \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{Na_2SO_4}$$

Official Description.—A white, impalpable powder, becoming yellowish-white on being triturated with strong pressure, and showing only small, isolated crystals when viewed under a lens having a magnifying power of one hundred diameters. Permanent in the air.

Odor and Taste.—Odorless and tasteless.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents.—Insoluble in ether and cold dilute acids.

Tests for Identity.—When strongly heated, Mercurous Chloride is volatilized without fusion or the evolution of brown vapors, leaving no appreciable residue.

In contact with calcium hydroxide T.S., or with solutions of alkali hydroxides, or with ammonia water, the salt is blackened.

When heated with dried sodium carbonate in a dry glass tube, it yields a sublimate of metallic mercury.

Impurities and Tests for Impurities.—*Heavy Metals.* If 1 Gm. of the salt be shaken with 10 Cc. of water or alcohol, and the mixture filtered, neither of the filtrates should respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Soluble impurities. Nor should any appreciable residue be left on evaporation.

Mercuric chloride. If 2 Gm. of the salt be shaken with 20 Cc. of ether, filtered, the filtrate evaporated, and 10 Cc. of distilled water added, not more than a slight opalescence should result upon the addition of silver nitrate T.S. to 5 Cc. of the filtrate, and no change in color should be produced upon adding a few drops of ammonium sulphide T.S. to the remainder.

Distinction from, and absence of, ammoniated mercury. On heating a portion of the salt in a test-tube with potassium hydroxide T.S., it should not evolve ammonia; and if another portion be shaken with acetic acid, and filtered, the filtrate should not be affected by hydrogen sulphide T.S., nor by silver nitrate T.S.

Foreign salts. If to 0.5 Gm. of Mercurous Chloride contained in a small beaker, 5 Cc. of nitric acid be added, and the mixture evaporated to dryness on a water-bath, and if, after dissolving the residue in about 25 Cc. of distilled water and 5 Cc. of hydrochloric acid, the solution be completely saturated with hydrogen sulphide, and allowed to stand for several hours in a well-corked flask, until the precipitate has subsided, and then filtered, the filtrate should be colorless and leave no weighable residue upon evaporation and gentle ignition.

Arsenic. If the precipitate obtained in the preceding test, after washing with about 100 Cc. of water, and draining, be rinsed into a beaker with about 20 Cc. of water and then 5 Cc. of stronger ammonia water added, and if, after covering and digesting the mixture for about 15 minutes on a water-bath, it be rinsed upon a filter and washed with a little water, the filtrate and washings, after evaporating to dryness, moistening with 6 drops of nitric acid, and again drying, should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Limit of foreign metals. If the precipitated sulphide remaining upon the filter be treated with diluted nitric acid (1 in 4), warmed, and then filtered, the filtrate should leave no weighable residue upon evaporation and gentle ignition.

Uses.—Calomel is largely used as an hepatic stimulant and alterative; it is also purgative, and, in large doses, sedative. It is given in doses of one-half grain to twenty grains (0.03 to 1.3 Gm.). Care must be exercised in prescribing calomel with other remedies that the chemical action does not produce corrosive sublimate.

HYDRARGYRI IODIDUM FLAVUM. U. S. Yellow Mercurous Iodide

$HgI = 324.40$

[GREEN IODIDE OF MERCURY MERCUROUS IODIDE PROTIODIDE OF MERCURY, YELLOW IODIDE OF MERCURY]

It should contain not less than 99.5 percent. of pure Mercurous Iodide.

	Metric	Old form
* **Mercury**	50 Gm.	1 oz. av. 293 gr.
Nitric Acid,		
Potassium Iodide,		
Distilled Water, each, a sufficient quantity		

Mix 20 Cc. [old form 5 fl. dr.] each, of Nitric Acid and Distilled Water, and, when the liquid is cold, pour it upon the Mercury contained in a glass beaker. Set the mixture aside in a dark place, and keep it at a temperature between 25° and 30° C. (77° and 86° F.),

with occasional agitation, until the reaction ceases and a little mercury still remains undissolved. Separate the crystals of mercurous nitrate, which will have formed, from the mother liquor, allow them to drain in a glass funnel, and dry them on bibulous paper, in a dark place. When the salt is dry dissolve 40 Gm. [old form 584 grains] of it in 650 Cc. [old form 20½ fl. oz.] of Distilled Water to which 6 Cc. [old form 92 minims] of Nitric Acid have previously been added. Having prepared a solution of 16 Gm. [old form 233 grains] of Potassium Iodide in 32 Cc. [old form 1 fl. oz.] of Distilled Water, slowly pour the solution of Potassium Iodide into the solution of Mercurous Nitrate, with constant stirring, which should be continued for fifteen minutes, allow the precipitate to subside, decant the supernatant liquid, and wash the precipitate by decantation with ten successive portions of 500 Cc. [old form 1 pint] each of Distilled Water. Finally, transfer the precipitate to a filter, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 40° C. (104° F.), and keep it in dark amber-colored vials, with the least possible exposure to light.

Instead of weighing off 40 Gm. [old form 584 grains] of the Mercurous Nitrate as above directed, the whole of the crystallized salt may be taken and the amount of Potassium Iodide, etc., adjusted to the proportions given above.

Official Description.—A bright yellow, amorphous powder. By exposure to light it becomes darker, in proportion as it undergoes decomposition into metallic mercury and mercuric iodide.

Odor and Taste.—Odorless and tasteless.

Solubility.—*Water.* Almost insoluble.
Alcohol. Wholly insoluble.
Other solvents. Wholly insoluble in ether.

Tests for Identity.—When slowly and moderately heated, it assumes at first an orange and then a red color, becoming yellow again on cooling. When quickly and strongly heated, it is at first partially decomposed into mercury and mercuric iodide, and finally is volatilized, leaving not more than 0.05 percent. of residue.

When Mercurous Iodide is heated with sulphuric acid and a little manganese dioxide, vapor of iodine is evolved.

In contact with a solution of potassium iodide, the salt is decomposed into mercuric iodide, which dissolves, and metallic mercury, which remains undissolved.

Impurity and Test.—*More than traces of mercuric iodide.* If 0.5 Gm. of the salt be shaken with 10 Cc. of alcohol and the mixture allowed to stand and then filtered, a portion of the perfectly clear filtrate should be scarcely affected by hydrogen sulphide T.S., nor should it produce more than a very faint, transient opalescence when dropped into water; and if 5 Cc. of the filtrate be evaporated on a white porcelain surface, not more than a very faint, red stain should remain.

Uses.—Yellow mercurous iodide is used as an alterative. It is better adapted for internal administration than the red iodide, because it is milder. The dose is from one-fifth to one grain (0.01 to 0.065 Gm.).

HYDRARGYRI IODIDUM RUBRUM. U.S. Red Mercuric Iodide

$HgI_2 = 450.30$

[Biniodide of Mercury Mercuric Iodide Red Iodide of Mercury]

It should contain not less than 98.5 percent. of pure Mercuric Iodide.

	Metric	Old form
* **Corrosive Mercuric Chloride**	40 Gm.	1 oz. av. 148 gr.
Potassium Iodide	50 Gm.	1 oz. av. 293 gr.
Distilled Water, a sufficient quantity		

Dissolve the Corrosive Mercuric Chloride and the Potassium Iodide, each, in 800 Cc. [old form 25½ fl. oz.] of Distilled Water, and filter the solutions separately. Pour both solutions, simultaneously and in a thin stream, with constant and very active stirring, into 2000 Cc. [old form 4 pints] of Distilled Water. When the precipitate has subsided, decant the supernatant liquid, collect the precipitate on a filter, and wash it with cold Distilled Water, until the washings give not more than a slight opalescence with silver nitrate test solution. Finally, dry it, in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.), and keep it in well-stoppered bottles, protected from light.

In this process mercuric iodide and potassium chloride are formed by double decomposition.

$$\underset{\substack{\text{Mercuric}\\\text{Chloride}}}{HgCl_2} + \underset{\substack{\text{Potassium}\\\text{Iodide}}}{2KI} = \underset{\substack{\text{Mercuric}\\\text{Iodide}}}{HgI_2} + \underset{\substack{\text{Potassium}\\\text{Chloride}}}{2KCl}$$

As mercuric iodide is soluble in solutions both of mercuric chloride and of potassium iodide, it is not profitable to use an excess of either. It may be obtained in handsome crystals by dissolving it in hot hydrochloric acid to saturation and allowing the solution to cool slowly.

Official Description.—A scarlet-red, amorphous powder; permanent in the air.

Odor and Taste.—Odorless; tasteless.

Solubility.—*Water.* Almost insoluble.

Alcohol. In 116 parts at 25° C. (77° F.), and in 15 parts of boiling alcohol.

Other solvents. In 85 parts of ether and 1340 parts of chloroform at 25° C. (77° F.); also in solutions of the soluble iodides, mercuric chloride, sodium thiosulphate, and hot solutions of the alkali chlorides.

Tests for Identity.—When heated to about 150° C. (302° F.), the salt becomes yellow, but again assumes a red color on cooling; at 253° C. (487.4° F.) it fuses to a dark yellow liquid, which, on cooling, forms a yellow, crystalline mass, and at higher temperatures is finally volatilized, leaving not more than 0.05 percent. of residue.

On heating the salt with potassium hydroxide T.S., and adding a little sugar of milk, metallic mercury is precipitated.

Mercuric chloride. A saturated solution of Mercuric Iodide in hot alcohol should, after cooling, be colorless; and when diluted with an equal volume of water, the solution should not redden blue litmus paper.

Limit of soluble chlorides or iodides. If about 0.5 Gm. of Mercuric Iodide be thoroughly agitated with 10 Cc. of distilled water, the filtered liquid should not become more than slightly colored by hydrogen sulphide T.S., nor give more than a slight opalescence with silver nitrate T.S.

Uses.—This iodide is used internally in the treatment of syphilis, in doses of one-twentieth of a grain (0.003 Gm.); it is frequently given in pill form combined with potassium iodide. Externally, it is often used in the form of an ointment, of the strength of sixteen grains in an ounce of simple ointment.

HYDRARGYRI OXIDUM FLAVUM. U.S. Yellow Mercuric Oxide

$HgO = 214.38$

It should contain not less than 99.5 percent. of pure Yellow Mercuric Oxide.

	Metric	Old form
***Corrosive Mercuric Chloride**	100 Gm.	1460 grains
Sodium Hydroxide	40 Gm.	584 grains
Distilled Water, a sufficient quantity		

Dissolve the Corrosive Mercuric Chloride in 1000 Cc. [old form 2 pints] of warm Distilled Water, and filter the solution. Dissolve the Sodium Hydroxide (which should contain at least 90 percent. of pure, anhydrous sodium hydroxide) in 1000 Cc. [old form 2 pints] of cold Distilled Water, and into this solution pour gradually, and with constant stirring, the solution of Corrosive Mercuric Chloride. Allow the mixture to stand for an hour at a temperature of about 30° C. (86° F.), stirring frequently. Then decant the supernatant, clear liquid from the precipitate, and wash the latter repeatedly by the addition and decantation of portions of Distilled Water, using 1000 Cc. [old form 2 pints] of Water each time. Collect the precipitate on a strainer, and continue the washing with warm Distilled Water, until a small portion of the washings, when poured on a little mercuric chloride test solution, no longer produces a yellowish turbidity at the line of contact of the two liquids. Then allow the precipitate to drain, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.), and keep it in well-stoppered bottles, protected from light.

$$\underset{\substack{\text{Mercuric}\\ \text{Chloride}}}{HgCl_2} + \underset{\substack{\text{Sodium}\\ \text{Hydroxide}}}{2NaHO} = \underset{\substack{\text{Mercuric}\\ \text{Oxide}}}{HgO} + \underset{\substack{\text{Sodium}\\ \text{Chloride}}}{2NaCl} + \underset{\text{Water}}{H_2O}$$

Official Description.—A light orange-yellow, amorphous, heavy, impalpable powder; permanent in the air, but turning darker on exposure to light.

Odor, Taste, and Reaction.—Odorless; somewhat metallic taste; when moistened with hot water, it should not turn red litmus paper blue.

Solubility.—*Water.* Almost insoluble.

Alcohol. Insoluble.

Other solvents. Readily and completely in diluted hydrochloric or nitric acid, forming colorless solutions.

Tests for Identity.—When moderately heated, Yellow Mercuric Oxide assumes a red color. At a red heat it is completely decomposed into oxygen and metallic mercury, and is finally volatilized, leaving not more than 0.1 percent. of residue.

If 0.5 Gm. of Yellow Mercuric Oxide be digested on a water-bath, for fifteen minutes, with a solution of 1 Gm. of oxalic acid in 10 Cc. of water, it will be converted into white mercuric oxalate (distinction from *red mercuric oxide*).

Impurities and Tests for Impurities.—*Limit of chlorides.* On dissolving 0.1 Gm. of the Oxide in 10 Cc. of diluted nitric acid, the resulting solution should be clear, and should not afford more than a slight opalescence with silver nitrate T.S.

The solution of 0.5 Gm. of the Oxide in a mixture of 2 Cc. of hydrochloric acid and 25 Cc. of water, should not respond to the tests for *foreign salts*, *metals*, or *arsenic*, as described under *Hydrargyri Chloridum Mite.*

Uses.—Yellow mercuric oxide is used in making the oleate of mercury and in the official ointment; it is employed only externally.

UNGUENTUM HYDRARGYRI OXIDI FLAVI. U.S. Ointment of Yellow Mercuric Oxide

This preparation is made by incorporating 10 Gm. of yellow mercuric oxide after thorough trituration with 10 Gm. of water, with 40 Gm. of hydrous wool-fat and 40 Gm. of petrolatum. Its uses are the same as those of the ointment of red mercuric oxide. (See Unguenta.)

OLEATUM HYDRARGYRI. U.S. Oleate of Mercury

This oleate is made by dissolving 25 Gm. of dried yellow mercuric oxide in 75 Gm. of oleic acid. The yellow mercuric oxide is first triturated with 25 Cc. of water, the oleic acid added and the water evaporated with the aid of a gentle heat. It is best to avoid much heat in making this preparation, to prevent partial decomposition and separation of metallic mercury; in time this change slowly takes place, even when the directions have been strictly followed (see page 325).

HYDRARGYRI OXIDUM RUBRUM. U.S. Red Mercuric Oxide

$HgO = 214.38$

[RED PRECIPITATE]

It should contain not less than 99.5 percent. of pure Red Mercuric Oxide, and should be kept in well-stoppered bottles, protected from light.

Preparation.—This oxide may be made by a former official process, as follows:

Take of Mercury, 36 oz.; Nitric Acid, 24 oz.; Water, 2 pints. Dissolve the Mercury, with the aid of a gentle heat, in the Acid and Water previously mixed, and evaporate to dryness. Rub the dry mass into powder, and heat it in a very shallow vessel until red vapors cease to rise.

Mercuric nitrate is first formed, and this is decomposed by heat.

$$\underset{\text{Mercuric Nitrate}}{2Hg(NO_3)_2} = \underset{\text{Mercuric Oxide}}{2HgO} + \underset{\text{Nitrogen Dioxide}}{4NO_2} + \underset{\text{Oxygen}}{O_2}$$

Official Description.—Heavy, orange-red, crystalline scales, or a crystalline powder, becoming more yellow the finer it is divided; permanent in the air.

Odor and Taste.—Odorless; somewhat metallic taste.

Solubility.—*Water.* Almost insoluble.

Alcohol. Insoluble.

Other solvents. Readily soluble in diluted nitric acid, forming a clear solution, or in hydrochloric acid (1 in 10) with faint opalescence.

Tests for Identity.—When heated to about 400° C. (752° F.), Red Mercuric Oxide becomes dark violet or almost black, but assumes its original color on cooling. At a red heat it is completely decomposed into oxygen and metallic mercury, and is finally volatilized, leaving no appreciable residue.

If 0.5 Gm. be digested on a water bath with a solution of 1 Gm. of oxalic acid in 10 Cc. of water, it will not change color within two hours (distinction from *yellow mercuric oxide*).

Impurities and Tests for Impurities.—*Nitrate.* If 1 Gm. of Red Mercuric Oxide be mixed with 5 Cc. of water, and 2 Cc. of sulphuric acid added, the mixture cooled, and 2 Cc. of ferrous sulphate T.S. be carefully poured upon it, no brown zone should be developed at the line of contact upon standing.

Limit of chlorides. On dissolving 0.1 Gm. of the Oxide in 10 Cc. of diluted nitric acid, the resulting solution should be clear, and should not produce more than a slight opalescence with silver nitrate T.S.

Foreign salts, metals, or arsenic. The solution of 0.5 Gm. of the Oxide in a mixture of 2 Cc. of hydrochloric acid and 25 Cc. of water, should not respond to the tests for *foreign salts, metals,* or *arsenic,* as described under *Hydrargyri Chloridum Mite.*

Uses.—Red mercuric oxide has the same chemical composition as the yellow oxide. It is used in the form of ointment for inflamed eyelids, in skin diseases, and for destroying body vermin.

UNGUENTUM HYDRARGYRI OXIDI RUBRI. U.S. Ointment of Red Mercuric Oxide

This preparation, usually known as *red precipitate ointment,* is made by incorporating 10 Gm. of red mercuric oxide, after thorough trituration with 10 Cc. of water, with 40 Gm. of hydrous wool fat and 40 Gm. of petrolatum. (See Unguenta.) It is used as a stimulating application to indolent sores and in blepharitis.

LIQUOR HYDRARGYRI NITRATIS. U.S. Solution of Mercuric Nitrate

A liquid, which should contain about 60 percent. of Mercuric Nitrate $[Hg(NO_2.O)_2 = 321.64]$, and about 11 percent. of free nitric acid.

	Metric	Old form
*** Red Mercuric Oxide**	**40 Gm.**	6 oz. av. 425 gr.
Nitric Acid	**45 Gm.**	5 fl. oz. 160 min.
Distilled Water	**15 Gm.**	2 fl. oz. 239 min.
To make	**100 Gm.**	8 fl. oz.

Mix the Nitric Acid with the Distilled Water, and dissolve the Red Mercuric Oxide in the mixture. Keep the product in glass-stoppered bottles.

Official Description.—A clear, nearly colorless, heavy liquid.

Odor and Reaction.—Faint odor of nitric acid; strongly acid reaction.

Specific Gravity.—About 2.086 at 25° C. (77° F.).

Tests for Identity.—On evaporating a few drops of the Solution in a porcelain dish, a white residue is left, which, on being heated, becomes successively yellow, red, and brown, and is finally completely volatilized.

On a bright surface of copper, the Solution deposits a coating of metallic mercury.

The Solution, diluted with water, yields with potassium hydroxide T.S. a yellow precipitate; and with potassium iodide T.S. a bright red one, soluble in an excess of the reagent.

A clear crystal of ferrous sulphate dropped into the Solution rapidly acquires a brown color, and becomes surrounded by a brownish-black zone.

Impurity and Test.—*Mercurous salt.* No precipitation or cloudiness should occur in the Solution on the addition of water, or of diluted hydrochloric acid.

Uses.—This is a corrosive liquid, used principally to cauterize malignant ulcerations, cancers, etc. It is never given internally.

UNGUENTUM HYDRARGYRI NITRATIS. U.S. Ointment of Mercuric Nitrate

This important ointment is made by heating 760 Gm. of lard to a temperature of 105° C. (221° F.), withdrawing the heat, and then adding gradually 70 Gm. of Nitric Acid, and, after the reaction has moderated, continuing the heat until effervescence ceases, and then allowing the mixture to cool to about 40° C. (104° F.); then dissolving 70 Gm. of mercury in 105 Gm. of nitric acid with the aid of sufficient heat, and adding this solution to the ointment before it has become entirely cold. When nitric acid is added to lard oil under the above circumstances, the *olein* of the oil is converted into elaïdin, and the color changes to a deep orange; this, upon stirring and cooling, becomes lighter, and it has received the name of *citrine ointment.* It is used in various skin diseases and in inflammation of the eyelids. (See Unguenta.)

CHAPTER XLVII

ANTIMONY, ARSENIC, AND BISMUTH

Sb ; 119.3. As; 74.4. Bi ; 206.9

THESE three metals, which have the Latin names Antimonium, Arsenium, Bismuthum, form a group which presents several analogies. Arsenic is regarded by a number of chemists as not metallic, and on account of some of its chemical relations it is classed by them with the non-metallic elements, but in some of its physical properties, notably its lustre, specific gravity, etc., it closely resembles the metals, and it is therefore considered in the group with antimony and bismuth.

Antimony (Stibium). Sb ; 119.3

This metal is found in nature in a free state, and as a sulphide, oxide, or oxysulphide. The native sulphide is the chief source of the metal, and roasting with iron and sodium sulphide is the process generally resorted to for obtaining it. It is a brittle, brilliant metal, of a lamellated texture, of a silver-white color when pure, but bluish-white as it occurs in commerce. When rubbed between the fingers, it imparts a sensible odor. Its specific gravity is 6.7, and its fusing point 425° C. (797° F.), or about a red heat. It forms three combinations with oxygen,—*antimony trioxide* (antimonous oxide), Sb_2O_3; *antimony tetroxide*, Sb_2O_4 (by some considered to be an antimonate of the teroxide of antimony, Sb_4O_8) ; and *antimony pentoxide* (antimonic oxide), Sb_2O_5. The first of these unites with water to form antimonous acid, the salts of which are called *antimonites;* the third unites with water to form antimonic acid, the salts of which are called *antimonates.*

Tests for Salts of Antimony

1. If hydrogen sulphide be added to an acidified solution of salt of antimony, an orange-red precipitate of sulphide will be produced. This is soluble in ammonium sulphide, but is again precipitated upon the addition of an acid.

2. If hydrochloric acid be added to the sulphide, so as to form a strong solution of antimonous chloride, and this be mixed with water, a white precipitate of oxychloride will be produced.

3. Zinc and iron precipitate antimony as a black powder from its solutions ; copper precipitates it as a metallic film: this may be dissolved by potassium permanganate, and this solution will yield antimony sulphide with hydrogen sulphide.

Official Salt and Preparation of Antimony

Official Name	Preparation
Antimonii et Potassii Tartras Tartar Emetic	By boiling antimonous oxide and acid potassium tartrate together with water, evaporating, and crystallizing
Vinum Antimonii	Four Gm. antimony and potassium tartrate, 65 Cc. distilled water, 175 Cc. alcohol, and sufficient white wine to make 1000 Cc.

Unofficial Salts and Preparations of Antimony

Antimonii Bromidum, $SbBr_3$ Antimony Bromide	By adding dry antimony to bromine contained in a retort, agitating until the combination is complete, then purifying by distillation, and collecting the crystals
Antimonii Fluoridum, $SbFl_3$ Antimony Fluoride	By placing antimony and mercury fluoride in a retort, distilling, and collecting the white mass
Antimonii Iodidum, SbI_3 Antimony Iodide	By direct combination of the elements
Antimonii Oxidum, Sb_2O_3 Antimony Oxide. U. S. P. 1890	By adding antimonous chloride to water, and treating the oxychloride formed with ammonia water
Antimonii Oxysulphidum, Sb_2S_3 and Sb_2O_3 Antimony Oxysulphide	By boiling 1 part black antimony with 250 parts water containing 23 parts sodium carbonate, filtering, and collecting the precipitate
Antimonii Pentasulphidum Antimony Pentasulphide	By adding 70 parts crystallized sodium carbonate to 250 parts water and boiling; then mixing with 26 parts lime and 80 parts water; lastly, adding 36 parts levigated antimony sulphide and 7 parts sublimed sulphur, boiling until the gray color disappears, filtering, and then crystallizing
Antimonii Sulphas, $Sb_2(SO_4)_3$ Antimony Sulphate	By boiling antimony with strong sulphuric acid, and collecting the white mass
Antimonii Sulphidum, Sb_2S_3 Antimony Sulphide. U. S. P. 1890	By purifying antimony ore by fusion
Antomonii Sulphidum Purificatum, Sb_2S_3 Purified Antimony Sulphide. U. S. P. 1890	By macerating antimonous sulphide with water containing a trace of ammonia water
Antimonium Sulphuratum Sulphurated Antimony. (Kermes Mineral). U. S. P. 1890	By boiling antimonous sulphide with solution of sodium hydroxide and adding sulphuric acid to the hot solution
Pilulæ Antimonii Compositæ Compound Pills of Antimony (Plummer's Pills). U. S. P. 1890	Made by forming a mass of 4 Gm. each sulphurated antimony, mild mercurous chloride, and guaiac with the aid of castor oil, and dividing the mass into 100 pills. Used in secondary syphilis and various skin diseases
Pulvis Antimonialis Antimonial Powder (James's Powder). U. S. P. 1890	Made by mixing 33 Gm. of antimony oxide with 67 Gm. of precipitated calcium phosphate. Used as a diaphoretic in doses of three to five grains (0.2 to 0.3 Gm.)

ANTIMONII ET POTASSII TARTRAS. U. S. Antimony and Potassium Tartrate

$$2K(SbO)C_4H_4O_6 + H_2O = 659.80$$

[TARTARATED ANTIMONY TARTAR EMETIC]

It should contain not less than 99.5 percent. of pure Antimony and Potassium Tartrate $[2C_2H_2(OH)_2(COOK)COOSbO + H_2O]$.

This, the most important antimonial compound, may be made by a former official process, as follows:

Take of Oxide of Antimony, in very fine powder, 2 oz.; Bitartrate of Potassium, in very fine powder, 2½ oz.; Distilled Water, 18 fl. oz. To the Water, heated to the boiling point in a glass vessel, add the powders, previously mixed, and boil for an hour; then filter the liquid while hot, and set it aside that crystals may form. Lastly, dry the crystals, and keep them in a well-stoppered bottle. By further evaporation the mother water may be made to yield more crystals, which should be purified by a second crystallization.

Like potassium and sodium tartrate, this is a double salt. Two replaceable hydrogen atoms of tartaric acid $(H_2C_4H_4O_6)$ are substituted by one of antimonyl (SbO) and one of potassium (K). The group (SbO) is hypothetical.

$$\underset{\text{Acid Potassium Tartrate}}{2KHC_4H_4O_6} + \underset{\text{Antimonous Oxide}}{Sb_2O_3} = \underset{\text{Antimony and Potassium Tartrate}}{2KSbOC_4H_4O_6} + \underset{\text{Water}}{H_2O}$$

Official Description.—Colorless, transparent crystals of the rhombic system, becoming opaque and white on exposure to air, or a white, granular powder.

Odor, Taste, and Reaction.—Without odor; sweet, afterwards disagreeable, metallic taste; slightly acid reaction.

Solubility.—*Water.* In 15.5 parts at 25° C. (77° F.); in 3 parts of boiling water.

Alcohol. Insoluble in alcohol, which precipitates it from its aqueous solution in the form of a crystalline powder.

Tests for Identity.—When heated to 110° C. (230° F.) in a vacuum, the salt loses its water of crystallization (2.71 percent.). When heated to redness, it chars, emits an odor resembling that of burning sugar, and leaves a blackened residue having an alkaline reaction.

The aqueous solution of the salt yields with hydrochloric acid a white precipitate, soluble in an excess of the acid; but no precipitate occurs if tartaric acid has previously been added.

In a solution of Antimony and Potassium Tartrate, acidulated with hydrochloric acid, hydrogen sulphide T.S. produces an orange-red precipitate, which is soluble in ammonium sulphide T.S. and potassium hydroxide T.S.

Antimony and Potassium Tartrate is precipitated from its aqueous solution by tannic acid T.S., and yields a white precipitate with solutions of the alkali carbonates and hydroxides, soluble in excess of the latter.

Impurities and Tests for Impurities.—*Sulphate.* An aqueous solution of the salt (1 in 100), acidulated with acetic acid, should not be affected by the addition of a few drops of barium chloride T.S.

Chloride. Or silver nitrate T.S.

Calcium. Or ammonium oxalate T.S.

Iron. Or potassium ferrocyanide T.S.

Heavy metals. If to the aqueous solution of the salt (1 in 100) just sufficient sodium hydroxide T.S. be added to redissolve the precipitate formed, and if to this solution an equal volume of freshly prepared hydrogen sulphide T.S. be added, no coloration should be noticeable after standing in a warm place for half an hour when viewed by reflected light while held against a white surface.

Potassium bitartrate. On adding sodium carbonate T.S. to crushed crystals of the salt, effervescence should not occur.

Arsenic.—If 0.1 Gm. of Antimony and Potassium Tartrate, be dissolved in 5 Cc. of hydrochloric acid, the solution should not respond to Bettendorf's test for *arsenic* (see U. S. P. Test No. 16, Chap. LXII).

Quantitative Test.—If 1 Gm. of Antimony and Potassium Tartrate be dissolved in sufficient water to measure 100 Cc., then 33 Cc. (32.99 Cc.) of this solution should, after the addition of 20 Cc. of a cold saturated aqueous solution of sodium bicarbonate and a little starch T.S., require not less than 19.9 Cc. of tenth-normal iodine V.S. to produce a permanent blue color (each Cc. corresponding to 5 percent. of the pure salt). Titration should begin immediately after the addition of the sodium bicarbonate solution.

Uses.—Tartar emetic, as its name implies, is used as an emetic, in doses of half a grain to one grain (0.03 to 0.065 Gm.), repeated until vomiting takes place. It is given in one-tenth grain (0.006 Gm.) doses as an alterative, diaphoretic, or expectorant. In cases of poisoning by an overdose, tannin should be administered in some form, freely; the insoluble tannate is formed.

VINUM ANTIMONII. U.S. Wine of Antimony

Made by dissolving 4 Gm. of antimony and potassium tartrate in 65 Cc. of boiling distilled water and 175 Cc. of alcohol, and adding sufficient white wine to make 1000 Cc. It is used as an addition to diaphoretic and expectorant mixtures. The dose is ten to twenty minims (0.6 to 1.2 Cc.). (See page 368.)

Arsenic. As; 74.4

Arsenic is found in many minerals, generally as a sulphide or an arsenide. It may be easily obtained from arsenous oxide by heating it with charcoal. Arsenic is a brilliant crystalline element, of a steel-gray color when freshly sublimed; upon exposure to the air its surface becomes blackish and dull. Its specific gravity is 5.73 to 5.88. It forms two combinations with oxygen, arsenous and arsenic oxides, As_2O_3 and As_2O_5 respectively, the corresponding acid to each of which is known, and three with sulphur,—namely, the disulphide, or *realgar*, As_2S_2; the trisulphide, or *orpiment*, As_2S_3, corresponding in composition to arsenous oxide; and the pentasulphide, As_2S_5, corresponding to arsenic oxide.

Tests for Arsenic and its Salts

1. Hydrogen sulphide, when added to an acidulated solution of arsenic trioxide, produces a bright yellow precipitate (orpiment). This is soluble in ammonia water and reprecipitated by acids.
2. If silver nitrate is added to a solution of arsenic trioxide, with a small quantity of ammonia water, a yellow precipitate (silver arsenite) is produced. This precipitate is soluble in an excess of ammonia, and also in nitric acid.
3. If cupric sulphate is added to a solution of arsenic trioxide, with a small quantity of ammonia water, a green precipitate (Scheele's green) is produced. This precipitate is soluble in an excess of ammonia.
4. If a liquid containing arsenic be added to a flask containing zinc and sulphuric acid, the hydrogen gas produced will upon ignition deposit a ring of metallic arsenic upon a cold surface (Marsh's test) (see Modified Gutzeit's Test for *arsenic*, Chap. LXII).
5. If a thin piece of bright copper plate be placed in an acidulated arsenical solution, and the latter be heated, a film of metallic arsenic will be deposited upon it (Reinsch's test).

Official Salts and Preparations of Arsenic

Official Name	Preparation
Arseni Trioxidum	By roasting arsenical ores and resubliming the sublimate
Liquor Acidi Arsenosi	10 Gm. arsenic trioxide, 50 Gm. diluted hydrochloric acid, distilled water to make 1000 Gm.
Potassii Arsenitis	10 Gm. arsenic trioxide, 20 Gm. potassium bicarbonate, 30 Gm. compound tincture of lavender, distilled water to make 1000 Gm.
Sodii Arsenas	By fusing arsenic trioxide with sodium nitrate and sodium carbonate
Arsenas Exsiccatus	By heating sodium arsenate until it ceases to lose weight
Liquor Sodii Arsenatis	By dissolving 1 Gm. exsiccated sodium arsenate in sufficient distilled water to make 100 Gm.
Arseni Iodidum	By fusing 1 part metallic arsenic and 5 parts iodine together and purifying the product
Liquor Arseni et Hydrargyri Iodidi	By dissolving 10 Gm. each of arsenous iodide and red mercuric iodide in sufficient distilled water to make 1000 Gm.

Unofficial Compounds of Arsenic

Arseni Bromidum, $AsBr_3$ Arsenic Bromide	By diffusing arsenic in powder in a retort filled with bromine vapor, then distilling the arsenic bromide from the excess of arsenic
Arseni Chloridum, $AsCl_3$ Arsenic Chloride	By direct combination of arsenic and chlorine
Arseni Disulphidum, As_2S_2 Arsenic Disulphide	By fusing together 5 parts arsenic trioxide and 3 parts sulphur, then collecting the mass
Arseni Trisulphidum, As_2S_3 Arsenic Trisulphide	By fusing 5 parts arsenic trioxide with 4 to 5 parts sulphur, then collecting the mass

ARSENI TRIOXIDUM. U.S. Arsenic Trioxide

$As_2O_3 = 196.44$

[ACIDUM ARSENOSUM, PHARM. 1890 ARSENOUS ACID ARSENOUS ANHYDRIDE ARSENOUS OXIDE WHITE ARSENIC]

It should contain not less than 99.8 percent. of pure Arsenic Trioxide.

Preparation.—Arsenic trioxide, or, as it is commonly termed, *arsenic*, is made by roasting arsenical ores in reverberatory furnaces with long horizontal flues; the arsenic trioxide collects as a solid sublimate, which is afterwards resublimed in cast iron vessels with conical heads. Chemically, it is an oxide, As_2O_3, the acid being formed when the oxide is dissolved in water.

$$\underset{\substack{\text{Arsenic}\\\text{Trioxide}}}{2As_2O_3} + \underset{\text{Water}}{6H_2O} = \underset{\substack{\text{Arsenous}\\\text{Acid}}}{4H_3AsO_3}$$

Official Description.—A heavy solid occurring either as an opaque, white powder, or in irregular masses of two varieties: one, amorphous, transparent, and colorless, like glass; the other, crystalline, opaque, and white, resembling porcelain. Frequently the same piece has an opaque, white, outer crust enclosing the glassy variety. Contact with moist air gradually changes the glassy into the white, opaque variety. Both are odorless and tasteless.

Odor, Taste, and Reaction.—Both varieties are odorless and tasteless; faintly acid reaction.

Solubility.—*Water.* In cold water both varieties dissolve very slowly, the degree of solubility varying according to conditions and time, the glassy variety requiring about 30, the porcelain-like or crystalline powder about 100 parts of water at 25° C. (77° F.). Both are slowly but completely soluble in 15 parts of boiling water.

Alcohol. In alcohol, Arsenic Trioxide is but sparingly soluble.

Other solvents. Soluble in about 5 parts of glycerin. Oil of turpentine dissolves only the glassy variety. Both varieties are freely soluble in hydrochloric acid, and in solutions of alkali hydroxides and carbonates.

Tests for Identity.—When slowly heated in a test-tube, Arsenic Trioxide yields a sublimate of minute, brilliant, transparent, octahedral crystals. When heated rapidly to about 200° C. (392° F.), the amorphous variety fuses, then sublimes, while the crystalline variety sublimes without fusing; no residue should remain after sublimation. When covered with charcoal in an ignition-tube, and strongly heated, Arsenic Trioxide is deoxidized, and metallic arsenic is deposited on the cooler portion of the tube as a mirror having a metallic lustre.

Cupric ammonium sulphate T.S. produces in an aqueous solution a bright green precipitate. If the green precipitate be dissolved in ammonia water, a deep blue-colored solution should be produced.

Silver ammonium nitrate T.S. produces in an aqueous solution a lemon-yellow precipitate, which dissolves on the addition of ammonia water; when this solution is heated, metallic silver is deposited (distinction from *arsenic acid*).

If 1 Gm. of Arsenic Trioxide be dissolved in 10 Cc. of ammonia water, with the aid of a gentle heat, a colorless solution should be produced.

Impurities and Tests for Impurities.—*Antimony, tin, and cadmium.* Hydrogen sulphide T.S. colors a solution of Arsenic Trioxide yellow; if a few drops of hydrochloric acid be added, it precipitates lemon-yellow arsenic trisulphide, which should be completely soluble in ammonium carbonate T.S.

Non-volatile matter and arsenous sulphide. When Arsenic Trioxide is carefully heated in a dry test-tube of hard glass, it should sublime without leaving a residue, and the sublimate should not at first show a yellow color.

Quantitative Test.—If 0.1 Gm. of Arsenic Trioxide be dissolved, together with 1 Gm. of sodium bicarbonate, in 20 Cc. of water, by the aid of a gentle heat, it should decolorize not less than 20.3 (20.32) Cc. of tenth-normal iodine V.S. (corresponding to at least 99.8 percent. of pure Arsenic Trioxide).

Uses.—Arsenic trioxide is used as an alterative, in doses of one-thirtieth of a grain (0.002 Gm.); externally, it is employed as an escharotic, and, mixed with various substances in the form of a paste, is often applied to cancers and ulcers. Two antidotes to arsenical poisoning are official (see page 642).

LIQUOR ACIDI ARSENOSI. U.S. Solution of Arsenous Acid

An aqueous solution, which should contain Arsenous Acid corresponding in amount to 1 percent. of arsenic trioxide [$As_2O_3 = 196.44$].

	Metric	Old form
* **Arsenic Trioxide**	10 Gm.	70 grains
Diluted Hydrochloric Acid	50 Gm.	350 grains
Distilled Water, a sufficient quantity,		
To make	1000 Gm.	16 oz. av.

Mix the Diluted Hydrochloric Acid with 250 Gm. [old form 4 fl. oz.] of Distilled Water, in a tared porcelain dish, add the Arsenic Trioxide, and boil the mixture until the Arsenic Trioxide is dissolved. Then add enough Distilled Water to make the product weigh 1000 Gm. [old form 16 oz. av.]. Filter through paper.

This is simply a solution of arsenous acid in diluted hydrochloric acid, no chemical action taking place.

Official Description.—A clear, colorless liquid.
Odor, Taste, and Reaction.—Odorless; acidulous taste; acid reaction.
Quantitative Test.—If to 24.6 Gm. of Solution of Arsenous Acid about 2 Gm. of sodium bicarbonate and 100 Cc. of water be added, not less than 50 Cc. of tenth-normal iodine V.S. should be required to produce a permanent yellow tint (corresponding to 1 Gm. of arsenic trioxide in 100 Gm. of the Solution).

Uses.—Solution of arsenous acid is used as an alterative, in doses of two to five minims (0.12 to 0.3 Cc.).

LIQUOR POTASSII ARSENITIS. U.S. Solution of Potassium Arsenite

[FOWLER'S SOLUTION]

An aqueous solution, which should contain Potassium Arsenite corresponding in amount to 1 percent. of arsenic trioxide.

	Metric	Old form
* **Arsenic Trioxide,** in fine powder	10 Gm.	70 grains
Potassium Bicarbonate	20 Gm.	140 grains
Compound Tincture of Lavender	30 Gm.	210 grains
Distilled Water, a sufficient quantity,		
To make	1000 Gm.	16 oz. av.

Boil the Arsenic Trioxide and Potassium Bicarbonate, in a tared dish, with 100 Gm. [old form $1\frac{1}{2}$ fl. oz.] of Distilled Water, until solution has been effected. Then add enough Distilled Water to make the solution weigh 970 Gm. [old form 15 oz. av., 228 grains] and, lastly, add the Compound Tincture of Lavender. Filter through paper.

$$\underset{\substack{\text{Acid Potassium}\\\text{Carbonate}}}{2KHCO_3} + \underset{\substack{\text{Arsenic}\\\text{Trioxide}}}{As_2O_3} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Potassium}\\\text{Arsenite}}}{2KH_2AsO_3} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{2CO_2}$$

When arsenic trioxide is boiled with acid potassium carbonate in concentrated solution, carbon dioxide is evolved, and potassium arsenite is produced; but, owing to the fact that the salts are soluble in the quantity of water directed in the formula, a solution can be effected without involving any chemical change. The proportionate quantity of potassium bicarbonate was doubled in the U. S. P. 1890. The corresponding British solution (Liquor Arsenicalis) is made from dilute solutions, and its title does not indicate any chemical action.

Quantitative Test.—If 24.6 Gm. of Solution of Potassium Arsenite be diluted with water to 100 Cc., the mixture very slightly acidified with diluted hydrochloric acid, and then made alkaline with 2 Gm. of sodium bicarbonate, it should require not less than 50 Cc. of tenth-normal iodine V.S. to produce a permanent yellow tint (corresponding to 1 Gm. of arsenic trioxide in 100 Gm. of the Solution).

Uses.—Solution of potassium arsenite is largely used as an alterative, in doses of three to five minims (0.2 to 0.3 Cc.).

SODII ARSENAS. U.S. Sodium Arsenate

$Na_2HAsO_4 + 7H_2O = 309.84$

For an account of the preparation and uses of this salt, see page 536.

SODII ARSENAS EXSICCATUS. U.S. Exsiccated Sodium Arsenate

$Na_2HAsO_4 = 184.68$

For the official method of preparation and its uses, see page 537.

LIQUOR SODII ARSENATIS. U.S. Solution of Sodium Arsenate

An aqueous solution, which should contain Sodium Arsenate corresponding in amount to not less than 1 percent. of Exsiccated Sodium Arsenate.

	Metric	Old form
* **Exsiccated Sodium Arsenate**	1 Gm.	35 grains
* **Distilled Water,** a sufficient quantity,		
To make	100 Gm.	8 oz. av.

Dissolve the Exsiccated Sodium Arsenate in a sufficient quantity of Distilled Water to make the product weigh 100 Gm. [old form 8 oz. av.]

The solution should conform to the reactions and tests for an aqueous solution of the salt given under *Sodii Arsenas Exsiccatus.*

Uses.—This solution is used as an alterative in doses of three to five minims (0.2 to 0.3 Cc.).

ARSENI IODIDUM. U.S. Arsenous Iodide

$AsI_3 = 452.10$

[ARSENIC IODIDE]

It should contain not less than 82.7 percent. of iodine, and 16.3 percent. of metallic arsenic. Arsenous Iodide should be kept in amber-colored, glass-stoppered vials, in a cool place, carefully protected from the light.

Preparation.—In the former official process this iodide was made by a direct combination of the elements.

Take of Arsenic, 60 grains; Iodine, 300 grains. Rub the Arsenic in a mortar until reduced to a fine powder; then add the Iodine, and rub them together until they are thoroughly mixed. Put the mixture into a small flask or a test-tube, loosely stoppered, and heat it very gently until liquefaction occurs. Then incline the vessel in different directions, in order that any portion of the iodine, which may have condensed on its surface, may be returned into the melted mass. Lastly, pour the melted iodide on a porcelain slab, and, when it is cold, break it into pieces, and keep it in a well-stoppered bottle.

By this process it is difficult to secure entire combination, but a purer salt can be made if the pieces be rubbed in a mortar to powder, chloroform added until as much as possible be dissolved, the solution evaporated, and the crystalline powder washed and dried. A better process consists in pouring a solution of 10 Gm. of arsenic trioxide in 250 Cc. of hydrochloric acid into a solution of 51 Gm. of potassium iodide in 40 Cc. of hot water, extracting the residue with chloroform, evaporating the solution, and washing and drying the crystalline powder.

Official Description.—An orange-red, crystalline powder, stable when protected from direct sunlight and kept in a cool place.

Odor.—Inodorous.

Solubility.— *Water.* Soluble with partial decomposition, in about 12 parts at 25° C. (77° F.).
Alcohol. In about 28 parts at 25° C. (77° F.).
Other solvents. Completely in chloroform, carbon disulphide, or ether.

Tests for Identity.—No loss of Iodine occurs when Arsenous Iodide is heated upon a water-bath, but at higher temperatures it completely volatilizes. When warmed with a few drops of nitric acid, brown vapors of nitrous oxide are evolved, followed by violet vapors of iodine.

The aqueous solution should be colorless to yellow, and upon standing gradually decomposes into arsenous and hydriodic acids.

If hydrogen sulphide T.S. be added to an aqueous solution of Arsenous Iodide acidulated with hydrochloric acid, a lemon-yellow precipitate of arsenous sulphide is produced.

Quantitative Test.—If 0.5 Gm. of Arsenous Iodide and 2 Gm. of sodium bicarbonate be dissolved in 50 Cc. of water, not less than 21.9 Cc. of tenth-normal iodine V.S. should be required to impart a slight yellow tint to the solution.

Uses.—The principal use of this compound is in making solution of arsenous and mercuric iodides. The dose is one-tenth of a grain (0.005 Gm.) as an alterative.

LIQUOR ARSENI ET HYDRARGYRI IODIDI. U.S. Solution of Arsenous and Mercuric Iodides

[Donovan's Solution]

An aqueous solution, which should contain not less than 1 percent. of Arsenous Iodide and 1 percent. of Mercuric Iodide.

	Metric	Old form
* **Arsenous Iodide**	10 Gm.	70 grains
Red Mercuric Iodide	10 Gm.	70 grains
Distilled Water, a sufficient quantity,		
To make	1000 Gm.	16 oz. av.

Rub the Arsenous Iodide and Red Mercuric Iodide together in a mortar, add 150 Cc. [old form 2½ fl. oz.] of Distilled Water, and continue the trituration until solution is effected. Filter the solution, and pass sufficient Distilled Water through the filter to make the product weigh 1000 Gm. [old form 16 oz. av.]. Mix thoroughly.

This solution, in which no chemical change occurs, should be of a light straw color; when darker than this, free iodine is probably present, and if a globule of mercury and a few grains of metallic arsenic are dropped into the bottle containing the solution, and the whole well agitated and filtered, the proper color may be restored.

Official Description.—A clear, colorless or pale yellowish liquid.

Odor and Taste.—Without odor, and having a disagreeable metallic taste.

Uses.—Solution of arsenous and mercuric iodides is used as an alterative. The dose is from three to five minims (0.2 to 0.3 Cc.), largely diluted.

Bismuth. Bi; 206.9

Bismuth is found in the metallic state, and occasionally as a sulphide. It is a crystalline, brittle, pulverizable, brilliant metal, having a silver color, with a reddish tint. Its specific gravity is 9.8. It closely resembles metallic antimony in appearance.

Tests for Salts of Bismuth

1. Hydrogen sulphide or ammonium sulphide produces in solutions of bismuth salts a black precipitate of sulphide, insoluble in excess.

2. When acid solutions of bismuth salts are poured into water, white precipitates (subsalts) are produced.

Official Salts and Preparations of Bismuth

Official Name	Preparation
Bismuthi Citras	By boiling bismuth subnitrate with citric acid and water, and adding distilled water to the clear solution
et Ammonii Citras	By dissolving bismuth citrate in ammonia water, evaporating the solution, and scaling
Subcarbonas	By dissolving bismuth in nitric acid, purifying, and precipitating by adding solution of sodium carbonate
Subgallas	By dissolving normal bismuth nitrate in glacial acetic acid, adding to the liquid an aqueous solution of gallic acid, collecting, washing, and drying the precipitate
Subnitras	By dissolving bismuth in nitric acid, purifying, and adding the solution in nitric acid to water
Subsalicylas	By dissolving normal bismuth nitrate in glycerin, adding the solution to a strong aqueous solution of sodium salicylate, collecting, washing, and drying the precipitate

Unofficial Salts of Bismuth

Bismuthi Bromidum, $BiBr_3$ Bismuth Bromide	By treating bismuth with excess of bromine and collecting the steel-gray mass
Bismuthi Chromas, $3Bi_2O_3.2CrO_3$ Bismuth Chromate	By adding a solution of bismuth nitrate to a moderately concentrated solution of acid potassium chromate in slight excess, and collecting the precipitate
Bismuthi Lactas Bismuth Lactate	By boiling 10 parts bismuth subnitrate with excess of sodium hydroxide, washing the oxide well with water, then mixing with 9 parts lactic acid, digesting the mixture, and drying with the aid of a water-bath
Bismuthi Oxalas, $C_6Bi_2O_{12}.15H_2O$ Bismuth Oxalate	By mixing bismuth nitrate with a solution of oxalic acid, and collecting the precipitate
Bismuthi Oxidum, Bi_2O_3 Bismuth Oxide	By mixing 4 oz. bismuth subnitrate and 1 pint solution of sodium hydroxide, then boiling for 5 minutes, decanting the liquid, and washing the precipitate with distilled water
Bismuthi Oxychloridum, $BiOCl$ Bismuth Oxychloride	By pouring slowly a solution of bismuth in nitric acid into a solution of sodium chloride, and collecting the precipitate
Bismuthi Phosphas, $BiPO_4$ Bismuth Phosphate	By adding bismuth nitrate to a solution of phosphoric acid containing nitric acid, and collecting the precipitate
Bismuthi Tannas Bismuth Tannate	By dissolving 22 parts bismuth nitrate in the least amount of nitric acid, previously diluted with half its weight of water, pouring the solution into an excess of solution of sodium hydroxide, washing the precipitate with water, then triturating the precipitate with 10 parts tannic acid diluted with water, straining, and drying
Bismuthi Tartras Bismuth Tartrate	By adding a hot, concentrated solution of 4 parts tartaric acid to a hot, moderately strong solution of 5 parts bismuth oxide in nitric acid, then washing the precipitate with an aqueous solution of tartaric acid
Bismuthi Valeras Bismuth Valerate	By dissolving bismuth nitrate in the smallest amount of nitric acid, previously diluted with half its weight of water, then adding a concentrated solution of sodium valerate, washing the precipitate with water mixed with valeric acid, and, lastly, drying the precipitate

BISMUTHI CITRAS. U.S. Bismuth Citrate

$BiC_6H_5O_7 = 394.52$

Bismuth Citrate should yield not less than 56 percent., nor more than 58 percent., of pure bismuth oxide.

	Metric	Old form
* **Bismuth Subnitrate**	**100 Gm.**	4 oz. av.
Citric Acid	**75 Gm.**	3 oz. av.
Distilled Water, a sufficient quantity		

Mix the Bismuth Subnitrate and the Citric Acid with 400 Cc. [old form 1 pint] of Distilled Water, and heat on a bath of boiling water, with frequent stirring, until a drop of the mixture yields a clear solution with ammonia water. Then add 5000 Cc. [old form 12 pints] of

Distilled Water, allow the suspended matter to deposit, wash the precipitate, first by decantation, and afterwards on a strainer, with Distilled Water, until the washings are tasteless, and dry the residue at a gentle heat.

In this process the bismuth salt is decomposed by the boiling solution of citric acid.

$$\underset{\substack{\text{Bismuth}\\\text{Subnitrate}}}{BiONO_3.H_2O} + \underset{\substack{\text{Citric}\\\text{Acid}}}{H_3C_6H_5O_7} = \underset{\substack{\text{Bismuth}\\\text{Citrate}}}{BiC_6H_5O_7} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{HNO_3} + \underset{\text{Water}}{2H_2O}$$

Official Description.—A white, amorphous or micro-crystalline powder.

Odor and Taste.—Odorless and tasteless.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. In ammonia water, and in solutions of alkali citrates.

Tests for Identity.—When strongly heated the salt chars, and, on ignition, leaves a more or less blackened residue having a yellow surface, and soluble in warm nitric acid; this solution, when dropped into a large excess of water, occasions a white turbidity.

A solution of 1 Gm. of Bismuth Citrate in ammonia water, when treated with hydrogen sulphide in excess, yields a black precipitate.

If the filtrate from the latter be deprived by heat of the excess of hydrogen sulphide and cooled, a portion of it, boiled with an excess of lime water, yields a white precipitate.

Impurities and Tests for Impurities.—*Limit of nitrate.* If 0.01 Gm. of the salt be mixed with 1 Cc. of water, 5 Cc. of sulphuric acid added, the mixture cooled and then 5 Cc. of ferrous sulphate T.S. carefully poured over it, without mixing, no red or brown zone should appear within 5 minutes.

Lead, copper, silver, chlorides, and sulphates. If 3 Gm. of the salt be ignited, the residue dissolved in just a sufficient quantity of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced. If the filtrate separated from this precipitate be evaporated on a water-bath to 30 Cc., the liquid again filtered, and the new filtrate divided into portions of 5 Cc. each, these should respond to the tests for purity described under *Bismuthi Subcarbonas.*

Arsenic. Three Gm. of Bismuth Citrate, after ignition, and treatment with nitric acid, as directed in the following test, should not respond to Bettendorf's Test for *arsenic* (see U. S. P. Test No. 16, Chap, LXII).

Quantitative Test.—If 1 Gm. of Bismuth Citrate be thoroughly ignited in a porcelain crucible, and, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warming until complete solution is effected, then evaporating to dryness, and again igniting, a residue of bismuth oxide should be left weighing not less than 0.56 Gm. nor more than 0.58 Gm.

Uses.—This salt may be used for the same purposes as the subnitrate. It was made official because it is used in making the soluble double salt of bismuth and ammonium citrate.

BISMUTHI ET AMMONII CITRAS. U.S. Bismuth and Ammonium Citrate

[BISMUTH AMMONIO-CITRATE]

Bismuth and Ammonium Citrate should yield not less than 46 percent. nor more than 50 percent. of pure bismuth oxide.

	Metric	Old form
* **Bismuth Citrate**	100 Gm.	1 oz. av.
Ammonia Water,		
Distilled Water, each, a sufficient quantity		

Mix the Bismuth Citrate with 200 Cc. [old form 2 fl. oz.] of Distilled Water and rub it to a smooth paste, heat the mixture on a water-bath, and gradually add Ammonia Water until the salt is dissolved and the liquid is neutral or has only a faintly alkaline reaction. Then filter the solution, evaporate it on a water-bath to a syrupy consistence, and spread it upon plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in amber-colored, well-stoppered bottles, protected from light.

This is the only official soluble salt of bismuth. If its aqueous solution is not perfectly transparent, it is probably due to the loss of ammonia on keeping the salt; a drop or two of ammonia water added to a cloudy solution will generally make it transparent.

Official Description.—Shining, pearly or translucent scales, becoming opaque with loss of ammonia on exposure to the air.
Odor, Taste, and Reaction.—Odorless; metallic taste; faintly alkaline reaction.
Solubility.—*Water.* Very soluble.
Alcohol. Sparingly.
Tests for Identity.—When strongly heated the salt fuses, and finally leaves a blackened residue, having a yellow surface, and soluble in warm nitric acid. The acid solution, when dropped into a large excess of water, occasions a white turbidity.

The aqueous solution of the salt is neutral or faintly alkaline to litmus paper.

When boiled with a slight excess of sodium hydroxide T.S. it evolves ammonia, and its aqueous solution, when treated with hydrogen sulphide, yields a black precipitate.

If the filtrate from the latter be deprived by heat of the excess of hydrogen sulphide and cooled, a portion of it, boiled with an excess of lime water, yields a white precipitate.

Impurities and Tests for Impurities.—*Limit of nitrate.* If 0.01 Gm. of the salt be dissolved in 1 Cc. of water, 5 Cc. of sulphuric acid added, the mixture cooled, and then 5 Cc. of ferrous sulphate T.S. carefully poured over it, without mixing, no red or brown zone should appear within 5 minutes.

If 3 Gm. of the salt be ignited and the residue dissolved in just a sufficient quantity of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced. If the filtrate separated from this precipitate be evaporated on a water-bath to 30 Cc., the liquid again filtered, and the new filtrate divided into portions of 5 Cc. each, these should respond to the tests for purity described under *Bismuthi Subcarbonas.*

Arsenic. Three Gm. of Bismuth and Ammonium Citrate, after ignition and treatment with nitric acid, as directed in the following test, should not respond to Bettendorf's Test for *arsenic* (see U. S. P. Test No. 16, Chap. LXII).

Quantitative Test.—If 1 Gm. of Bismuth and Ammonium Citrate be thoroughly ignited in a porcelain crucible, and if, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warmed until complete solution is effected, then evaporated to dryness, and again ignited, the residue of bismuth oxide should weigh not less than 0.46 Gm., nor more than 0.50 Gm.

Uses.—This salt is astringent, and is generally prescribed in solution. The dose is from one to three grains (0.065 to 0.2 Gm.).

BISMUTHI SUBCARBONAS. U.S. Bismuth Subcarbonate

Bismuth Subcarbonate should yield not less than 90 percent. of pure bismuth oxide.

Preparation.—Bismuth subcarbonate may be made by the former official process, as follows:

Take of Bismuth, in pieces, 2 oz. troy; Nitric Acid, $8\frac{1}{2}$ oz. troy; Water of Ammonia, 5 fl. oz.; Carbonate of Sodium, 10 oz. troy; Distilled Water, a sufficient quantity. Mix $4\frac{1}{4}$ oz. troy of the Nitric Acid with 4 fl. oz. of Distilled Water in a capacious glass vessel, and, having added the Bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with 10 fl. oz. of Distilled Water, stir it thoroughly, and, after twenty-four hours, filter through paper. To the filtered liquid, previously diluted with 4 pints of Distilled Water, slowly add the Water of Ammonia, constantly stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with 2 pints of Distilled Water, and drain it again. Then place the precipitate in a proper vessel, add the remainder of the Nitric Acid, and afterwards 4 fl. oz. of Distilled Water, and set the solution aside. At the end of twenty-four hours, filter through paper. Dissolve the Carbonate of Sodium in 12 fl. oz. of Distilled Water, with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with Distilled Water until the washings pass tasteless. Lastly, press, dry it on bibulous paper with a gentle heat, and rub it into powder.

As metallic bismuth generally contains arsenic, it is very important to provide that this should be left behind, in the processes for making its medicinal preparations. It is on this account that the above formula is so elaborate. The bismuth is first dissolved in nitric acid, a portion of which oxidizes the metal, with the evolution of nitrous vapors, while another portion combines with the oxide produced to form bismuth nitrate. At the same time the arsenic is also oxidized at the expense of the nitric acid, and unites with a portion of the oxidized metal so as to produce bismuth arsenate. Both of these salts, therefore, are contained in the solution, which is very concentrated. Both have the property, when their solution is diluted with water, of separating into two salts, one an insoluble subsalt which is deposited, and the other a soluble acid salt which is held in solution. But the arsenate is more disposed to the change than the nitrate, and requires for the purpose a smaller amount of water of dilution. The subarsenate is slowly deposited in twenty-four hours, and is then separated by filtration. The addition of a large quantity of distilled water precipitates the bismuth subnitrate, the ammonia being added to separate it more thoroughly by combining with the nitric acid. The precipitate, thus freed from arsenic, is now redissolved in nitric acid partially diluted and added to solution of sodium carbonate; by double decomposition, bismuth subcarbonate and sodium nitrate are thus produced.

Official Description.—A white or pale yellowish-white powder, of somewhat varying chemical composition; permanent in the air.

Odor and Taste.—Odorless; tasteless.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Completely in nitric or hydrochloric acid, with copious effervescence.

Tests for Identity.—When heated to redness the salt loses water and carbon dioxide, and should leave not less than 90 percent. of a yellow residue, which is soluble in nitric or hydrochloric acid and blackened by hydrogen sulphide T.S.

Impurities and Tests for Impurities.—*Limit of chlorides.* If a solution of 0.3 Gm. of the salt in 10 Cc. of diluted nitric acid be treated with 0.1 Cc. of tenth-normal silver nitrate V.S., and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of the reagent.

On boiling 1 Gm. of the salt with 10 Cc. of potassium hydroxide T.S., it should not evolve the odor of ammonia.

If 3 Gm. of the salt be dissolved in just a sufficient quantity (about 4 Cc.) of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced. After filtering, and evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing this filtrate into portions of 5 Cc. each, these should respond to the following tests:

Lead. On mixing one portion with an equal volume of diluted sulphuric acid, it should not become cloudy.

Copper. If another portion be precipitated with a slight excess of ammonia water, the supernatant liquid should not exhibit a bluish tint.

Sulphate. Other portions should not be affected by barium nitrate T.S.

Silver. Nor yield with hydrochloric acid a precipitate which is insoluble in a slight excess of the latter.

Alkalies and alkali earths. If 1 Gm. of the salt be boiled with 10 Cc. of a mixture of equal parts of acetic acid and water, the solution cooled and filtered, and the filtrate freed from bismuth by hydrogen sulphide, boiled, and again filtered, the last filtrate should leave no residue on evaporation.

Limit of subnitrate. If 0.05 Gm. of Bismuth Subcarbonate be agitated with 5 Cc. of a mixture of equal parts of water and ferrous sulphate T.S., and then cautiously poured over 5 Cc. of sulphuric acid (freed from nitrous compounds), so as to form a layer above, no brownish-red zone should form at the line of contact of the two liquids.

Arsenic. Two Gm. of Bismuth Subcarbonate should not respond to Bettendorf's Test for *arsenic* (see U. S. P. Test No. 16, Chap. LXII).

Quantitative Test.—If 1 Gm. of Bismuth Subcarbonate be thoroughly ignited at red heat in a porcelain crucible, the residue of bismuth oxide should weigh not less than 0.9 Gm.

Uses.—This bismuth compound is astringent and tonic. It is employed for the same purposes as the subnitrate; the latter is much more frequently used. The dose is five to ten grains (0.3 to 0.6 Gm.).

BISMUTHI SUBGALLAS. U. S. Bismuth Subgallate

Bismuth Subgallate should yield not less than 52 percent., nor more than 57 percent., of pure bismuth oxide.

Preparation.—Bismuth Subgallate or *dermatol* may be made by dissolving Bismuth Subnitrate in diluted acetic acid and precipitating the solution with gallic acid, but a more convenient and rapid method is that of Thibault, which is as follows: Bismuth trioxide is triturated with water, and an excess of pure gallic acid added, continuing the trituration until the color of the mixture has changed to a greenish-yellow. It is allowed to stand twenty-four hours, washed and dried. It is said to have the composition $BiC_7H_7O_7$.

Official Description.—An amorphous bright yellow powder, somewhat variable in chemical composition; permanent in the air.

Odor and Taste.—Without odor or taste.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble.

Other solvents. Insoluble in ether; readily with decomposition in hydrochloric, nitric, and sulphuric acids, if these be heated; insoluble in very dilute mineral acids; readily in solutions of the alkali hydroxides, forming a clear yellow-colored solution, which rapidly changes to a deep red.

Tests for Identity.—When heated to 120° C. (248° F.) the salt loses from 5 to 7 percent. of water, and on subsequent heating to redness it at first chars, finally leaving a yellow residue, which is soluble in hydrochloric and nitric acids and is blackened by ammonium sulphide T.S.

Upon thoroughly agitating 0.1 Gm. of Bismuth Subgallate with an excess of hydrogen sulphide T.S., a black precipitate results; upon filtering and then boiling the filtrate to remove the dissolved gas, the cold filtrate, after the addition of 1 drop of ferric chloride T.S., will assume a blue-black coloration.

Impurities and Tests for Impurities.—*Free gallic acid.* If 0.5 Gm. of the salt be well shaken with 5 Cc. of alcohol and filtered at once, the filtrate should not turn moistened blue litmus paper red.

Limit of nitrate. If 0.5 Gm. of Bismuth Subgallate be well mixed with 5 Cc. of diluted sulphuric acid and 5 Cc. of ferrous sulphate T.S., the mixture filtered, and the filtrate cautiously poured, without shaking, over 5 Cc. of sulphuric acid (free from nitrous compounds) contained in a test-tube, no brown ring should form after standing for ten minutes.

If 3 Gm. of Bismuth Subgallate be ignited in a porcelain crucible, and, after cooling, nitric acid be cautiously added to the residue drop by drop, warming until it is dissolved, then evaporating to dryness and again igniting and cooling, the residue, after cautiously dissolving in nitric acid by the aid of gentle heat, should, after concentrating to about 4 Cc., be poured into 100 Cc. of water, and after filtering and evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing this filtrate into portions of 5 Cc., then each of these should respond to the tests for purity described under *Bismuthi Subcarbonas*.

Arsenic. The residue resulting from the ignition and subsequent treatment of 2 Gm. of the salt, as described below, should not respond to Bettendorf's Test for *arsenic* (see U. S. P. Test No. 16, Chap. LXII).

Quantitative Test.—If 1 Gm. of Bismuth Subgallate be thoroughly ignited in a porcelain crucible, and, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warming until complete solution has been effected, this, upon evaporating to dryness and again igniting, should leave a residue of bismuth oxide weighing not less than 0.52 Gm. nor more than 0.57 Gm.

Uses.—Bismuth subgallate has been used as an astringent sedative in doses of fifteen grains (1 Gm.); it is more valuable as an external application to wounds and ulcerations and in the treatment of eczema.

BISMUTHI SUBNITRAS. U.S. Bismuth Subnitrate

Bismuth Subnitrate should yield not less than 80 percent. of pure bismuth oxide.

Preparation.—This important salt may be made by the former official process, as follows:

Take of Bismuth, in pieces, 2 oz. troy; Nitric Acid, 8½ oz. troy; Carbonate of Sodium, 10 oz. troy; Water of Ammonia, 5 fl. oz.; Distilled Water, a sufficient quantity. Mix 4½ oz. troy of the Nitric Acid with 4 fl. oz. of Distilled Water, in a capacious glass vessel, and, having added the Bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with 10 fl. oz. of Distilled Water, stir it thoroughly, and, after twenty-four hours, filter through paper. Dissolve the Carbonate of Sodium in 20 fl. oz. of Distilled Water with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with Distilled Water until the washings pass tasteless, and drain again as completely as possible. Then place the moist precipitate in a capacious vessel, gradually add the remainder of the Nitric Acid, and afterwards 4 fl. oz. of Distilled Water, and set the solution aside. At the end of twenty-four hours, filter through paper, and to the filtered liquid, previously diluted with 4 pints of Distilled Water, slowly add the Water of Ammonia, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with 2 pints of Distilled Water, drain it again, and press out as much of the liquid as possible. Lastly, dry it upon bibulous paper with a gentle heat, and rub it into powder.

The separation of the arsenic is accomplished by first preparing the carbonate, by adding the acid solution of bismuth to a solution of sodium carbonate in excess, whereby most of the arsenic is retained in the solution, probably as sodium arsenate, while the insoluble carbonate is precipitated. This is dissolved, with the aid of heat, in nitric acid, so as to make a very concentrated solution of the nitrate, to which, when cold, just so much water is added as to begin to produce a permanent turbidness. The object of this is to allow any arsenic that may be still present to be deposited, which happens for reasons stated in explaining the process for procuring the subcarbonate (see page 691). The deposited matter having been precipitated, only the pure nitrate remains in solution, which is made to yield the subnitrate by large dilution with water, and still more completely by the addition of ammonia.

$$\underset{\text{Bismuth}}{Bi_2} + \underset{\text{Nitric Acid}}{8HNO_3} = \underset{\text{Bismuth Nitrate}}{2Bi(NO_3)_3} + \underset{\text{Water}}{4H_2O} + \underset{\text{Nitrogen Monoxide}}{2NO}$$

then

$$\underset{\substack{\text{Bismuth}\\\text{Nitrate}}}{5Bi(NO_3)_3} + \underset{\text{Water}}{8H_2O} = \underset{\text{Bismuth Subnitrate}}{4BiONO_3.H_2O} + \underset{\substack{\text{Bismuth}\\\text{Nitrate}}}{Bi(NO_3)_3} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{8HNO_3}$$

Official Description.—A white powder, of somewhat varying chemical composition; permanent in the air.

Odor, Taste, and Reaction.—Odorless; almost tasteless; slightly acid reaction.

Solubility.—*Water.* Almost insoluble.
Alcohol. Insoluble.
Other solvents. Readily in nitric or hydrochloric acid.

Tests for Identity.—When heated to 120° C. (248° F.) for twelve hours the salt loses not over 3 percent. of moisture; when subsequently heated to redness it evolves nitrous vapors, leaving not less than 80 percent. of its weight of a yellow residue, which is soluble in nitric or hydrochloric acid and blackened by hydrogen sulphide.

Impurities and Tests for Impurities.—*Carbonate.* On adding 3 Gm. of the salt to 3 Cc. of warm nitric acid no effervescence should occur.

Insoluble foreign salts. No residue should be left.

If this solution be poured into 100 Cc. of water, a white precipitate is produced.

If the filtrate separated from this precipitate be evaporated on a water-bath to 30 Cc., the liquid again filtered, and the new filtrate divided into portions of 5 Cc. each, these should respond to the tests for purity described under *Bismuthi Subcarbonas.*

On boiling 0.1 Gm. of the salt with 5 Cc. of potassium hydroxide T.S., no odor of ammonia should be perceptible.

Arsenic. If 2 Gm. of the salt be heated in a porcelain crucible until nitrous vapors cease to be evolved, the residue of bismuth oxide, when cold, should weigh not less than 1.6 Gm., and should not respond to Bettendorf's Test for *arsenic* (see U. S. P. Test No. 16, Chap. LXII).

Uses.—Bismuth subnitrate is largely used in intestinal disorders; it is astringent, tonic, and sedative. The dose is from three to ten grains (0.2 to 0.6 Gm.).

BISMUTHI SUBSALICYLAS. U.S. Bismuth Subsalicylate

Bismuth Subsalicylate should yield not less than 62 nor more than 66 percent. of pure bismuth oxide.

Preparation.—Bismuth Subsalicylate is apt to be an unstable salt. It may be made by Thibault's process, as follows: 15 Gm. of crystallized bismuth nitrate dissolved in nitric acid are precipitated by an excess of solution of sodium hydroxide. After boiling, the whole of the amorphous, white, hydrated oxide is transformed into yellow crystallized anhydrous oxide; it is then thoroughly washed, and 10 Gm. of salicylic acid, rubbed up with 200 Cc. of water, are added. The whole is then left on the water-bath, and when there are no more opaque, yellow needles of anhydrous oxide left, it is thoroughly washed with cold alcohol, and dried in an oven. The chemical formula is said to be $Bi_2O_3(C_7H_6O_3)_3$.

Official Description.—A white, or nearly white, amorphous or crystalline powder; permanent in the air.

Odor and Taste.—Odorless; tasteless.

Solubility.—Almost insoluble in cold water; upon prolonged boiling with water a portion of the salicylic acid passes into solution with the formation of a more basic bismuth salicylate. It is partly soluble with decomposition in hydrochloric and nitric acids, a white, flocculent precipitate of salicylic acid separating.

Tests for Identity.—When heated at 120° C. (248° F.) Bismuth Subsalicylate should not lose more than 1 percent. of water, and on subsequently heating to redness it at first chars, finally leaving a yellow residue, which is soluble in hydrochloric or nitric acid and is blackened by ammonium sulphide T.S.

When Bismuth Subsalicylate is agitated with a solution of 5 drops of ferric chloride T.S. in 10 Cc. of water, a deep violet-blue coloration is produced.

If 1 Gm. of Bismuth Subsalicylate be thoroughly agitated with 10 Cc. of diluted hydrochloric acid and filtered, the residue, after washing and drying, should conform to the reactions and tests given under *Acidum Salicylicum.*

Upon pouring the filtrate into an excess of water, a heavy white precipitate of basic bismuth chloride should be obtained.

Impurities and Tests for Impurities.—*Limit of free salicylic acid.* If 1 Gm. of the salt be agitated with 5 Cc. of chloroform, and the liquid filtered through a double filter of fine texture into 5 Cc. of water containing 3 drops of ferric chloride T.S., no violet zone should form within 1 minute at the line of contact of the two liquids.

If 3 Gm. of Bismuth Subsalicylate be ignited in a porcelain crucible, and, after cooling, nitric acid be cautiously added to the residue, solution should be complete if gently heated; if this solution, after concentrating to about 4 Cc., be poured into 100 Cc. of water, and after filtering and evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing this filtrate into portions of 5 Cc., then each of these should respond to the tests for purity described under *Bismuthi Subcarbonas.*

Limit of nitrates. If 0.05 Gm. of Bismuth Subsalicylate be triturated with 0.1 Gm. of sodium salicylate and 5 Cc. of distilled water, and carefully poured, without mixing, over 5 Cc. of sulphuric acid (free from nitrous compounds) contained in a test-tube, no pink to brownish-red zone should form immediately.

Arsenic. The residue resulting from the ignition and subsequent treatment of 2 Gm. of the salt, as described below, should not respond to Bettendorf's Test for *arsenic* (see U. S. P. Test No. 16, Chap. LXII).

Quantitative Test.—If 1 Gm. of Bismuth Subsalicylate, dried at 120° C. (248° F.), be thoroughly ignited in a porcelain crucible, and, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warming until complete solution has been affected, this, upon evaporating to dryness and again igniting, should leave a residue of bismuth oxide weighing not less than 0.62 Gm. nor more than 0.66 Gm.

Uses.—This salt is used as an intestinal antiseptic in doses of from five to fifteen grains (0.3 to 1 Gm.).

CHAPTER XLVIII

GOLD AND PLATINUM

Au ; 195.7 Pt. ; 193.3

SALTS of these precious metals are official,—the gold salt as a substance in the materia medica, the platinum salt as a test solution ; both are chlorides. Gold and platinum are both found native in the free state. Latin names for these metals are Aurum and Platinum.

Tests for Gold Salts

1. If hydrogen sulphide be added to the solution of a gold salt, a dark brown, almost black, precipitate (auric sulphide) will be produced, soluble in ammonium sulphide.
2. If ferrous sulphate be added to a solution of a gold salt, metallic gold in the form of a fine precipitate will be produced ; this may be fused into a button of gold by the use of the blowpipe.
3. Stannous chloride if added to dilute solutions of gold salts produces a purple precipitate (purple of Cassius).

Tests for Platinum Salts

1. If hydrogen sulphide or ammonium sulphide be added to a solution of platinic chloride, a brown precipitate of platinic sulphide will be produced, soluble in excess of ammonium sulphide.
2. If a solution of potassium chloride be added to a solution of platinic chloride acidulated with hydrochloric acid, a yellow precipitate (double chloride) will be formed.

Official Salt and Preparation of Gold and Platinum

Official Name	Preparation
Auri et Sodii Chloridum	Equal parts of anhydrous gold chloride and anhydrous sodium chloride
Test solution of platinic chloride	Dissolve 2.6 parts of platinic chloride in 20 parts of distilled water

Unofficial Salts of Gold

Auri Bromidum, $AuBr_3$ Gold Bromide	By dissolving gold in a mixture of nitric and hydrobromic acids, concentrating, then crystallizing
Auri Chloridum, $AuCl_3$ Gold Chloride	By dissolving gold in nitrohydrochloric acid, concentrating carefully, then crystallizing Gold Chloride (see Test Solution U. S. P., Chap. LXII)
Auri Iodidum, AuI_3 Gold Iodide	By gradually adding a neutral solution of auric chloride to a solution of potassium iodide, then collecting and drying the precipitate

AURI ET SODII CHLORIDUM. U.S. Gold and Sodium Chloride

A mixture of equal parts, by weight, of anhydrous Gold Chloride [$AuCl_3 = 301.24$] and anhydrous Sodium Chloride [$NaCl = 58.06$], representing not less than 30 percent. of metallic gold. It should be kept in well-stoppered, amber-colored vials.

Preparation.—It may be made by dissolving gold in nitrohydrochloric acid, evaporating the solution to dryness, weighing, and dissolving the dry mass in eight times its weight of distilled water. To this solution a weight of pure anhydrous common salt equalling that of the anhydrous gold chloride is added, previously dissolved in four parts of water. The mixed solution is then evaporated to dryness, being constantly stirred with a glass rod.

Official Description.—An orange-yellow powder; deliquescent when exposed to damp air.
Odor and Taste.—Odorless; saline and metallic taste.
Solubility.—*Water.* Very.
Alcohol. At least one-half of it should be soluble in cold alcohol.

Tests for Identity.—When exposed to a red heat, it is decomposed, and metallic gold is separated.

A fragment of the compound imparts a persistent, intensely yellow color to a non-luminous flame.

Its aqueous solution has a slightly acid reaction, and yields with silver nitrate T.S., a white precipitate insoluble in nitric acid and soluble in ammonia water.

Impurities and Tests for Impurities.—*Free hydrochloric acid.* On bringing a glass rod moistened with ammonia water close to a portion of Gold and Sodium Chloride, no white fumes should make their appearance.

Metallic impurities.—The filtrate from the precipitated gold should not be affected by hydrogen sulphide T.S., nor, after being supersaturated with ammonia water, by ammonium sulphide T.S.

Quantitative Test.—If 0.5 Gm. of Gold and Sodium Chloride be dissolved in 25 Cc. of water, in a porcelain dish, the solution made alkaline by the addition of 5 Cc. of potassium hydroxide T.S., and, after the addition of 5 Cc. of solution of hydrogen dioxide, heated for about one hour on a water-bath, a precipitate of metallic gold will be obtained, which, when washed with water slightly acidulated with hydrochloric acid, dried, and ignited, should weigh not less than 0.15 Gm. (corresponding to at least 30 percent. of metallic gold).

Uses.—This salt is used internally as an alterative. The dose is from one-twelfth to one-fourth of a grain (0.005 to 0.016 Gm.).

Condensed Chart of Official Chemical Substances and their Preparations

Official Name	Chemical Composition	Uses and Doses	Official Preparations in heavy type; those in which the Substance is used, in Roman type
Acetanilidum	C_8H_9NO	Antipyretic; gr. v–xv (0.3–1 Gm.)	Compound Acetanilide Powder
Acetonum	C_3H_6O	. . . .	Oleoresins of Aspidium, Capsicum, Lupulin, Pepper, and Ginger
Acetphenetidinum	$C_{10}H_{13}NO_2$	Antipyretic; gr. v–x (0.3–0.6 Gm.)	
Acidum Aceticum	$HC_2H_3O_2$	Rubefacient	**Diluted Acetic Acid,** Elixir of Iron, Quinine and Strychnine Phosphates, Extracts of Colchicum Corm and Nux Vomica, Fluidextracts of Conium, Ergot, Lobelia, Nux Vomica and Squill, Syrup of Ipecac and Tincture of Sanguinaria
Aceticum Dilutum	. . . . . .	Refrigerant; ♏x (0.6 Cc.)	Vinegars of Opium and Squill, Solution of Ammonium Acetate, and Solution of Iron and Ammonium Acetate
Aceticum Glaciale	$HC_2H_3O_2$	Solvent, caustic	
Benzoicum	$HC_7H_5O_2$	Stimulant; gr. x (0.6 Gm.)	Antiseptic Solution and Camphorated Tincture of Opium
Boricum	H_3BO_3	Antiseptic; gr. v (0.3 Gm.)	Cataplasm of Kaolin, Glycerite of Boroglycerin, Antiseptic Solution, and Ointment of Boric Acid
Camphoricum	$H_2C_{10}H_{14}O_4$	Antiseptic; gr. xv (1 Gm.)	
Citricum	$H_3C_6H_5O_7 + H_2O$	Refrigerant; gr. v–xxx (0.3–2 Gm.)	Bismuth Citrate, Citrated Caffeine, Effervescent Citrated Caffeine, Solution of Magnesium Citrate, Solution of Potassium Citrate, Compound Solution of Sodium Phosphate, Effervescent Lithium Citrate, Effervescent Magnesium Sulphate, Effervescent Potassium Citrate, Effervescent Sodium Phosphate, Syrups of Citric Acid, Orange, and Lactucarium
Gallicum	$HC_7H_5O_5 + H_2O$	Astringent; gr. v–xv (0.3–1 Gm.)	
Hydriodicum Dilutum	HI	Alterative; ♏viii (0.5 Cc.)	**Syrup of Hydriodic Acid**
Hydrobromicum Dilutum	HBr	Hypnotic; fʒi (4 Cc.)	
Hydrochloricum	HCl	Tonic, refrigerant; ♏v–x (0.3–0.6 Cc.)	**Diluted Hydrochloric Acid, Nitrohydrochloric Acid, Diluted Nitrohydrochloric Acid,** Moulded Silver Nitrate, Purified Animal Charcoal, Compound Solution of Chlorine, Solution of Ferric Chloride, Solution of Zinc Chloride, Resin of Podophyllum, Precipitated Sulphur, and Purified Talc
Hydrochloricum Dilutum	. . . . . .	Tonic, refrigerant; ♏xv–xxx (0.9–2 Cc.)	Extract of Ergot, Solution of Arsenous Acid, and Diluted Hydrocyanic Acid
Hydrocyanicum Dilutum	HCN	Sedative, anodyne; ♏1½ (0.1 Cc.)	
Hypophosphorosum	HPH_2O_2	. . . .	**Diluted Hypophosphorous Acid**
Hypophosphorosum Dilutum	. . . . . .	Tonic, refrigerant; ♏x–xxx (0.6–2 Cc.)	Syrup of Ferrous Iodide, Syrup of Hypophosphites, and Compound Syrup of Hypophosphites

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Acidum Lacticum	$HC_3H_5O_3$	Solvent	Syrup of Calcium Lactophosphate
Nitricum	HNO_3	Too caustic to use internally	**Diluted Nitric Acid, Nitrohydrochloric Acid, Diluted Nitrohydrochloric Acid,** Yellow Mercurous Iodide, Solution of Ferric Chloride, Solution of Ferric Subsulphate, Solution of Ferric Sulphate, Solution of Mercuric Nitrate, Solution of Zinc Chloride, Ointment of Mercuric Nitrate
Nitricum Dilutum	. . . . . .	Tonic, antiseptic; ♏xxx (2 Cc.)	
Nitrohydrochloricum	. . . . . .	Cholagogue; ♏iii (0.2 Cc.)	
Nitrohydrochloricum Dilutum	. . . . . .	Cholagogue; ♏xv (1 Cc.)	
Oleicum	$HC_{18}H_{33}O_2$	Vehicle, externally	Ammonia Liniment, Oleates of Atropine, Cocaine, Mercury, Quinine, and Veratrine
Phosphoricum	H_3PO_4	Tonic, refrigerant; ♏v (0.3 Cc.)	**Diluted Phosphoric Acid,** Elixir of Iron, Quinine and Strychnine Phosphates, Glycerite of the Phosphates of Iron, Quinine, and Strychnine, and Syrup of Calcium Lactophosphate
Phosphoricum Dilutum	. . . . . .	Tonic, refrigerant; ♏xxx (2 Cc.)	
Salicylicum	$HC_7H_5O_3$	Antirheumatic; gr. x (0.6 Gm.)	
Stearicum	$HC_{18}H_{35}O_2$	In making glycerin suppositories	Suppositories of Glycerin
Sulphuricum	H_2SO_4	Too caustic to use internally	**Aromatic Sulphuric Acid, Diluted Sulphuric Acid,** Sulphurous Acid, Purified Petroleum Benzin, Ammoniated Glycyrrhizin, Solution of Ferric Subsulphate, Solution of Ferric Sulphate, Ethereal Oil, Spirit of Nitrous Ether
Sulphuricum Aromaticum	. . . . . .	Tonic, astringent; ♏xv (1 Cc.)	
Sulphuricum Dilutum	. . . . . .	Tonic, refrigerant; ♏xxx (2 Cc.)	Granulated Ferrous Sulphate, Syrup of Rose
Sulphurosum	SO_2	Antiferment; ♏xxx (2 Cc.)	
Tannicum	$HC_{14}H_9O_9$	Astringent; gr. v (0.3 Gm.)	**Glycerite, Troches, Ointment,** Styptic Collodion
Tartaricum	$H_2C_4H_4O_6$	Refrigerant; gr. x (0.6 Gm.)	Diluted Hydriodic Acid, Effervescent Citrated Caffeine, Effervescent Lithium Citrate, Effervescent Magnesium Sulphate, Effervescent Potassium Citrate, Compound Effervescing Powder, Effervescent Sodium Phosphate
Trichloraceticum	$HC_2Cl_3O_2$	Caustic; external use	
Æther	$(C_2H_5)_2O$	Anæsthetic; ♏xv (1 Cc.)	**Spirit, Compound Spirit,** Collodion, Styptic Collodion, Pills of Ferrous Iodide, Pills of Phosphorus, Ethereal Oil
Aceticus	$C_2H_5.C_2H_3O_2$	Stimulant, antispasmodic; ♏xv (1 Cc.)	

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Æthylis Carbamas	$C_3H_7NO_2$	Hypnotic; gr. xv (1 Gm.)	
Chloridum	C_2H_5Cl	Local anæsthetic; externally	
Alcohol	C_2H_5OH	Used as a solvent	**Diluted Alcohol,** Fluidextracts, Spirits, Tinctures, etc.
Absolutum	C_2H_5OH	Used as a solvent	
Dilutum	. . . . . .	Used as a solvent	Fluidextracts, Tinctures, etc.
Alumen	$AlK(SO_4)_2 + 12H_2O$	Astringent, emetic; gr. v–xxx (0.3–2 Gm.)	**Exsiccated Alum,** Aluminum Hydroxide
Exsiccatum	$AlK(SO_4)_2$	Astringent, escharotic; gr. iii (0.2 Gm.)	
Alumini Hydroxidum	$Al(OH)_3$	Astringent; gr. v (0.3 Gm.)	
Sulphas	$Al_2(SO_4)_3 + 16H_2O$	Astringent; gr. v (0.3 Gm.)	
Ammonii Benzoas	$NH_4C_7H_5O_2$	Stimulant; gr. xv (1 Gm.)	
Bromidum	NH_4Br	Nervine; gr. xv (1 Gm.)	
Carbonas	$C_2H_{11}N_3O_5$	Stimulant, irritant; gr. v (0.3 Gm.)	Elixir of Iron, Quinine and Strychnine Phosphates, Solution of Ammonium Acetate, Aromatic Spirit of Ammonia
Chloridum	NH_4Cl	Expectorant; gr. x (0.6 Gm.)	**Troches**
Iodidum	NH_4I	Resolvent; gr. iii (0.2 Gm.)	
Salicylas	$NH_4C_7H_5O_3$	Antirheumatic; gr. iv (0.25 Gm.)	
Valeras	$NH_4C_5H_9O_2$	Nervine; gr. v (0.3 Gm.)	
Amylis Nitris	$C_5H_{11}NO_2$	Cardiac stimulant; ♏iii (0.2 Cc.)	
Antimonii et Potassii Tartras	$2K(SbO)C_4H_4O_6 + H_2O$	Expectorant; gr. $\frac{1}{10}$–$\frac{1}{2}$ (0.005–0.03 Gm.)	Compound Syrup of Squill, Wine of Antimony
Antipyrina	$C_{11}H_{12}N_2O$	Antipyretic; gr. iv (0.25 Gm.)	
Apomorphinæ Hydrochloridum	$C_{17}H_{17}NO_2.HCl$	Emetic, expectorant; gr. $\frac{1}{30}$–$\frac{1}{10}$ (0.002–0.005 Gm.)	
Aqua	H_2O		
Ammoniæ	NH_3	Stimulant, antacid; ♏xv (1 Cc.)	**Liniment,** Bismuth and Ammonium Citrate, Elixir of Iron, Quinine, and Strychnine Phosphates, Pure Extract of Glycyrrhiza, Ferric Hydroxide, Fluidextract of Glycyrrhiza, Ammoniated Glycyrrhizin, Precipitated Manganese Dioxide, Ammoniated Mercury, Aromatic Spirit of Ammonia, Washed Sulphur
Ammoniæ Fortior	NH_3	. . . .	**Spirit**
Destillata	H_2O		
Hydrogenii Dioxidi	H_2O_2	Antiseptic; f℥i (4 Cc.)	Precipitated Manganese Dioxide

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Argenti Cyanidum	$AgCN$	For preparing HCN	Diluted Hydrocyanic Acid
Nitras	$AgNO_3$	Stimulant; astringent; gr. $\frac{1}{5}$ (0.01 Gm.)	**Moulded Silver Nitrate** (with HCl) **Mitigated Silver Nitrate** (with KNO_3)
Nitras Fusus	. . . .	Caustic	
Nitras Mitigatus	. . . .	Caustic	
Oxidum	Ag_2O	Tonic; gr. $\frac{1}{2}$–ii (0.03–0.12 Gm.)	
Arseni Iodidum	AsI_3	Alterative; gr. $\frac{1}{10}$ (0.005 Gm.)	Solution of Arsenous and Mercuric Iodides
Trioxidum	As_2O_3	Alterative; gr. $\frac{1}{30}$ (0.002 Gm.)	Solution of Arsenous Acid, Solution of Potassium Arsenite
Atropina	$C_{17}H_{23}NO_3$	Mydriatic; gr. $\frac{1}{120}$–$\frac{1}{160}$ (0.0005–0.0004 Gm.)	Oleate of Atropine
Atropinæ Sulphas	$(C_{17}H_{23}NO_3)_2.H_2SO_4$	Mydriatic; gr. $\frac{1}{160}$ (0.0004 Gm.)	
Auri et Sodii Chloridum	$AuCl_3$ and $NaCl$	Alterative; gr. $\frac{1}{10}$ (0.005 Gm.)	
Benzaldehydum	C_7H_6O	Flavoring; ♏$\frac{1}{2}$ (0.03 Cc.)	
Benzinum	$C_5H_{12}.C_6H_{14}$	. . . .	**Purified Petroleum Benzin,** Mustard Paper
Purificatum	. . . .	. . . .	Deodorized Opium, Tincture of Lactucarium, and Tincture of Deodorized Opium
Benzosulphinidum	$C_6H_4.SO_2.CO.NH$	Sweetening; gr. iii (0.2 Gm.)	
Betanaphthol	$C_{10}H_7OH$	Antiseptic; gr. iv (0.25 Gm.)	
Bismuthi Citras	$BiC_6H_5O_7$	Nervine; gr. ii (0.12 Gm.)	**Bismuth and Ammonium Citrate**
et Ammonii Citras	. . . .	Nervine; gr. ii (0.12 Gm.)	
Subcarbonas	. . . .	Astringent, antispasmodic; gr. viii (0.5 Gm.)	
Subgallas	. . . .	Astringent, gr. iv (0.25 Gm.)	
Subnitras	. . . .	Astringent, antispasmodic; gr. viii (0.5 Gm.)	Bismuth Citrate
Subsalicylas	. . . .	Astringent, antirheumatic; gr. iv (0.25 Gm.)	
Bromoformum	$CHBr_3$	Anæsthetic; ♏iii (0.2 Cc.)	
Bromum	Br	Alterative, stimulant; gr. $\frac{1}{2}$ (0.03 Gm.) greatly diluted	
Caffeina	$C_8H_{10}N_4O_2 + H_2O$	Stimulant; gr. i (0.065 Gm.)	Citrated Caffeine, Compound Acetanilide Powder
Citrata	. . . .	Stimulant; gr. ii (0.03 Gm.)	Effervescent Citrated Caffeine
Citrata Effervescens	. . . .	Stimulant; gr. lx (4 Gm.)	
Calcii Bromidum	$CaBr_2$	Stimulant, nervine: gr. xv (1 Gm.)	

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Calcii Carbonas Præcipitatus	$CaCO_3$	Antacid, astringent; gr. x–xl (0.6–2.5 Gm.)	Compound Powder of Morphine, Syrup of Calcium Lactophosphate
Chloridum	$CaCl_2$	Alterative; gr. x (0.6 Gm.)	
Hypophosphis	$Ca(PH_2O_2)_2$	Alterative; gr. x (0.6 Gm.)	Emulsion of Cod Liver Oil with Hypophosphites, Syrup of Hypophosphites, Compound Syrup of Hypophosphites
Phosphas Præcipitatus	$Ca_3(PO_4)_2$	An aid to filtering	
Sulphas Exsiccatus	$CaSO_4$	For surgical purposes	Sulphurated Lime
Calx	CaO	Escharotic	**Solution, Syrup,** Precipitated Sulphur
Chlorinata	. . . .	Disinfectant	Solution of Chlorinated Soda
Sulphurata	CaS and $CaSO_4$	Depilatory	
Camphora	$C_{10}H_{16}O$	Stimulant; gr. ii (0.13 Gm.)	**Water, Liniment, Spirit,** Cerate of Lead Subacetate, Belladonna Liniment, Soap Liniment, Compound Powder of Morphine, Camphorated Tincture of Opium
Monobromata	$C_{10}H_{15}BrO$	Nervous sedative; gr. ii (0.125 Gm.)	
Carbo Animalis	. . . .	Absorbent	
Animalis Purificatus	. . . .	Absorbent	
Ligni	C	Disinfectant, absorbent; gr. xv (1 Gm.)	Sulphurous Acid and Sulphurated Lime
Carbonei Disulphidum	CS_2	Solvent	Mustard Paper
Cerii Oxalas	. . . .	Sedative, tonic; gr. i (0.065 Gm.)	
Chloralformamidum	$C_3H_4Cl_3NO_2$	Hypnotic; gr. xv (1 Gm.)	
Chloralum Hydratum	$C_2HCl_3O + H_2O$	Sedative; gr. xv (1 Gm.)	
Chloroformum	$CHCl_3$	Anæsthetic, sedative; ♏v (0.3 Cc.)	**Water, Emulsion, Spirit, Liniment,** Cantharidal Collodion, Pills of Phosphorus
Chromii Trioxidum	CrO_3	Escharotic	
Chrysarobinum	$C_{30}H_{26}O_7$	Alterative; externally	Chrysarobin Ointment
Cinchonidinæ Sulphas	$(C_{19}H_{22}N_2O)_2.H_2SO_4 + 3H_2O$	Tonic, febrifuge; gr. i–xxx (0.06–2 Gm.)	
Cinchoninæ Sulphas	$(C_{10}H_{22}N_2O)_2.H_2SO_4 + 2H_2O$	Tonic; gr. i–xxx (0.06–2 Gm.)	
Cinnaldehydum	C_9H_8O	Stimulant, carminative; ♏i (0.05 Cc.)	
Cocaina	$C_{17}H_{21}NO_4$	Local anæsthetic; gr. ½ (0.03 Gm.)	Oleate of Cocaine
Cocainæ Hydrochloridum	$C_{17}H_{21}NO_4.HCl$	Local anæsthetic; gr. ½ (0.03 Gm.)	
Codeina	$C_{18}H_{21}NO_3 + H_2O$	Narcotic; gr. ¼–i (0.016–0.6 Gm.)	
Codeinæ Phosphas	$C_{18}H_{21}NO_3.H_3PO_4 + 2H_2O$	Narcotic; gr. ¼–i (0.016–0.6 Gm.)	

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Codeinæ Sulphas	$(C_{18}H_{21}NO_3)_2.H_2SO_4 + 5H_2O$	Narcotic; gr. $\frac{1}{4}$–i (0.016–0.6 Gm.)	
Colchicina	$C_{22}H_{25}NO_6$	Antirheumatic; gr. $\frac{1}{128}$ (0.0005 Gm.)	
Creosotum	. . . . . .	Antiferment; ♏iii (0.2 Cc.)	**Water**
Cresol	$C_7H_7.OH$	Disinfectant; ♏i (0.05 Cc.)	**Compound Solution**
Creta Præparata	$CaCO_3$	Antacid; gr. x–xl (0.6–4 Gm.)	**Compound Chalk Powder** and Mercury with Chalk
Cupri Sulphas	$CuSO_4 + 5H_2O$	Astringent, emetic; gr. $\frac{1}{5}$–iv (0.01–0.25 Gm.)	
Elaterinum	$C_{20}H_{28}O_5$	Hydragogue cathartic; gr. $\frac{1}{10}$ (0.005 Gm.)	**Trituration**
Eucalyptol	$C_{10}H_{18}O$	Antiseptic, stimulant; ♏v–x (0.3–0.6 Cc.)	Antiseptic solution
Eugenol	$C_{10}H_{12}O_2$	Stimulant; ♏iii (0.2 Cc.)	
Ferri Carbonas Saccharatus	. . . . . .	Tonic; gr. v–xx (0.3–1.3 Gm.)	
Chloridum	$FeCl_3 + 6H_2O$	Hæmostatic	
Citras	. . . . . .	Tonic; gr. v–xx (0.3–1.3 Gm.)	
et Ammonii Citras	. . . . . .	Tonic; gr. v (0.3 Gm.)	Wine of Iron
et Ammonii Sulphas	$FeNH_4(SO_4)_2 + 12H_2O$	Styptic; gr. viii (0.5 Gm.)	
et Ammonii Tartras	. . . . . .	Tonic; gr. iv (0.25 Gm.)	
et Potassii Tartras	. . . . . .	Tonic; gr. iv (0.25 Gm.)	
et Quininæ Citras	. . . . . .	Tonic; gr. iv (0.25 Gm.)	
et Quininæ Citras Solubilis	. . . . . .	Tonic; gr. iv (0.25 Gm.)	Bitter Wine of Iron
et Strychninæ Citras	. . . . . .	Tonic; gr. ii (0.12 Gm.)	
Hydroxidum	$Fe(OH)_3$	Antidote to Arsenic	
Hydroxidum cum Magnesii Oxido	. . . . . .	Antidote to Arsenic	
Hypophosphis	$Fe(PH_2O_2)_3$	Tonic; gr. iii (0.2 Gm.)	Compound Syrup of Hypophosphites
Phosphas Solubilis	. . . . . .	Tonic; gr. iv (0.25 Gm.)	Elixir of Iron, Quinine, and Strychnine Phosphates and Glycerite of the Phosphates of Iron, Quinine, and Strychnine
Pyrophosphas Solubilis	. . . . . .	Tonic; gr. iv (0.25 Gm.)	
Sulphas	$FeSO_4 + 7H_2O$	Astringent, tonic; gr. iii (0.2 Gm.)	**Exsiccated Ferrous Sulphate, Granulated Ferrous Sulphate,** Saccharated Ferrous Carbonate, Solution of Ferric Subsulphate, Solution of Ferric Sulphate, Mass of Ferrous Carbonate, and Compound Iron Mixture
Sulphas Exsiccatus	. . . . . .	Astringent, tonic	Pills of Aloes and Iron

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Ferri Sulphas Granulatus	$FeSO_4 + 7H_2O$	Astringent, tonic; gr. iii (0.2 Gm.)	Pills of Ferrous Carbonate
Ferrum	Fe	. . . .	Solution of Ferric Chloride, Syrup of Ferrous Iodide
Ferrum Reductum	Fe	Tonic; gr. i (0.065 Gm.)	Pills of Ferrous Iodide
Glycerinum	$C_3H_5(OH)_3$	Solvent and used externally	**Suppositories,** Cataplasm of Kaolin, Extracts, Fluidextracts, Glycerinated Gelatin, Infusion of Wild Cherry, Solution of Iron and Ammonium Acetate, Mass of Mercury, Clarified Honey, Mixture of Rhubarb and Soda, Mucilage of Tragacanth, Glycerites, Pills, Syrups, Tinctures, and Ointments of Tannic Acid and Iodine
Glycyrrhizinum Ammoniatum	. . . . . .	Expectorant; gr. iv (0.25 Gm.)	
Guaiacol	$C_7H_8O_2$	Bactericide; ♏viii (0.5 Cc.)	
Guaiacolis Carbonas	$(C_7H_7O)_2CO_3$	Bactericide; gr. xv (1 Gm.)	
Hexamethylenamina	$C_6H_{12}N_4$	Urinary antiseptic; gr. iv (0.25 Gm.)	
Homatropinæ Hydrobromidum	$C_{16}H_{21}NO_3 . HBr$	Mydriatic; gr. $\frac{1}{128}$ (0.0005 Gm.)	
Hydrargyri Chloridum Corrosivum	$HgCl_2$	Antisyphilitic, alterative; gr. $\frac{1}{20}$ (0.003 Gm.)	Red Mercuric Iodide, Yellow Mercuric Oxide and Ammoniated Mercury
Chloridum Mite	$HgCl$	Laxative, alterative; gr. i–ii (0.065–0.12 Gm.)	Compound Cathartic Pills
Iodidum Flavum	HgI	Antisyphilitic, alterative; gr. $\frac{1}{5}$ (0.01 Gm.)	
Iodidum Rubrum	HgI_2	Antisyphilitic, alterative; gr. $\frac{1}{20}$ (0.003 Gm.)	Solution of Arsenous and Mercuric Iodides
Oxidum Flavum	HgO	Externally	**Oleate of Mercury, Ointment**
Oxidum Rubrum	HgO	Externally	**Ointment,** Solution of Mercuric Nitrate
Hydrargyrum	Hg	. . . .	**Plaster, Mass, Ointment,** Yellow Mercurous Iodide, Mercury with Chalk, Ointment of Mercuric Nitrate, Blue Ointment (from Mercurial Ointment)
Ammoniatum	$HgNH_2Cl$	Used externally	**Ointment**
cum Creta	. . . . . .	Alterative; gr. iv (0.25 Gm.)	
Hydrastina	$C_{21}H_{21}NO_6$	Alterative; gr. $\frac{1}{5}$ (0.01 Gm.)	
Hydrastininæ Hydrochloridum	$C_{11}H_{11}NO_2 . HCl$	Alterative; gr. $\frac{1}{4}$–$\frac{1}{2}$ (0.016–0.03 Gm.)	
Hyoscinæ Hydrobromidum	$C_{17}H_{21}NO_4 . HBr + 3H_2O$	Sedative; gr. $\frac{1}{128}$ (0.0005 Gm.)	
Hyoscyaminæ Hydrobromidum	$C_{17}H_{23}NO_3 . HBr$	Sedative; gr. $\frac{1}{128}$ (0.0005 Gm.)	

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Hyoscyaminæ Sulphas	$(C_{17}H_{23}NO_3)_2.H_2SO_4$	Sedative; gr. $\frac{1}{128}$ (0.0005 Gm.)	
Iodoformum	CHI_3	Anæsthetic, antiseptic; gr. iv (0.25 Gm.)	**Ointment**
Iodolum	$C_4I_4.NH$	Antiseptic; gr. iv (0.25 Gm.)	
Iodum	I	Alterative, stimulant; gr. $\frac{1}{10}$ (0.005 Gm.)	**Compound Solution, Ointment, Tincture,** Pills of Ferrous Iodide, Sulphur Iodide, Syrup of Ferrous Iodide
Kaolinum	. . . . . .	Used externally	**Cataplasm**
Liquor Acidi Arsenosi	. . . . . .	Alterative; ♏iii (0.2 Cc.)	
Ammonii Acetatis	$NH_4C_2H_3O_2$	Diaphoretic; fʒiv (16 Cc.)	Solution of Iron and Ammonium Acetate
Arseni et Hydrargyri Iodidi	. . . . . .	Alterative; ♏i½ (0.1 Cc.)	
Calcis	$Ca(OH)_2$	Antacid; fʒiv (16 Cc.)	**Liniment,** Mucilage of Acacia
Chlori Compositus	. . . . . .	Stimulant, antiseptic; fʒi (4 Cc.)	
Cresolis Compositus	. . . . . .	Antiseptic, externally	
Ferri Chloridi	$FeCl_3$	Styptic; ♏1½ (0.1 Cc.)	**Ferric Chloride, Tincture**
Ferri et Ammonii Acetatis	. . . . . .	Ferruginous tonic; fʒiv (16 Cc.)	
Ferri Subsulphatis	. . . . . .	Styptic; ♏iii (0.2 Cc.)	
Ferri Tersulphatis	$Fe_2(SO_4)_3$	Styptic; ♏iii (0.2 Cc.)	Ferric Hydroxide, Ferric Hydroxide with Magnesium Oxide
Formaldehydi	$H.COH$	Antiseptic, preservative	
Hydrargyri Nitratis	$Hg(NO_3)_2$	Escharotic	
Iodi Compositus	. . . . . .	Alterative; ♏iii (0.2 Cc.)	
Magnesii Citratis	. . . . . .	Cathartic; f℥xii (360 Cc.)	
Plumbi Subacetatis	$Pb_2O(C_2H_3O_2)_2$	Externally	**Cerate, Diluted Solution**
Plumbi Subacetatis Dilutus	. . . . . .	Externally	
Potassii Arsenitis	. . . . . .	Alterative; ♏iii (0.2 Cc.)	
Potassii Citratis	$K_3C_6H_5O_7$	Refrigerant, diaphoretic; fʒiv (16 Cc.)	
Potassii Hydroxidi	KOH	Antacid, antilithic; ♏xv (1 Cc.)	Fluidextract of Senega
Sodæ Chlorinatæ	. . . . . .	Stimulant, antiseptic; ♏xv (1 Cc.)	
Sodii Arsenatis	. . . . . .	Alterative; ♏iii (0.2 Cc.)	
Sodii Hydroxidi	. . . . . .	Antacid, antilithic; ♏xv (1 Cc.)	Fluidextract of Taraxacum, Rectified Oil of Turpentine
Sodii Phosphatis Compositus	. . . . . .	Purgative; fʒii (8 Cc.)	
Zinci Chloridi	$ZnCl_2$	Disinfectant	

Official Name	Chemical Composition	Uses and Doses	Official Preparations in heavy type; those in which the Substance is used, in Roman type
Lithii Benzoas	$LiC_7H_5O_2$	Diuretic; gr. xv (1 Gm.)	
Bromidum	$LiBr$	Nervine; gr. xv (1 Gm.)	
Carbonas	$LiCO_3$	Diuretic; gr. viii (0.5 Gm.)	
Citras	$Li_3C_6H_5O_7 + 4H_2O$	Diuretic; gr. viii (0.5 Gm.)	**Effervescent Lithium Citrate**
Citras Effervescens	. . . .	Diuretic; ʒii (8 Gm.)	
Salicylas	$LiC_7H_5O_3$	Antirheumatic; gr. xv (1 Gm.)	
Magnesii Carbonas	$(MgCO_3)_4.Mg(OH)_2 + 5H_2O$	Antacid; gr. xlv (3 Gm.). Used as absorbent powder	Solution of Magnesium Citrate, Syrups of Orange, Tar, Tolu, and Ginger
Oxidum	MgO	Antacid, laxative; gr. xxx (2 Gm.)	Ferric Hydroxide with Magnesium Oxide, Aromatic Fluidextract of Cascara Sagrada, Compound Powder of Rhubarb
Oxidum Ponderosum	MgO	Antacid, laxative; gr. xxx (2 Gm.)	
Sulphas	$MgSO_4 + 7H_2O$	Cathartic; ℥ss (16 Gm.)	**Effervescent Magnesium Sulphate,** Compound Infusion of Senna
Sulphas Effervescens	. . . .	Cathartic; ℥ss (16 Gm.)	
Mangani Dioxidum Præcipitatum	MnO_2	Tonic, alterative; gr. iv (0.25 Gm.)	
Hypophosphis	$Mn(PH_2O_2)_2 + H_2O$	Alterative; gr. iii (0.2 Gm.)	Compound Syrup of Hypophosphites
Sulphas	$MnSO_4 + 4H_2O$	Cholagogue, tonic; gr. iv (0.25 Gm.)	Precipitated Manganese Dioxide
Menthol	$C_{10}H_{19}OH$	Stimulant; gr. i (0.065 Gm.)	
Methylis Salicylas	$CH_3C_7H_5O_3$	Antirheumatic; ♏xv (1 Cc.)	
Methylthioninæ Hydrochloridum	$C_{16}H_{18}N_3SCl$	Bactericide; gr. iv (0.25 Gm.)	
Morphina	$C_{17}H_{19}NO_3 + H_2O$	Sedative; gr. $\frac{1}{6}$ (0.01 Gm.)	
Morphinæ Acetas	$C_{17}H_{19}NO_3.C_2H_4O_2 + 3H_2O$	Sedative; gr. $\frac{1}{4}$ (0.015 Gm.)	
Hydrochloridum	$C_{17}H_{19}NO_3.HCl + 3H_2O$	Sedative; gr. $\frac{1}{4}$ (0.015 Gm.)	
Sulphas	$(C_{17}H_{19}NO_3)_2.H_2SO_4 + 5H_2O$	Sedative; gr. $\frac{1}{4}$ (0.015 Gm.)	**Compound Powder**
Naphthalenum	$C_{10}H_8$	Insecticide	
Oleum Æthereum	. . . .	Anodyne; ♏i (0.05 Cc.)	Compound Spirit of Ether
Paraffinum	. . . .	Used in ointments, etc.	Cerate of Lead Subacetate, Ointment of Boric Acid
Paraldehydum	$C_6H_{12}O_3$	Sedative; ♏xxx (2 Cc.)	
Pelletierinæ Tannas	. . . .	Tænicide; gr. iv (0.25 Gm.)	

Official Name	Chemical Composition	Uses and Doses	Official Preparations in heavy type; those in which the Substance is used, in Roman type
Petrolatum	. . . . . .	Externally	Adhesive Plaster, Blue Ointment, Ointment of Yellow Mercuric Oxide, Ointment of Red Mercuric Oxide
Album	. . . . . .	Externally	Cerate, Camphor Cerate, Cerate of Lead Subacetate, Ointments of Boric Acid, Ammoniated Mercury, Phenol and Zinc Stearate
Liquidum	. . . . . .	Externally	Cantharides Cerate
Phenol	C_6H_5OH	Irritant, disinfectant; gr. i (0.065 Gm.)	**Ointment, Liquefied Phenol**
Liquefactum	. . . . . .	Irritant, disinfectant; ♏ i (0.05 Cc.)	**Glycerite**
Phenylis Salicylas	$C_{13}H_{10}O_3$	Internal antiseptic; gr. viii (0.5 Gm.)	
Phosphorus	P	Aphrodisiac, stimulant; gr. $\frac{1}{128}$ (0.0005 Gm.)	**Pills**
Physostigminæ Salicylas	$C_{15}H_{21}N_3O_2.C_7H_6O_3$	Sedative; gr. $\frac{1}{64}$ (0.001 Gm.)	
Sulphas	$(C_{15}H_{21}N_3O_2)_2.H_2SO_4$	Sedative; gr. $\frac{1}{64}$ (0.001 Gm.)	
Pilocarpinæ Hydrochloridum	$C_{11}H_{16}N_2O_2.HCl$	Diaphoretic; gr. $\frac{1}{6}$ (0.01 Gm.)	
Nitras	$C_{11}H_{16}N_2O_2.HNO_3$	Diaphoretic; gr. $\frac{1}{6}$ (0.01 Gm.)	
Piperina	$C_{17}H_{19}NO_3$	Stimulant; gr. iii (0.2 Gm.)	
Plumbi Acetas	$Pb(C_2H_3O_2)_2 + 3H_2O$	Astringent, sedative; gr. i (0.065 Gm.)	Lead Plaster and Solution of Lead Subacetate
Iodidum	PbI_2	Externally	
Nitras	$Pb(NO_3)_2$	Externally	
Oxidum	PbO	. . . .	Solution of Lead Subacetate
Potassii Acetas	$KC_2H_3O_2$	Diuretic; gr. xxx (2 Gm.)	
Bicarbonas	$KHCO_3$	Antacid, diuretic; gr. xxx (2 Gm.)	Solution of Magnesium Citrate, Solution of Potassium Arsenite, Solution of Potassium Citrate
Bitartras	$KHC_4H_4O_6$	Purgative; gr. xxx (2 Gm.)	Compound Powder of Jalap
Bromidum	KBr	Nervine; gr. xv (1 Gm.)	
Carbonas	K_2CO_3	Antacid, diuretic; gr. xv (1 Gm.)	Compound Iron Mixture, Pills of Ferrous Carbonate, Spirit of Nitrous Ether, Syrup of Rhubarb, Aromatic Syrup of Rhubarb, Ointment of Potassium Iodide
Chloras	$KClO_3$	Alterative; gr. iv (0.25 Gm.)	**Troches**, Compound Solution of Chlorine
Citras	$K_3C_6H_5O_7 + H_2O$	Refrigerant, diaphoretic; gr. xv (1 Gm.)	Effervescent Potassium Citrate
Citras Effervescens	. . . . . .	Refrigerant, diaphoretic; gr. lx (4 Gm.)	
Cyanidum	KCN	Sedative; gr. $\frac{1}{6}$ (0.01 Gm.)	
Dichromas	$K_2Cr_2O_7$	Escharotic, alterative; gr. $\frac{1}{6}$ (0.01 Gm.)	

Official Name	Chemical Composition	Uses and Doses	Official Preparations in heavy type; those in which the Substance is used, in Roman type
Potassii et Sodii Tartras	$KNaC_4H_4O_6 + 4H_2O$	Purgative; ʒii (8 Gm.)	Compound Effervescing Powder
Ferrocyanidum	$K_4Fe(CN)_6 + 3H_2O$	Sedative; gr. viii (0.5 Gm.)	
Hydroxidum	KOH	Escharotic	**Solution**, Compound Solution of Cresol, Soft Soap
Hypophosphis	KPH_2O_2	Alterative; gr. viii (0.5 Gm.)	Diluted Hydriodic Acid, Emulsion of Cod Liver Oil with Hypophosphites, Syrup of Hypophosphites, Compound Syrup of Hypophosphites
Iodidum	KI	Alterative; gr. viii (0.5 Gm.)	**Ointment**, Diluted Hydriodic Acid, Yellow Mercurous Iodide, Red Mercuric Iodide, Compound Solution of Iodine, Tincture of Iodine, Iodine Ointment
Nitras	KNO_3	Diuretic; gr. viii (0.5 Gm.)	Mitigated Silver Nitrate
Permanganas	$KMnO_4$	Disinfectant, emmenagogue; gr. i (0.065 Gm.)	Purified Petroleum Benzin
Sulphas	K_2SO_4	Purgative; gr. xxx (2 Gm.)	
Pyrogallol	$C_6H_6O_3$	Externally	
Pyroxylinum	. . . .	. . . .	**Collodion**
Quinina	$C_{20}H_{24}N_2O_2 + 3H_2O$	Tonic febrifuge; gr. iv (0.25 Gm.)	**Oleate**, Elixir of Iron, Quinine and Strychnine Phosphates, Glycerite of the Phosphates of Iron, Quinine and Strychnine, Compound Syrup of Hypophosphites
Quininæ Bisulphas	$C_{20}H_{24}N_2O_2.H_2SO_4 + 7H_2O$	Tonic febrifuge; gr. iv (0.25 Gm.)	
Hydrobromidum	$C_{20}H_{24}N_2O_2.HBr + H_2O$	Tonic febrifuge; gr. iv (0.25 Gm.)	
Hydrochloridum	$C_{20}H_{24}N_2O_2.HCl + 2H_2O$	Tonic febrifuge; gr. iv (0.25 Gm.)	
Salicylas	$2C_{20}H_{24}N_2O_2.C_7H_6O_3 + H_2O$	Tonic febrifuge; gr. iv (0.25 Gm.)	
Sulphas	$(C_{20}H_{24}N_2O_2)_2.H_2SO_4 + 7H_2O$	Tonic febrifuge; gr. iv (0.25 Gm.)	
Resorcinol	$C_6H_6O_2$	Antipyretic, antiseptic; gr. ii (0.12 Gm.)	
Saccharum	$C_{12}H_{22}O_{11}$	. . . .	**Syrup**, Syrups, Troches, Confections, Pills, etc.
Lactis	$C_{12}H_{22}O_{11} + H_2O$	. . . .	Extract of Nux Vomica, Extract of Opium, Extract of Quassia, Pills of Podophyllum, Belladonna and Capsicum, Powder of Ipecac and Opium, Trituration of Elaterin
Safrolum	$C_{10}H_{10}O_2$	Stimulant; ♏v (0.3 Cc.)	
Salicinum	$C_{13}H_{18}O_7$	Tonic febrifuge; gr. xv (1 Gm.)	
Santoninum	$C_{15}H_{18}O_3$	Anthelmintic; gr. i (0.065 Gm.)	**Troches**
Sapo	. . . .	Antacid; gr. x (0.6 Gm.)	**Liniment**, **Plaster**, Lead Plaster, Compound Extract of Colocynth, Pills of Aloes, Asafetida, Opium
Mollis	. . . .	Externally	**Liniment**

Official Name	Chemical Composition	Uses and Doses	Official Preparations in heavy type; those in which the Substance is used, in Roman type
Scopolaminæ Hydrobromidum	$C_{17}H_{21}NO_4.HBr + 3H_2O$	Sedative; gr. $\frac{1}{128}$ (0.0005 Gm.)	
Sodii Acetas	$NaC_2H_3O_2 + 3H_2O$	Diuretic; gr. xv (1 Gm.)	
Arsenas	$Na_2HAsO_4 + 7H_2O$	Alterative; gr. $\frac{1}{10}$ (0.005 Gm.)	Exsiccated Sodium Arsenate
Arsenas Exsiccatus	Na_2HAsO_4	Alterative; gr. $\frac{1}{20}$ (0.003 Gm.)	**Solution**
Benzoas	$NaC_7H_5O_2$	Antirheumatic; gr. xv (1 Gm.)	
Bicarbonas	$NaHCO_3$	Antacid; gr. xv (1 Gm.)	**Troches,** Effervescent Citrated Caffeine, Saccharated Ferrous Carbonate, Effervescent Lithium Citrate, Effervescent Magnesium Sulphate, Mixture of Rhubarb and Soda, Effervescent Potassium Citrate, Compound Acetanilide Powder, Compound Effervescing Powder, Effervescent Sodium Phosphate
Bisulphis	$NaHSO_3$	Antiseptic; gr. viii (0.5 Gm.)	
Boras	$Na_2B_4O_7 + 10H_2O$	Refrigerant, Diuretic; gr. viii (0.5 Gm.)	Ointment of Rose Water
Bromidum	$NaBr$	Nervine; gr. xv (1 Gm.)	
Carbonas Monohydratus	$NaCO_3 + H_2O$	Antacid; gr. iv (0.25 Gm.)	Aluminum Hydroxide, Extract of Ergot, Solution of Chlorinated Soda, Mass of Ferrous Carbonate, Spirit of Nitrous Ether, and Suppositories of Glycerin
Chloras	$NaClO_3$	Alterative; gr. iv (0.25 Gm.)	
Chloridum	$NaCl$	Emetic; ℥ss (16 Gm.)	
Citras	$2Na_3C_6H_5O_7 + 11H_2O$	Refrigerant, diaphoretic; gr. xv (1 Gm.)	Compound Syrup of Hypophosphites
Hydroxidum	$NaOH$	Escharotic	**Solution,** Purified Petroleum Benzin, Yellow Mercuric Oxide
Hypophosphis	$NaPH_2O_2 + H_2O$	Alterative; gr. xv (1 Gm.)	Emulsion of Cod Liver Oil with Hypophosphites, Syrup of Hypophosphites, Compound Syrup of Hypophosphites
Iodidum	NaI	Alterative; gr. viii (0.5 Gm.)	
Nitras	$NaNO_3$	Diuretic; gr. xv (1 Gm.)	Compound Solution of Sodium Phosphate
Nitris	$NaNO_2$	. . . .	Spirit of Nitrous Ether
Phenolsulphonas	$NaC_6H_5O_4S + 2H_2O$	Antiferment; gr. iv (0.25 Gm.)	
Phosphas	$Na_2HPO_4 + 12H_2O$	Purgative; gr. xxx (2 Gm.)	**Exsiccated, Compound Solution**
Phosphas Effervescens	. . . . . .	Purgative; ʒii (8 Gm.)	
Phosphas Exsiccatus	. . . . . .	Purgative; gr. xv (1 Gm.)	**Effervescent Sodium Phosphate**
Pyrophosphas	$Na_4P_2O_7 + 10H_2O$	Purgative; gr. xxx (2 Gm.)	
Salicylas	$NaC_7H_5O_3$	Antirheumatic; gr. xv (1 Gm.)	
Sulphas	$Na_2SO_4 + 10H_2O$	Cathartic; ℥ss (16 Gm.)	
Sulphis	$Na_2SO_3 + 7H_2O$	Antiferment; gr. xv (1 Gm.)	

Official Name	Chemical Composition	Uses and Doses	Official Preparations in heavy type; those in which the Substance is used, in Roman type
Sodii Thiosulphas	$Na_2S_2O_3 + 5H_2O$	Alterative; gr. xv (1 Gm.)	
Sparteinæ Sulphas	$C_{15}H_{26}N_2.H_2SO_4 + 5H_2O$	Cardiac stimulant; gr. $\frac{1}{5}$ (0.01 Gm.)	
Spiritus Ætheris Nitrosi	$C_2H_5NO_2$	Diuretic, diaphoretic; ♏xxx (2 Cc.)	Compound Mixture of Glycyrrhiza
Ammoniæ	NH_3	Stimulant; ♏xv (1 Cc.)	
Ammoniæ Aromaticus	. . . . . .	Stimulant; ♏xxx (2 Cc.)	Ammoniated Tincture of Guaiac, Ammoniated Tincture of Valerian
Glycerylis Nitratis	$C_3H_5(NO_3)_3$	Cardiac stimulant; ♏i (0.05 Cc.)	
Strontii Bromidum	$SrBr_2 + 6H_2O$	Nervine; gr. xv (1 Gm.)	
Iodidum	$SrI_2 + 6H_2O$	Alterative; gr. viii (0.5 Gm.)	
Salicylas	$Sr(C_7H_5O_3)_2 + 2H_2O$	Antirheumatic; gr. xv (1 Gm.)	
Strophanthinum	. . . . . .	Cardiac stimulant; gr. $\frac{1}{200}$ (0.0003 Gm.)	
Strychnina	$C_{21}H_{22}N_2O_2$	Tonic; gr. $\frac{1}{64}$ (0.001 Gm.)	Elixir of Iron, Quinine and Strychnine Phosphates, Glycerite of the Phosphates of Iron, Quinine and Strychnine, Compound Laxative Pills, Compound Syrup of Hypophosphites
Strychninæ Nitras	$C_{21}H_{22}N_2O_2.HNO_3$	Tonic; gr. $\frac{1}{64}$ (0.001 Gm.)	
Sulphas	$(C_{21}H_{22}N_2O_2)_2.H_2SO_4 + 5H_2O$	Tonic; gr. $\frac{1}{64}$ (0.001 Gm.)	
Sulphonethylmethanum	$C_8H_{18}S_2O_4$	Hypnotic; gr. xv (1 Gm.)	
Sulphonmethanum	$C_7H_{16}S_2O_4$	Hypnotic; gr. xv (1 Gm.)	
Sulphur Lotum	S	Diaphoretic, resolvent; ʒi (4 Gm.)	**Ointment**, Compound Powder of Glycyrrhiza, Sulphur Iodide
Præcipitatum	S	Diaphoretic, resolvent; ʒi (4 Gm.)	
Sublimatum	S	Diaphoretic, resolvent; ʒi (4 Gm.)	Precipitated Sulphur, Washed Sulphur
Sulphuris Iodidum	. . . . . .	Externally	
Syrupus Acidi Hydriodici	HI	Alterative; fʒi (4 Cc.)	
Calcii Lactophosphatis	. . . . . .	Alterative; fʒii (8 Cc.)	
Ferri Iodidi	FeI_2	Alterative; ♏xv (1 Cc.)	
Talcum	. . . . . .	. . . .	Purified Talc
Purificatum	. . . . . .	Filtering medium	
Terebinum	$C_{10}H_{16}$	Expectorant; ♏viii (0.5 Cc.)	
Terpini Hydras	$C_{10}H_{20}O_2 + H_2O$	Expectorant; gr. ii (0.12 Gm.)	
Thymol	$C_{10}H_{14}O$	Antiseptic; gr. ii (0.12 Gm.)	Cataplasm of Kaolin and Antiseptic Solution
Thymolis Iodidum	$C_{20}H_{24}O_2I_2$	Antiseptic, externally	

Official Name	Chemical Composition	Uses and Doses	Official Preparations in heavy type; those in which the Substance is used, in Roman type
Tinctura Ferri Chloridi	$FeCl_3$	Tonic; ♏viii (0.5 Cc.)	Solution of Iron and Ammonium Acetate
Iodi	I	Alterative, irritant; ♏1½ (0.1 Cc.)	
Vanillinum	$C_8H_8O_3$	Flavor; gr. ½ (0.03 Gm.)	
Veratrina	. . . . . .	Externally	**Oleate, Ointment**
Zinci Acetas	$Zn(C_2H_3O_2)_2 + 2H_2O$	Astringent; gr. ii (0.12 Gm.)	
Bromidum	$ZnBr_2$	Nervine; gr. ii (0.12 Gm.)	
Carbonas Præcipitatus	. . . . . .	Externally	Solution of Zinc Chloride
Chloridum	$ZnCl_2$	Escharotic	
Iodidum	ZnI_2	Externally	
Oxidum	ZnO	Externally	**Ointment**
Phenolsulphonas	$Zn(C_6H_5O_4S)_2 + 8H_2O$	Externally, antiseptic, astringent	
Stearas	. . . . . .	Externally	**Ointment**
Sulphas	$ZnSO_4 + 7H_2O$	Astringent; gr. iv (0.24 Gm.)	
Valeras	$Zn(C_5H_9O_2)_2 + 2H_2O$	Antispasmodic; gr. ii (0.12 Gm.)	
Zincum	Zn	. . . .	Solution of Zinc Chloride

PART IV

ORGANIC SUBSTANCES

INTRODUCTORY

THE view formerly held by chemists, that vegetable and animal substances owed their peculiar chemical and physical properties exclusively to the mysterious action of life, was seriously affected by the labors of such chemists as Wöhler, in 1828, and Kolbe and Frankland, in 1847, who succeeded in producing synthetically a number of compounds from mineral substances. These so-called artificial bodies were proved to be identical in chemical composition and physical properties with those obtained from nature, and the subsequent discovery of many others has necessitated a change in the definition of the term *organic chemistry.* This no longer means the study of substances produced through living organisms, but, as all organic bodies have been found upon analysis to contain carbon (generally associated with hydrogen, and often with oxygen and nitrogen), the most acceptable definition is that *organic chemistry is the science which treats of the carbon compounds.*

The plan of this work will not admit of the acceptance of the latest systems of classification which have been advanced, for, notwithstanding the ingenious skill which is clearly perceptible in many of the groupings, they are not well adapted for the study of the carbon compounds from a pharmaceutical point of view. The groups which are characterized in modern organic chemistry as alcohols, ethers, esters, aldehydes, ketones, amines, and amides, necessarily bring together many substances used in the materia medica which possess few pharmaceutical or medical analogies. For instance, glycerin, mannite, and cholesterin are properly regarded as alcohols, and they would have to be grouped together, notwithstanding their physical dissimilarities. The same classification would compel the consideration of such an incongruous pharmaceutical group as spirit of nitrous ether, stearin, and beeswax under the head of esters.

It must not be understood that the present methods of grouping the carbon atoms is not of great value *in studying chemistry* from a purely chemical standpoint. Indeed, with the enormous advances which have been made in theoretical chemistry within the last half-century, it would be impossible to reject the results upon which the present system of classification rests.

In the following pages the carbon compounds are considered in the usual groups only when the substances composing them have similar chemical and physical properties. The opening chapters are devoted to lignin and its derivatives; then its isomer, starch, and the allied products, gums, mucilages, etc.; then the sugars and the products derived from them as the result of decomposition and fermentation, alcohol, ether, etc., including the various synthetic products which are derived from organic bases or acids. Following these the acid saccharine fruits, with the important acids which they contain, are considered, and then the products obtained from them and from other plants; *i.e.*, the volatile oils. Oleoresins, resins, gum-resins, and balsams naturally succeed these, and then the classification is based upon the prominent constituents which are found in the substances, astringents, cathartics, etc., being all grouped together. Drugs containing alkaloids are among the last groups of carbon compounds. The alkaloids are highly organized, and most of them are powerful poisons. This plan thus begins with elementary substances, like lignin, starch, and gum, and leads by regular progression to the most powerful compounds in the materia medica, the alkaloids.

A sharp distinction is made between the official and the unofficial preparations, the latter always following the former. This will enable the student to distinguish at a glance the more important compounds, and they can be studied either together or separately, at will.

CHAPTER XLIX

THE CELLULOSE GROUP

Cellulose. $C_6H_{10}O_5$

Cellulose.—The woody fibre of plants, which forms the skeleton or framework for the vegetable tissues, is termed *cellulose*, or *cellulin.* During the natural growth of the plant, the walls of the cells become filled with various principles, coloring matter, resins, salts of various kinds, etc., and these give to the plant physical properties which render it useful in medicine. Pharmacy teaches the various methods of extracting the *valuable principles* from plants. Cellulose constitutes the greater part of the inert residues (see Percolation).

The term *lignin* was formerly applied to cellulose; indeed, three words, *lignin*, *cellulin*, and *cellulose*, were used synonymously; a distinction, however, is sometimes made, the substances which are found adhering to the cellulose skeleton of plants and vegetable tissues being called *lignin.* The latter is less digestible than cellulose, and it is believed by Payen and others to vary from it somewhat in chemical composition. *Fungin*, from fungi, *hordein*, from barley, *medullin*, from the pith of various plants, *pollenin*, from pollen granules, are mixed and special forms of cellulose.

Cellulose is seen in a pure form in raw cotton, the hairs of the seed of various species of Gossypium, and in many other vegetable products. It is the most useful and valuable substance obtained from plants; fabrics like cotton, linen, or hemp goods are made on an immense scale from cellulose. When pure, cellulose is white, translucent, unalterable in the air, and has the specific gravity of 1.5. It is insoluble in water, alcohol, ether, petroleum benzin, and oils, but is soluble in an ammoniacal solution of copper oxide, and this latter fact has been taken advantage of to form many useful articles by partially dissolving a woven cotton material and rolling or pressing it into any desired shape. When cellulose is treated with strong sulphuric acid or phosphoric acid, it is converted into dextrin. If the mixture be diluted with water and heated, glucose is produced. If cellulose in the form of unsized paper is passed through a mixture made from two parts of sulphuric acid of specific gravity 1.840 and one part of water (*both by measure*), and the whole *cooled to* 15° C. (59° F.), the valuable product known as *parchment paper* is produced. The strips of paper should be well washed by passing them through a dilute solution of ammonia and water. This paper is useful as a dialyzing medium; it forms, when perfect, the best septum (see Dialysis). When cellulose is treated with nitric acid, pyroxylin, or gun cotton, is produced.

GOSSYPIUM PURIFICATUM. U.S. Purified Cotton

[ABSORBENT COTTON]

The hairs of the seed of *Gossypium Herbaceum* Linné, or of other cultivated species of Gossypium (Fam. *Malvaceæ*) freed from adhering impurities and deprived of fatty matter.

Purified cotton wool is cellulose in one of its purest forms. For a long time one of the most important uses of this valuable staple, that of an absorbent and substitute for sponge, was neglected, because a trace of fatty matter was permitted to remain, which coated the filaments and prevented them from absorbing liquids freely and uniformly. The so-called absorbent cotton of commerce was introduced, and it soon became an important product. This is cotton freed from the trace of fatty matter by boiling it in a weak alkaline solution, rinsing it in a weak solution of chlorinated lime to whiten it, dipping it into a very dilute solution of hydrochloric acid, and then thoroughly rinsing it with pure water; the cotton, having been thoroughly dried, is then carded. The loss is about 10 percent.

Official Description.—White, soft, fine filaments, appearing under the microscope as hollow, flattened and twisted bands, spirally striate, and slightly thickened at the edges.

Odor and Taste.—Inodorous; tasteless.

Solubility.—Insoluble in ordinary solvents, but soluble in an ammoniacal solution of cupric oxide.

Tests for Identity.—Purified Cotton should be perfectly free from all visible impurities, and on combustion should not leave more than 0.3 percent. of ash.

Impurity and Test.—*Evidence of proper purification and absence of fatty matter.* When Purified Cotton, previously compressed in the hand, is thrown on the surface of cold water, it should readily absorb the latter and sink, and the water should not acquire either an acid or an alkaline reaction.

Uses.—Cellulose is employed in the form of filtering paper, in muslin and cotton cloth strainers, for surgical bandages, paper, lint, etc. Purified cotton is used in funnels for straining, in percolators for controlling the flow of the percolate, and for many other purposes.

Products resulting from the Decomposition of Cellulose

Under this head will be included—1. The preparations made by decomposing cellulose or lignin by the action of acids or alkalies. 2. Those made by destructive distillation.

Pyroxylin is placed in the first class, primarily because of its importance in pharmacy, medicine, and the arts.

PYROXYLINUM. U.S. Pyroxylin

[SOLUBLE GUN COTTON]

A product obtained by the action of nitric and sulphuric acids on cotton, and consisting chiefly of cellulose tetranitrate $[C_{12}H_{16}(ONO_2)_4O_6]$. It should be kept in cartons, protected from the light.

The process official in the U. S. P. 1890 is as follows:

	Metric	Old form
Purified Cotton	100 Gm.	½ oz. av.
Nitric Acid	1400 Cc.	7 fl. oz.
Sulphuric Acid	2200 Cc.	11 fl. oz.
Alcohol,		
Ether,		
Water, each, a sufficient quantity		

Mix the Acids gradually in a glass or porcelain vessel, and, when the temperature of the mixture has fallen to 32° C. (90° F.), add the Purified Cotton. By means of a glass rod imbue it thoroughly with the Acids, and allow it to macerate, until a sample of it, taken out, thoroughly washed with a large quantity of Water, and subsequently with Alcohol, and pressed, is found to be soluble in a mixture of 1 volume of Alcohol and 3 volumes of Ether. Then remove the Cotton from the Acids, transfer it to a larger vessel, and wash it, first, with cold Water, until the washings cease to have an acid taste, and then with boiling Water, until they cease to redden blue litmus paper. Finally, drain the Pyroxylin on filtering paper, and dry it in small, detached pellets, by means of a water-bath or steam-bath at a temperature not exceeding 60° C. (140° F.). Keep the Pyroxylin, loosely packed, in well-closed vessels containing not more than about 25 Gm., in a cool and dry place, remote from lights or fire.

Schönbein first pointed out the fact that nitric acid acts on cotton and produces a soluble compound. It was subsequently proved that this substance, pyroxylin, or gun cotton, belongs to a series of closely related nitro-compounds in which the nitric acid radical replaces the hydroxyl of the cellulose formula. This may be shown by taking the double formula for cellulose $C_{12}H_{20}O_{10}$ and the displacement of the HO, thus:

$$\underset{\text{Nitric Acid}}{6HNO_3} + \underset{\text{Cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{Cellulose hexanitrate}}{C_{12}H_{14}O_4(NO_3)_6} + \underset{\text{Water}}{6H_2O}$$

$$\underset{\text{Nitric Acid}}{5HNO_3} + \underset{\text{Cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{Cellulose pentanitrate}}{C_{12}H_{15}O_5(NO_3)_5} + \underset{\text{Water}}{5H_2O}$$

$$\underset{\text{Nitric Acid}}{4HNO_3} + \underset{\text{Cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{Cellulose tetranitrate}}{C_{12}H_{16}O_6(NO_3)_4} + \underset{\text{Water}}{4H_2O}$$

$$\underset{\text{Nitric Acid}}{3HNO_3} + \underset{\text{Cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{Cellulose trinitrate}}{C_{12}H_{17}O_7(NO_3)_3} + \underset{\text{Water}}{3H_2O}$$

$$\underset{\text{Nitric Acid}}{2HNO_3} + \underset{\text{Cellulose}}{C_{12}H_{20}O_{10}} = \underset{\text{Cellulose dinitrate}}{C_{12}H_{18}O_8(NO_3)_2} + \underset{\text{Water}}{2H_2O}$$

The soluble pyroxylin used in preparing collodion is a varying mixture of the di-, tri-, tetra-, and pentanitrates, but mainly tetranitrate. The hexanitrate is the true explosive gun cotton, and is insoluble in ether, alcohol, acetone, or water.

Official Description.—A yellowish-white, matted mass of filaments, resembling raw cotton in appearance, harsh to the touch; exceedingly inflammable, burning, when unconfined, very rapidly with a luminous flame; less explosive than cellulose trinitrate. When kept in well-closed bottles and exposed to the light, it is decomposed with the evolution of nitrous vapors, a carbonaceous mass being deposited.

Solubility.—Slowly but completely soluble in 25 parts of a mixture of 3 volumes of ether and 1 volume of alcohol. Soluble in acetone and in glacial acetic acid, and precipitated from these solutions on addition of water.

Test for Impurity.—It should leave no weighable residue of mineral impurity when ignited.

Uses.—Pyroxylin has been used very largely by photographers for producing the basis of the sensitized film upon which impressions are made. It is now replaced to a great extent by gelatin. The composition known as *celluloid*, which is used so largely for useful and ornamental articles, is made from pyroxylin, camphor, and coloring matter heated together and powerfully pressed into appropriate moulds. Pharmaceutically, pyroxylin is used in collodions (see page 319).

Official Preparations of Pyroxylin

Collodium Collodion	Made by introducing 40 Gm. of pyroxylin in a suitable bottle and adding 750 Cc. of ether and allowing it to stand for fifteen minutes, to permit the penetration of the ether to all parts of the pyroxylin; 250 Cc. of alcohol are now added, and the mixture shaken until the pyroxylin is dissolved. Pyroxylin, even of the best quality, is never entirely soluble; hence the direction to decant the liquid from any sediment and transfer it to bottles. The sediment consists of little filaments, probably of unaltered cotton; many physicians prefer to shake the bottle so as to incorporate the sediment, under the belief that the film is stronger on account of their presence. Collodion is used to protect inflamed surfaces by applying a small quantity with a brush; a thin, closely adherent film remains after the ether and alcohol evaporate; this film is contractile, and is useful on this account in many minor surgical operations (see page 319). It is desirable at times to have a flexible film, especially when applied to parts of the body which are required to be in motion. Flexible Collodion should then be used (see page 320)
Collodium Flexile Flexible Collodion	Made by mixing 50 Gm. of Canada turpentine and 30 Gm. of castor oil with 920 Gm. of collodion. If an astringent is needed for application to a bleeding surface, the styptic collodion may be employed (see page 320)
Collodium Stypticum Styptic Collodion	Made by placing 20 Gm. of tannic acid in a graduated bottle, adding 5 Cc. of alcohol, 25 Cc. of ether, and sufficient collodion to make 100 Cc., then agitating until the tannic acid is dissolved. If a blistering effect is desired, the cantharidal collodion may be used (see page 319)
Collodium Cantharidatum Cantharidal Collodion	Made by percolating 60 Gm. of powdered cantharides with commercial chloroform until the cantharides is exhausted, then recovering by distillation all but one-fifth of the percolate, and, after evaporating the residue on a water-bath to 15 Gm., mixing it with 85 Gm. of flexible collodion. Cantharidin, the vesicating principle of cantharides, is very soluble in chloroform, which has the advantage over ether as a solvent of not being inflammable. There is considerable loss of menstruum in carrying out the process practically. The percolator shown on page 426 may be used, and distillation very carefully performed with a condenser having a large refrigerating surface.

ACIDUM OXALICUM. Oxalic Acid

$$H_2C_2O_4 + 2H_2O = 125.10$$

This acid was omitted from the alphabetical list of chemical substances in the U. S. Pharmacopœia; it is found, however, among the official reagents.

Preparation.—Oxalic acid may be made by acting on cellulose, sugar, or starch with nitric acid, with the aid of heat, but is prepared on a commercial scale by heating dried sawdust with a mixture of two molecules of caustic soda, and one molecule of caustic potash. The mixture of caustic alkalies and sawdust is made in a thick paste, and then heated for several hours *in vacuo* to a temperature of 180° C. (356° F.). The gray mass is then washed with sodium carbonate, whereby the potash is removed as carbonate, the less soluble sodium oxalate remaining. This is converted into calcium oxalate by milk of lime, and the calcium salt is then decomposed with sulphuric acid. The impure oxalic acid is then purified by recrystallization.

It occurs in small, colorless clino-rhombic crystals, which are odorless and have a very sour taste; it is slightly efflorescent in dry air, fusible at 98° C. (208.4° F.), and entirely volatile at a red heat.

The crystals should dissolve in twelve parts of distilled water at 25° C. (77° F.). It is soluble in 4.5 parts of absolute alcohol, and in 7 parts of alcohol, and almost insoluble in ether, chloroform, benzene, and petroleum benzin. It fuses in its water of hydration at 98° C. (208.4° F.), although continued exposure to a heat of 60° to 70° C. (140° to 158° F.) will render it perfectly anhydrous. Solutions of oxalic acid at 100° C. (212° F.) lose acid by sublimation, and at 157° C. (314.6° F.) it sublimes rapidly. If the heat rise to 160° C. (320° F.), much loss of acid occurs.

It combines with salifiable bases, and forms salts called oxalates. The most important of these are the three *potassium salts,—oxalate, binoxalate*, and *quadroxalate* (acid potassium oxalate plus free oxalic acid), *ammonium oxalate* (used as a test), and *calcium oxalate.* The binoxalate and quadroxalate, both popularly called *salt of sorrel* or *essential salt of lemons*, are employed for removing iron stains from linen, and act by their excess of acid, which forms a soluble salt with the ferric oxide constituting the stain.

This acid in solution combines readily with lime, and forms with it an insoluble white precipitate consisting of calcium oxalate, which is insoluble in an excess of oxalic or acetic acid, but is dissolved by dilute hydrochloric acid.

Uses.—This acid is used analytically in volumetric estimation for establishing a standard for volumetric solutions since a pure acid may be easily obtained and a definite quantity weighed (see Tests, Reagents), but its use in the U. S. Pharmacopœia (8th Rev.) has been limited to three volumetric tests, and other acid volumetric solutions have replaced it in many instances where it was used in previous Pharmacopœias. This is due to the tendency of the solution to crystallize at the delivery point of the burette and cause errors through the crystals falling into the solution which is being tested.

The best antidote to poisoning by oxalic acid is a paste made by mixing prepared chalk or powdered chalk with water or lime water; it must be administered promptly and freely.

Products resulting from the Destructive Distillation of Cellulose and Lignin

When wood is distilled in close vessels many products are obtained. These vary with the kind of wood used, the care used in the distillation, and the temperature at which the distillation is effected. When dry hard woods (oak, walnut, or beech) are distilled, about 25 percent. of charcoal is obtained; the liquid portion amounts to about 53 percent., while the remainder, 22 percent., is represented by waste products, principally uncondensible gases, carbon dioxide, carbon monoxide, etc. The principal solid, liquid, and gaseous products are shown by the following list:

Solids.—Charcoal, inorganic salts, etc. **Liquids.**—1. Aqueous liquid, containing *acetic, formic, butyric, crotonic, capronic, propionic acids, acetone, methyl alcohol, furfurol, methylamine, pyrocatechin*, and small quantities of empyreumatic oils and resins. 2. Tarry liquid, containing *toluol, xylol, cumol, methol, mesitylene, pseudocumol, phenol, cresol, guaiacol, creosol, phlorol, and methylcreosol, naphthalene, paraffin, pyrene, chrysene, retene, mesit.* **Gases.**—*Carbon dioxide, carbon monoxide, marsh-gas, acetylene, ethylene, propene*, and others. The most important products are charcoal, tar, acetic acid, acetone, methyl alcohol, and creosote. Of these, charcoal has been considered in Part III.

ACIDUM ACETICUM. U.S. Acetic Acid

A liquid composed of not less than 36 percent., by weight, of absolute Acetic Acid [$CH_3.COOH = 59.58$], and about 64 percent. of water, and obtained by the oxidation of ethyl alcohol or by the destructive distillation of wood.

Preparation.—The best acetic acid for pharmaceutical and medical uses is now made by subjecting oak wood, cut into small billets, to a carefully regulated heat, the temperature being much less than that necessary to produce charcoal. The distilled aqueous liquid (*pyroligneous acid*) is treated with soda ash and the resulting sodium acetate decomposed by sulphuric acid and the acetic acid recovered by distillation. The advantages are that the production of the empyreumatic substances, which constitute the most objectionable impurities in the commercial acid, is largely curtailed, the process being at the same time more economical, as the residue of slightly darkened wood is more valuable than the completely charred carbon left by the ordinary process (see U. S. Dispensatory, 18th edition, page 16).

Acetic acid is also made by distilling *vinegar*, a liquid made by the oxidation of dilute alcoholic liquids, such as cider, wine, etc. In Germany acetic acid is made by mixing alcohol with water in the proportion of eight parts of the former to ninety-two parts of the latter, and then pouring it upon beech wood shavings, so that as it trickles through it is oxidized by the action of the air in contact. Aldehyde is an intermediate product. This "quick vinegar" process is now extensively used in the United States.

$$\underset{\text{Alcohol}}{C_2H_6O} + \underset{\text{Oxygen}}{O} = \underset{\text{Aldehyde}}{C_2H_4O} + \underset{\text{Water}}{H_2O}$$

$$\underset{\text{Aldehyde}}{C_2H_4O} + \underset{\text{Oxygen}}{O} = \underset{\text{Acetic Acid}}{C_2H_4O_2}$$

or

$$\underset{\text{Alcohol}}{C_2H_6O} + \underset{\text{Oxygen}}{O_2} = \underset{\text{Acetic Acid}}{C_2H_4O_2} + \underset{\text{Water}}{H_2O}$$

Two strengths of acetic acid are found in commerce,—the official acid, (36 percent.) which has the sp. gr. 1.045 at 25° C. (77° F.), and the No. 8 acid, as it is called, (30 percent.) which is still used; the latter has the sp. gr. 1.038 at 25° C. (77° F.), and is weaker than the official acid. It is termed "No. 8" because it was formerly used in the proportion of one part in eight to make the ordinary diluted acetic acid, or distilled vinegar. The salts of acetic acid are termed acetates; they are all soluble in water, and may be recognized by heating with sulphuric acid, when the odor of acetic acid will be developed; a neutral solution of an acetate is colored deep red by a solution of ferric chloride, and, if the mixture is boiled, a brownish-red oxyacetate is precipitated.

Official Description.—A clear, colorless liquid.

Odor, Taste, and Reaction.—Strong, vinegar-like odor; purely acid taste; strongly acid reaction.

Specific Gravity.—About 1.045 at 25° C. (77° F.).

Solubility.—*Water.* Miscible in all proportions.

Alcohol. Miscible in all proportions.

Tests for Identity.—When heated, the Acid is volatilized without leaving a residue.

On adding to Acetic Acid enough ammonia water to neutralize it or to leave the Acid in slight excess, and then ferric chloride T.S., the liquid will acquire a blood-red color, which is discharged by strongly acidulating with sulphuric acid.

Impurities and Tests for Impurities.—*Copper.* When the Acid is slightly supersaturated with ammonia, the liquid should not have a bluish tint.

Other fixed impurities. Nor should more than 0.01 percent. of residue be left after evaporating the alkaline liquid on a water-bath.

Heavy metals. Acetic Acid diluted with 20 volumes of water should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Sulphuric acid. Acetic Acid diluted with 10 volumes of water should not yield a precipitate or turbidity with barium chloride T.S.

Hydrochloric acid. Or with silver nitrate T.S.

Formic or sulphurous acids. If 5 Cc. of the Acid be supersaturated with 10 Cc. of ammonia water, and 5 Cc. of tenth-normal silver nitrate V.S. be added, and the mixture boiled one or two minutes, no dark deposit should be produced.

Limit of empyreumatic substances. When the Acid is slightly supersaturated with potassium hydroxide T.S., the liquid should not develop a smoky odor or taste. If 5 drops of tenth-normal potassium permanganate V.S. be mixed with 2 Cc. of the Acid, previously diluted with 10 Cc. of water, and contained in a clean, glass-stoppered vial, the pink tint should not change to brown at once, and should not become entirely brown, or free from pinkish-brown, in less than half a minute.

Quantitative Test.—If 10 Gm. of Acetic Acid be diluted with water to measure 100 Cc., then 59.6 Cc. of this solution should require not less than 36 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Acetic Acid), phenolphthalein T.S. being used as indicator.

Uses.—Acetic Acid is used in pharmacy as a solvent and menstruum, and for making the diluted acetic acid.

ACIDUM ACETICUM DILUTUM. U. S. Diluted Acetic Acid

It should contain not less than 6 percent., by weight, of absolute Acetic Acid [$CH_3.COOH = 59.58$], and about 94 percent. of water.

	Metric	Old form
* **Acetic Acid**	100 Gm.	4 fl. oz.
Distilled Water	500 Gm.	21 fl. oz.
To make	600 Gm.	25 fl. oz.

Mix them.

Specific Gravity.—About 1.009 at 25° C. (77° F.).

Impurities and Tests for Impurities.—It should respond to the tests of purity given under *Acidum Aceticum.*

Quantitative Test.—To neutralize 23.8 Gm. of Diluted Acetic Acid should require not less than 24 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 0.25 percent. of absolute Acetic Acid), phenolphthalein T.S. being used as indicator.

Uses.—Diluted acetic acid is superior to vinegar as a menstruum, and is used officially because of its greater purity, more uniform strength, and freedom from color. The dose is thirty minims (2 Cc.).

ACIDUM ACETICUM GLACIALE. U. S. Glacial Acetic Acid

A liquid containing not less than 99 percent., by weight, of absolute Acetic Acid [$CH_3.COOH = 59.58$], and not more than 1 percent. of water.

Preparation.—This acid (which is termed "glacial" because of its glassy appearance at low temperatures) is made by fusing carefully fifty-four parts of pure crystallized sodium acetate; the residue is coarsely powdered, placed in a retort, mixed with forty parts of pure concentrated sulphuric acid, and distilled; the distillate is glacial acetic acid.

$$\underset{\text{Sodium Acetate}}{NaC_2H_3O_2} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Glacial Acetic}\\\text{Acid}}}{HC_2H_3O_2} + \underset{\substack{\text{Acid Sodium}\\\text{Sulphate}}}{NaHSO_4}$$

The specific gravity of glacial acetic acid (100 percent.) is 1.0472 at 25° C. (77° F.), and the specific gravity of 39 percent acetic acid is nearly the same, 1.0473, while 80, 79, 78, 77, and 76 percent. acids have exactly the same density. It will thus be seen that specific gravity cannot be relied upon as a criterion for strength. The glacial acid may, however, be distinguished from the 39 percent. acid by adding 10 percent. of water, when, if the density increases, the specimen is the stronger acid. (See Acetic Acid table, U. S. P., 8th Rev.)

Official Description.—A clear, colorless liquid.
Odor and Taste.—Strong, vinegar-like odor; very pungent, acid taste.
Specific Gravity.—Not above 1.049 at 25° C. (77° F.).
Tests for Identity.—At a temperature somewhat below 15° C. (59° F.), the Acid becomes a crystalline solid. At 117° to 118° C. (242.6° to 244.4° F.) it boils, evolving inflammable vapors.

Glacial Acetic Acid should respond to the tests of purity given under *Acidum Aceticum;* but the tint produced by the addition of 2 drops of tenth-normal potassium permanganate V.S. to 2 Cc. of the Acid diluted with 10 Cc. of water, contained in a clean, glass-stoppered bottle, should not be changed to brown within two hours.

Quantitative Test.—Introduce into a stoppered weighing-bottle 3 Cc. of Glacial Acetic Acid and weigh accurately. Dilute the Acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using phenolphthalein T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 5.958, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Acetic Acid in the latter.

Uses.—Glacial acetic acid is a solvent for oil of lemon and other oils; and, medicinally, it is a caustic and vesicant when applied externally. It is often sold under various disguises as a corn solvent.

ACIDUM TRICHLORACETICUM. U.S. Trichloracetic Acid

$HC_2Cl_3O_2 = 162.12$

A monobasic organic acid [$CCl_3.COOH$], usually obtained by the oxidation of hydrated chloral with nitric acid. It should be kept in dark amber-colored, well-stoppered bottles, in a cool place.

This acid, discovered by Dumas in 1838, may be made by treating hydrated chloral with three times its volume of fuming nitric acid, and placing the mixture in sunlight until the red fumes have disappeared; the liquid is then distilled, and the portion coming over at 195° C. (383° F.) is trichloracetic acid, which is then crystallized.

Official Description.—White, deliquescent, rhombohedral crystals.
Odor and Reaction.—Slight characteristic odor; acid reaction.
Solubility.—Very soluble in water, alcohol, and ether. The aqueous solution, on boiling, is decomposed with the formation of chloroform and carbon dioxide.
Tests for Identity.—Heated to 52° C. (125.6° F.) it melts, and at 195° C. (383° F.) it boils and vaporizes without leaving a residue.

On heating with potassium hydroxide T.S., it is decomposed with the formation of chloroform and potassium carbonate.

If to its aqueous solution (1 in 10) ferric chloride T.S. be added, a faint reddish color is developed.

Quantitative Test.—One Gm. when diluted with 50 Cc. of water should not require less than 6.1 Cc. of normal sodium hydroxide V.S. for neutralization, phenolphthalein T.S. being used as indicator.

Uses.—This acid was introduced into the U. S. P. (8th Rev.); it is used as a caustic in solution or in crystals.

ACETONUM. U.S. Acetone

A liquid containing not less than 99 percent., by weight, of absolute Acetone [Dimethyl-ketone, $CH_3.CO.CH_3 = 57.61$]. It should be kept in well-closed vessels in a cool place, remote from lights or fire.

This liquid may be made by the distillation of dry calcium acetate at 290° C. (554° F.); it is also found in crude wood spirit in varying proportions; it is separated from methyl alcohol, which constitutes the principal bulk in the wood spirit, with difficulty, because methyl alcohol boils at 55.1° C. (131° F.) and acetone at 56.5° C. (133.7° F.), the difference being too slight to use fractional distillation with success.

Official Description.—A transparent, colorless, mobile, and volatile liquid.
Odor, Taste, and Reaction.—Characteristic ethereal odor; pungent, sweetish taste; neutral reaction.
Specific Gravity.—Specific gravity about 0.790 at 25° C. (77° F.).
Solubility.—*Water.* Miscible in all proportions, without cloudiness.
Alcohol. Miscible.
Other solvents. Miscible with ether, chloroform, and volatile oils.
Tests for Identity.—It volatilizes at low temperatures and boils from 56° to 57° C. (132.8° to 134.6° F.). It is inflammable and burns with a luminous non-sooty flame.
If 50 Cc. of Acetone be evaporated in a clean glass vessel no weighable residue should remain.
Impurity and Test.—*Limit of empyreumatic substances.* If 20 Cc. of Acetone contained in a clean glass-stoppered vial be mixed with 0.1 Cc. of tenth-normal potassium permanganate V.S., the pink tint produced by the admixture should not wholly disappear in less than 15 minutes.

Uses.—Acetone is used as a solvent in the preparation of oleoresins and for dissolving fatty bodies, resins, pyroxylin, etc. It is at present largely used in the manufacture of chloroform.

PIX LIQUIDA. U.S. Tar

A product obtained by the destructive distillation of the wood of *Pinus palustris* Miller, or of other species of Pinus (Fam. *Pinaceæ*).

Tar is usually obtained as a by-product in the manufacture of charcoal or acetic acid (see page 720).

Official Description.—Semiliquid, viscid, blackish-brown, non-crystalline, translucent in thin layers, becoming granular and opaque with age.
Odor, Taste, and Reaction.—Odor empyreumatic, terebinthinate; taste sharp and empyreumatic; acid reaction.
Solubility.—*Water.* Heavier than water and slightly soluble in it, the solution being of a pale yellowish-brown color.
Alcohol. Miscible.
Other solvents. Soluble in fixed or volatile oils.

Uses.—The volatile products of tar are expectorant, and tar inhalations are often used. Externally, tar is stimulating, and is used in skin diseases.

Official Preparations

Syrupus Picis Liquidæ Syrup of Tar	Made by washing 5 Gm. of tar, mixed with 10 Gm. of sand with cold water, treating the residue with 50 Cc. of alcohol, triturating with 10 Gm. of magnesium carbonate and 50 Gm. of sugar, adding 400 Cc. of water, stirring occasionally during 2 hours, filtering, dissolving 800 Gm. of sugar in the filtrate, and adding sufficient water to make 1000 Cc. (see page 295). Dose, one to two fluidrachms (4 to 8 Cc.)
Unguentum Picis Liquidæ Tar Ointment	Made by mixing 500 Gm. of tar with 150 Gm. of yellow wax and 350 Gm. of lard, straining, and stirring until cold

OLEUM PICIS LIQUIDÆ. U.S. Oil of Tar

A volatile oil distilled from tar.

Official Description.—An almost colorless liquid when freshly distilled, but soon acquiring a dark reddish-brown color.
Odor, Taste, and Reaction.—Strong, tarry odor and taste; acid reaction in alcoholic solution.
Specific Gravity.—About 0.892 at 25° C. (77° F.).
Solubility.—*Alcohol.* Soluble.

Uses.—The constituents of oil of tar are complex and numerous; the residue left after the distillation of tar is *black pitch*. The oil is preferred to tar for most medicinal uses, because the insoluble and inert substances have been separated.

OLEUM CADINUM. U.S. Oil of Cade

[OIL OF JUNIPER TAR OLEUM JUNIPERI EMPYREUMATICUM]

A product of the dry distillation of the wood of *Juniperus Oxycedrus* Linné (Fam. *Coniferæ*).

Official Description.—A brownish or dark brown, clear, thick liquid.

Odor, Taste, and Reaction.—A tarry odor, and an empyreumatic, burning, somewhat bitter taste. Imparts an acid reaction to water.

Solubility.—*Water.* Almost insoluble.

Alcohol. Partially soluble.

Other solvents. Completely soluble in ether.

Uses.—Its uses in medicine are the same as those of tar and oil of tar (see page 723).

CREOSOTUM. U.S. Creosote

A mixture of phenols and phenol derivatives, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably of that derived from the beech, *Fagus silvatica* Linné or *Fagus ferruginea* Aiton (Fam. *Fagaceæ*).

Preparation.—This is a product of the distillation of wood tar, consisting mainly of the following phenols: *guaiacol*, or *oxycresol*, $C_7H_8O_2$, boiling at 200° C. (392° F.); *creosol*, $C_8H_{10}O_2$, boiling at 217° C. (422.6° F.); *methyl-creosol*, $C_9H_{12}O_2$, boiling at 214° C. (417° F.) to 218° C. (424.4° F.); and *phlorol*, $C_8H_{10}O$, boiling at 219° C. (426.2° F.).

The lower oily layer which forms in the distillate from wood tar is treated with potassium carbonate to neutralize the acid present. Fractional distillation is now resorted to, with alternate treatment of the distillate with sulphuric acid and solution of potassium hydroxide to separate impurities; the liquid is finally distilled, and the portion coming over between 205° and 220° C. (401° and 428° F.) is considered to be creosote. Formerly much of the liquid sold for and labelled "creosote" in the market was impure phenol (carbolic acid), or coal-tar creosote. In view of the extensive use of wood creosote in large doses internally in phthisis, the liability of administering a large dose of phenol and causing death through this substitution is very great. Phenol may be distinguished from true wood creosote by the tests given below. The odor of each is distinctive and characteristic.

Official Description.—An almost colorless, yellowish (not pinkish), highly refractive, oily liquid; it should not become brown in color on exposure to light.

Odor, Taste, and Reaction.—Penetrating, smoky odor; burning, caustic taste; neutral or only faintly acid reaction.

Specific Gravity.—Not below 1.078 at 25° C. (77° F.).

Solubility.—*Water.* Its solution in about 140 parts at 25° C. (77° F.) is not perfectly clear.

Other solvents. Soluble in all proportions in absolute alcohol, ether, chloroform, carbon disulphide, acetic acid, and fixed and volatile oils.

Tests for Identity.—With 120 parts of hot water it forms a clear liquid, which, on cooling, becomes turbid from the separation of minute oily drops (distinction from, and absence of, both *phenol* and so-called "*coal-tar creosote*"). The filtrate from these separated oily globules yields a reddish-brown precipitate with bromine T.S. (distinction from *phenol* and so-called "*coal-tar creosote*," both of which yield white precipitates).

When distilled, most of it comes over between 200° and 220° C. (392° and 428° F.). When cooled to —20° C. (—4° F.), it becomes gelatinous, but does not solidify (difference from *phenol*). It is inflammable, burning with a luminous smoky flame.

On stirring together equal volumes of Creosote and collodion in a dry test-tube, no permanent coagulum should form (difference from *phenol* and so-called "*coal-tar creosote*," and limit of the former).

If 1 volume of Creosote be mixed with 1 volume of 95 percent. glycerin, a clear mixture will result, from which a creosotic layer, equal to or greater in volume than the Creosote employed, will separate on the addition of one-fourth volume of water (difference from, and limit of, *phenols*).

On adding to 10 Cc. of a saturated aqueous solution of Creosote 1 drop of ferric chloride T.S., the liquid develops a clear violet-blue color, which is very transient; it then clouds almost instantly, the color passing rapidly from a grayish-green into a muddy brown, with finally the formation of a brown precipitate (difference from *phenol* and so-called "*coal-tar creosote*," and limit of the former).

If 1 Cc. of Creosote be mixed with 10 Cc. of a solution of potassium hydroxide in absolute alcohol (1 in 5), a solid crystalline mass will form (difference from *phenol* and so-called "*coal-tar creosote*," and limit of the former).

Impurities and Tests for Impurities.—*Absence of neutral oils.* Two Cc. of Creosote should require not less than 10 Cc. nor more than 18 Cc. of normal sodium hydroxide V.S. to produce a clear, pale yellow liquid, which remains unclouded on diluting with 50 Cc. of water.

Cœrulignol and some other high-boiling constituents of wood-tar. If 1 Cc. of Creosote be cautiously and gently shaken with 2 Cc. of petroleum benzin and 2 Cc. of freshly prepared barium hydroxide T.S. until a uniform mixture is produced, upon complete separation three distinct layers are visible, the middle one of which contains the Creosote, unaltered in appearance; while the petroleum benzin should not be blue or muddy, and the aqueous layer should not have acquired a red tint.

Uses.—Creosote is a powerful antiseptic. It is used as a caustic application, and is frequently applied upon cotton to exposed nerves in teeth, when it acts as a local anæsthetic. It is also hæmostatic when applied to bleeding surfaces. In the form of creosote water it is used internally to check nausea. When taken internally, undiluted, and in large doses, it is a powerful poison. The administration of mucilaginous drinks, and the prompt evacuation of the stomach by the stomach pump, would be the best treatment, no antidote to poisoning by creosote being known. In phthisis it is given internally in doses of fifteen minims (1 Cc.) per day.

Official Preparation

Aqua Creosoti Creosote Water	One percent. aqueous solution of creosote (see page 277). Dose, one to two fluidrachms (4 to 8 Cc.)

GUAIACOL. U.S. Guaiacol

$C_7H_8O_2 = 123.13$

One of the chief constituents [$C_6H_4(OH)(OCH_3)$ 1 : 2] of creosote, the product from beechwood-tar, obtained by collecting and purifying the fraction of creosote boiling between 200° and 205° C. (392° and 401° F.); or prepared synthetically from either catechol by methylating, or from ortho-anisidin by diazotizing and boiling. Guaiacol should be preserved in amber-colored bottles, protected from light.

Official Description.—A colorless, crystalline solid, melting at 28.5° C. (83.3° F.), or a colorless refractive liquid, boiling at 205° C. (401° F.).

Odor.—Agreeable aromatic odor.

Specific Gravity.—Of liquid, from 1.110 to 1.114 at 25° C. (77° F.).

Solubility.—*Water.* Soluble in 53 parts at 25° C. (77° F.).

Alcohol. In all proportions.

Other solvents. In ether in all proportions, and in acetic acid and in 1 part of glycerin.

Tests for Identity.—The addition of ferric chloride T.S. to an alcoholic solution of Guaiacol (1 in 100) causes an immediate blue color, changing to emerald-green, and finally becoming yellowish.

If 2 Cc. of Guaiacol be shaken with 4 Cc. of petroleum benzin, the mixture should separate, on standing, into two distinct layers. Permanent turbidity or failure to separate into layers indicates the presence of impurities.

Impurities and Tests for Impurities.—*Oily hydrocarbons.* One Cc. of Guaiacol should dissolve in 2 Cc. of potassium hydroxide solution (15 percent.), when heated, and, on cooling, the mixture should congeal to a nearly white mass. Much coloration or failure to congeal indicates the presence of impurities. The mass thus obtained should form a clear solution with 20 volumes of water (turbidity indicates *oily hydrocarbons*).

Uses.—Guaiacol is used internally as a remedy in tuberculosis in doses of five to ten minims (0.3 to 0.6 Cc.) and by inhalation.

GUAIACOLIS CARBONAS. U.S. Guaiacol Carbonate

$(C_7H_7O)_2CO_3 = 272.05$

A guaiacol derivative $[(C_6H_4(OCH_3)O)_2.CO]$, obtained by the action of carbonyl chloride upon sodium-guaiacolate.

Official Description.—White, crystalline powder.
Odor, Taste, and Reaction.—Almost odorless and tasteless; neutral reaction.
Solubility.—*Water.* Insoluble.
Alcohol. In 48 parts at 25° C. (77° F.); readily soluble in hot alcohol.
Other solvents. In 1.5 parts of chloroform and 13 parts of ether at 25° C. (77° F.); readily soluble in benzene; slightly soluble in glycerin and fatty oils.
Tests for Identity.—When heated between 84° and 87° C. (183.2° and 188.6° F.), it fuses.
Guaiacol Carbonate is at once decomposed when treated with alcoholic potassium hydroxide T.S., and from the solution so obtained guaiacol may be separated on the addition of an acid.
Impurity and Test.—*Free guaiacol.* An alcoholic solution of Guaiacol Carbonate should not yield a bluish-green color on the addition of ferric chloride T.S.

Uses.—Guaiacol Carbonate, known also as *duotal*, is given as a remedy in tuberculosis in doses of eight to fifteen grains (0.5 to 1 Gm.).

Unofficial Products of the Destructive Distillation of Cellulose and Allied Substances

Acetophenone, C_8H_8O, or $C_6H_5CO.CH_3$ Hypnone. Phenyl-methyl-ketone	Hypnotic. Dose, three to ten grains (0.2 to 0.6 Gm.)
Methyl Alcohol, CH_3HO Methylic Alcohol Wood Naphtha Wood Alcohol Pyroxylic Spirit	It occurs among the products of the dry distillation of wood. The watery liquid is separated from the tar and distilled; then the first portion of the distillate is rectified over slaked lime, so as to remove acid, etc., and the product treated with sulphuric acid to remove tar and neutralize ammonia and methylamine, and, lastly, redistilled. It is a colorless, limpid liquid, of a peculiar odor, resembling alcohol and acetic ether, and of a warm taste. It is a good solvent for volatile oils, fats, and many resins. When purified it is designated as Columbian Spirit, and although this is rectified it should never be used internally; death and permanent blindness have been produced through the administration of methyl alcohol. The practice of substituting any form of this liquid for ethyl alcohol in pharmaceutical preparations is very reprehensible

Products resulting from the Natural Decomposition of Cellulose and Lignin and their Derivatives

Coal is fossil fuel, which is found in the earth at various depths, and which has been formed by the decomposition of the cellulose, lignin, and other constituents of vegetable matter under the changing influences of moisture, temperature, and pressure to which it is subjected. The differences in the structure and composition of coal are undoubtedly due to the variations in these influences, as well as to the alterations in the character of the vegetable substances.

Coal Tar.—Many valuable compounds have been contributed by recent researches to the arts and medicine from this formerly useless by-product. Coal tar is a residue left after the dry distillation of bituminous coal in the process for making illuminating gas (see page 110). It is a very complex substance; its composition varies considerably with the temperature at which the distillation of the coal is effected, the yield of solid bodies and of gases being larger when the temperature is higher, while at a lower temperature the liquid portion of the tar is in increased amount. When coal tar is submitted to distillation and rectification, it yields a brown, oily liquid, known technically as *light oil*, and consisting of benzene, toluene, etc.; then a black liquid, *dead oil*, is obtained, which contains aniline, naphthalene, phenol, etc.; the residue in the still is pitch, sometimes called *asphalt*. New products are continually being discovered; the principal constituents may be arranged in three classes.

1. *Solids.*—Naphthalene, $C_{10}H_8$; methyl-naphthalene, $C_{11}H_{10}$; acetyl-naphthalene and acenaphthene, $C_{12}H_{10}$; fluorene, $C_{13}H_{10}$; anthracene and phenanthrene, $C_{14}H_{10}$; pseudophenanthrene, $C_{16}H_{12}$; fluoranthene, $C_{15}H_{10}$; methyl-anthracene, $C_{15}H_{12}$; retene, $C_{18}H_{18}$; chrysene, $C_{18}H_{12}$; pyrene, $C_{16}H_{10}$; picene, $C_{22}H_{14}$; benzerythrene, $C_{24}H_{18}$; and carbazol, $C_{16}H_{11}N$.

2. *Liquids.*—These may be neutral hydrocarbons, acids, and ethers of the same, or bases. The *neutral hydrocarbons* are benzene, C_6H_6; toluene, C_7H_8; methyl-toluene and iso-xylol, C_8H_{10}; pseudocumol and mesitylene, C_9H_{12}; and cymol, $C_{10}H_{14}$. The *acid constituents* are phenol, C_6H_6O; cresol; orthocresol, paracresol, and metacresol, C_7H_8O; phlorol, $C_8H_{10}O$; rosolic acid, $C_{20}H_{16}O_3$; pyrocatechin, $C_6H_6O_2$; and creosote, consisting of the methyl ethers of pyrocatechin and its homologues, $C_7H_8O_2$, $C_8H_{10}O_2$, and $C_9H_{12}O_2$. There are also present, probably in combination with the ammonia of the ammoniacal liquor, acetic, butyric, carbonic, hydrocyanic, sulphocyanic, and hydrosulphuric acids. The *bases* are ammonia, NH_3; methylamine, CH_3NH_2; ethylamine, $C_2H_5NH_2$; phenylamine, $C_6H_5NH_2$; pyridine, C_8H_5N; picoline, C_6H_8N; lutidine, C_7H_9N; collidine, $C_8H_{11}N$; leucoline, C_9H_7N; iridoline, $C_{10}H_9N$; cryptidine, $C_{11}H_{11}N$; acridine, $C_{13}H_9N$; coridine, $C_{10}H_{15}N$; rubidine, $C_{11}H_{17}N$; and viridine, $C_{12}H_{19}N$.

3. *Gases.*—(*a*) *Illuminating gases.* Acetylene, C_2H_2; ethylene, C_2H_4; propylene, C_3H_6; butylene, C_4H_8; allylene, C_3H_4; crotonylene, C_4H_6; terene, C_5H_8; and vapors of benzene, C_6H_6; styrolene, C_8H_8; naphthalene, $C_{10}H_8$; methyl-naphthalene, $C_{11}H_{10}$; fluorene, $C_{13}H_{10}$; fluoranthene, $C_{15}H_{10}$; propyl, $(C_3H_7)_2$; and butyl, $(C_4H_9)_2$.

(*b*) *Heating and diluting gases.* Hydrogen, H_2; marsh-gas (methane), CH_4; and carbon monoxide, CO.

(*c*) *Impurities.* Carbon dioxide, CO_2; ammonia, NH_3; cyanogen, $(CN)_2$; methyl-cyanide, CH_3CN; sulphocyanic acid, CNSH; hydrogen sulphide, H_2S; carbon disulphide, CS_2; carbon oxysulphide, COS; and nitrogen, N_2.

NAPHTHALENUM. U.S. Naphthalene

$C_{10}H_8 = 127.10$

[NAPHTALINUM, PHARM. 1890 NAPHTALIN NAPHTHALIN]

A hydrocarbon obtained from coal-tar, and purified by crystallization. It should be kept in well-stoppered, amber-colored bottles.

On subjecting coal tar to distillation this substance passes over into the condensing vessels immediately after the naphtha.

Official Description.—Colorless, shining, transparent laminæ; slowly volatilized on exposure to air: by exposure to light acquiring a brownish color.

Odor, Taste, and Reaction.—Strong, characteristic odor resembling that of coal-tar; burning, aromatic taste; neutral to litmus paper moistened with alcohol.

Solubility.—*Water.* Insoluble in water, but when boiled with it, the water acquires a faint odor and taste.

Alcohol. Soluble in 13 parts of alcohol at 25° C. (77° F.), and very soluble in boiling alcohol.

Other solvents. Very soluble in ether, chloroform, carbon disulphide, and fixed or volatile oils.

Tests for Identity.—Naphthalene volatilizes slowly at ordinary temperatures, but rapidly when heated. It also volatilizes with the vapors of water or alcohol. At 80° C. (176° F.) it melts, and at 218° C. (424.4° F.) it boils. Its vapor is inflammable, burning with a luminous but smoky flame. When ignited, it is consumed, leaving no residue.

Impurities and Tests for Impurities.—*Impurities derived from coal-tar.* On shaking a small portion of naphthalene with concentrated sulphuric acid, the acid should remain colorless, and should not acquire more than a pale reddish tint if the mixture be heated for five minutes on a water-bath.

Uses.—Naphthalene, or *coal tar camphor*, is used almost exclusively as an insecticide, to prevent the ravages of moths in woollen clothing. For this purpose it has to a large extent replaced camphor. It is occasionally given internally in doses of two grains (0.12 Gm.).

BETANAPHTHOL. U.S. Betanaphthol

$C_{10}H_7OH = 142.98$

[NAPHTOL, PHARM. 1890]

A monatomic phenol occurring in coal-tar, but usually prepared from napthalene. Betanaphthol should be kept in dark amber-colored, well-stoppered bottles.

When naphthalene is digested with fuming sulphuric acid, two acids may be obtained; at a temperature of 80° to 90° C. (176° to 194° F.) alphanaphthalene sulphonic acid is chiefly formed, but at 200° C. (392° F.) the beta variety is the principal product, and when this latter acid is fused with an alkali hydroxide and hydrochloric acid added, the official compound, betanaphthol, is liberated.

Official Description.—Colorless or pale buff-colored, shining crystalline laminæ or a white or yellowish-white crystalline powder; permanent in the air.

Odor, Taste, and Reaction.—Faint, phenol-like odor; sharp and pungent but not persistent taste; neutral reaction.

Solubility.—*Water.* In about 950 parts at 25° C. (77° F.); in about 75 parts of boiling water.

Alcohol. In 0.61 part at 25° C. (77° F.); very soluble in boiling alcohol.

Other solvents. Easily in ether, chloroform, or solutions of alkali hydroxides.

Tests for Identity.—Betanaphthol melts at 122° C. (251.6° F.) and boils at 286° C. (546.8° F.). It sublimes readily when heated; when in alcoholic or aqueous solution, it is volatilized with the vapor of alcohol or water. On ignition it leaves no residue.

A cold saturated aqueous solution of Betanaphthol when mixed with ammonia water exhibits a faint bluish fluorescence.

On adding about 0.1 Gm. of Betanaphthol to about 5 Cc. of an aqueous solution of potassium hydroxide (1 in 4), then about 1 Cc. of chloroform, and gently warming the mixture, the aqueous layer will acquire a blue tint, changing afterwards to green and brown.

Ferric chloride T.S. colors an aqueous solution greenish, and after some time causes the separation of white flakes, which turn brown upon the application of heat.

Impurities and Tests for Impurities.—*Naphthalene.* Betanaphthol should dissolve in 50 parts of ammonia water without leaving a residue.

Other organic impurities. The above solution should not have a deeper color than pale yellow.

Distinction from, and absence of, alphanaphthol. An aqueous solution of Betanaphthol on the addition of chlorinated lime should show a pale yellow color and not a dark violet.

Distinction from, and absence of, alphanaphthol, which produces an intensely violet color. An aqueous solution of Betanaphthol on the addition of a few drops of iodine T.S., followed by sodium hydroxide T.S. in excess, should show no color.

Uses.—Betanaphthol is used as an antiseptic in skin diseases. It retards the growth of bacteria, and has been given internally in doses of three to five grains (0.2 to 0.3 Gm.).

CRESOL. U. S. Cresol

$C_7H_7.OH = 107.25$

A mixture $[C_6H_4(CH_3)OH]$ of the three isomeric Cresols obtained from coal-tar, freed from phenol, hydrocarbons, and water. It should be preserved in amber-colored bottles, protected from light.

Soon after the introduction of carbolic acid (phenol) into use as an antiseptic it was discovered that some of the homologous constituents of *crude carbolic acid* were more active than the phenol which it contained. Cresol or *cresylic acid*, as it was then called, was the most important among these, and experience has developed its value. Official cresol consists of a mixture of three isomers existing according to Schulze in coal-tar approximately in the proportion of 40 percent. of *metacresol*, 35 percent. of *orthocresol*, and 25 percent. of *paracresol*. Cresol has a higher boiling point than phenol and is separated from it by fractional distillation. It was introduced into the U. S. P. (8th Rev.).

Official Description.—A colorless or straw-colored refractive liquid, turning yellowish-brown on prolonged exposure to light.

Odor.—Phenol-like odor.

Specific Gravity.—From 1.036 to 1.038 at 25° C. (77 °F.).

Solubility.—*Water.* Soluble in 60 parts at 25° C. (77 °F.).

Alcohol. Miscible in all proportions.

Other solvents. Miscible in all proportions with petroleum benzin, benzene, ether, and glycerin; miscible with alkali hydroxide solutions.

Test for Identity.—When distilled, 90 percent. of the Cresol should boil between 195° and 205° C. (383° and 401° F.).

Impurities and Tests for Impurities.—*Absence of, or limit of, hydrocarbons.* If 1 Cc. of Cresol be mixed with 1 Cc. of an aqueous solution of sodium hydroxide (1 in 10), it should dissolve with no appreciable liquid residue.

Uses.—Cresol is antiseptic and resembles phenol in its medical properties, but owing to its greater insolubility in water is nearly always employed in combination with alkalies associated with fatty bodies, or soaps. (See Liquor Cresolis Compositus, page 280). The dose is five minims (0.3 Cc.).

LIQUOR CRESOLIS COMPOSITUS. U.S. Compound Solution of Cresol

	Metric	Old form
* **Cresol**	**500 Gm.**	8 oz. av.
Linseed Oil	**350 Gm.**	5 oz. av. 260 gr.
Potassium Hydroxide	**80 Gm.**	1 oz. av. 122 gr.
Water, a sufficient quantity,		
To make	**1000 Gm.**	16 oz. av.

Dissolve the Potassium Hydroxide in 50 Gm. [old form 6 drachms] of Water in a tared dish, add the Linseed Oil, and mix thoroughly. Then add the Cresol and stir, until a clear solution is produced, and finally sufficient Water to make the finished product weigh 1000 Gm. [old form 16 oz. av.].

This liquid has been introduced into the U. S. P. (8th Rev.) to supply a need for an antiseptic solution, which will readily mix with water, it closely resembles *lysol*, *creolin*, *solveol*, and *solutol*. If a few drops of freshly prepared compound solution of cresol added to four fluidounces of water produces a cloudy solution it will usually be found that after the compound solution has been allowed to stand several hours there will then be no difficulty in forming a clear solution with water, the cresol used must comply with the official tests given under cresol.

Uses.—Compound solution of cresol is a valuable antiseptic solution for local applications. It is sometimes used internally in doses of five to ten minims (0.3 to 0.6 Cc.).

PHENOL. U.S. Phenol

$C_6H_5OH = 93.34$

[ACIDUM CARBOLICUM, PHARM. 1890 CARBOLIC ACID]

Hydroxybenzene, obtained either from coal-tar by fractional distillation and subsequent purification, or made synthetically. It should contain, when assayed by the process given below, not less than 96 percent. of absolute Phenol. It should be kept in dark amber-colored, well-stoppered bottles.

Preparation.—This valuable product is properly termed phenol, and it belongs to a well marked class of hydrocarbons of which it is the type. It is made by distilling crude carbolic acid, and separating and purifying the distillate by repeated crystallizations. When perfectly pure, phenol is devoid of the odor of creosote, but it has a peculiar aromatic odor, which is not disagreeable. Crystallized Phenol, as found commercially, is much purer than the liquid forms, and has the advantage that it may be transported in cans or bottles without risk of loss by leakage. (See Phenol Liquefactum, page 731).

Official Description.—Colorless, interlaced, or separate needle-shaped crystals, or a white, crystalline mass, sometimes acquiring a reddish tint.

Odor, Taste, and Reaction.—Characteristic, somewhat aromatic odor; when copiously diluted with water it has a sweetish taste, with a slightly burning after-taste, and when undiluted, cauterizes and whitens the skin and mucous membrane; faintly acid reaction.

Solubility.—*Water.* In 19.6 parts at 25° C. (77° F.), varying according to the degree of hydration.

Alcohol. Very soluble.

Other solvents. Very soluble in ether, chloroform, benzene, carbon disulphide, glycerin, fixed and volatile oils; almost insoluble in petroleum benzin.

Tests for Identity.—When gently heated, Phenol melts, forming a highly refractive liquid. It is also liquefied by the addition of about 8 percent. of water. If the Phenol be liquefied by a gentle heat, and then slowly cooled under constant stirring, until it is partly recrystallized, the semi-liquid mass should have a temperature (remaining stationary for a short time) not lower than 39°C. (102.2°F.).

Phenol should have a boiling point from 178° to 182° C. (352.4° to 359.6° F.).

When heated upon a water-bath, it should be volatilized without leaving a residue. The vapor is inflammable.

Phenol is faintly acid to blue litmus paper.

Its aqueous solution yields, with bromine water, a white precipitate of tribromphenol, which at first redissolves, but becomes permanent as more of the reagent is added, and appears crystalline when viewed under the microscope.

On adding to 10 Cc. of an aqueous solution of Phenol (1 in 100) 1 drop of ferric chloride T.S., the liquid acquires a violet-blue color.

Impurity and Test.—*Creosote and cresol.* One volume of cold, liquefied Phenol (rendered liquid by the addition of 8 percent. of water) forms, with 1 volume of glycerin, a clear liquid which is not rendered turbid by the addition of 3 volumes of water.

Assay.—Dissolve 1.556 Gm. of the Phenol to be valued in a sufficient quantity of water to make 1000 Cc. . Transfer 25 Cc. of this solution (containing 0.0389 Gm. of Phenol) to a glass-stoppered bottle having a capacity of about 200 Cc., add 30 Cc. of tenth-normal bromine V.S., then 5 Cc. of hydrochloric acid, and immediately insert the stopper. Shake the bottle repeatedly during half an hour, then remove the stopper just sufficiently to introduce quickly 5 Cc. of an aqueous solution of potassium iodide (1 in 5), being careful that no bromine vapor escapes, and immediately stopper the bottle. Shake the latter thoroughly, remove the stopper and rinse it and the neck of the bottle with a little water, so that the washings may flow into the bottle, and then add 1 Cc. of chloroform and shake well. Add, from a burette, tenth-normal sodium thiosulphate V.S., until the iodine tint is exactly discharged, and does not reappear after thorough agitation. Note the number of Cc. of tenth-normal sodium thiosulphate V.S. consumed (which should not exceed 6 Cc). The percentage of absolute Phenol is found by subtracting the number of Cc. of tenth-normal sodium thiosulphate V.S. used, from 30 (the number of Cc. of bromine V.S. originally added), and multiplying the remainder by 4.

Uses.—Phenol is unquestionably the most largely used antiseptic, and because of this fact great caution must be observed in dispensing it, as it is employed more frequently for suicidal purposes than any other poison; when applied to the skin or mucous membrane, it cauterizes and produces blanching; alcohol applied at once to the cauterized part causes the disappearance of the white spots. Alcohol has been used successfully in the treatment of poisoning by "carbolic acid" after it has been swallowed; the stomach pump should also be employed, as vomiting is rendered almost impossible owing to the benumbing influence of the poison. The dose is one grain (0.065 Gm.)

Official Preparations

Phenol Liquefactum Liquefied Phenol	Made by melting phenol, adding 10 percent. of water to the liquid, and mixing (see page 731)
Unguentum Phenolis Ointment of Phenol	Made by melting 97 Gm. of White Petrolatum, adding 3 Gm. of phenol, and stirring until cold (see page 1266)

PHENOL LIQUEFACTUM. U.S. Liquefied Phenol

A liquid composed of not less than 86.4 percent., by weight, of absolute Phenol [$C_6H_5OH = 93.34$], and about 13.6 percent., by weight, of water.

* **Phenol,** a convenient quantity
Distilled Water, a sufficient quantity

Liquefy the Phenol by placing the unstoppered container in a water-bath, and apply heat gradually until the crystals have melted; transfer the liquid to a tared vessel and weigh; then add for each 9 Gm. [old form 9 oz. av.] of Phenol 1 Gm. [old form 1 oz. av.] of Distilled Water and mix thoroughly. It should be kept in dark amber-colored, well-stoppered bottles.

Official Description.—A colorless liquid, which may develop a slight reddish tint upon keeping.

Odor, Taste, and Reaction.—Characteristic, somewhat aromatic odor, and when copiously diluted with water, a sweetish taste with a slightly burning after-taste, and when undiluted, cauterizing and whitening the skin and mucous membrane.

Specific Gravity.—About 1.065 at 25° C. (77° F.).

Solubility.—*Water.* In 12 parts at 25° C. (77° F.).
Alcohol. Miscible in all proportions.
Other solvents. Miscible in all proportions with ether and glycerin.

Tests for Identity.—One part of Liquefied Phenol acquires a permanent cloudiness when mixed respectively with 2 parts of chloroform, 1.5 parts of benzene, 2.5 parts of carbon disulphide, 2 parts of oil of turpentine, or 2.5 parts of olive oil.

Liquefied Phenol begins to crystallize when the temperature of the liquid is lowered to about 13.5° C. (56.3° F.).

When heated, Liquefied Phenol begins to boil at about 115° C. (239° F.), and upon continuing the heat the boiling point rises; it should not exceed 188° C. (370.4° F.). When thus deprived of water, it should respond to the tests given under *Phenol.*

Uses.—Liquefied phenol was introduced into the U. S. P. (8th Rev.) to furnish a uniform and convenient method of using phenol in a concentrated liquid form, the practice of adding 10 percent. of water to crystallized phenol has long been used, this liquid being often more convenient for compounding prescriptions than the crystals; allowance must of course be made for the presence of 10 percent. of water. The dose is one minim (0.05 Cc.).

Official Preparation

Glyceritum Phenolis Glycerite of Phenol	Made by mixing 20 Cc. of liquefied phenol with 80 Cc. of glycerin (see page 306)

THYMOL. U.S. Thymol

$C_{10}H_{14}O = 148.98$

A phenol [$C_6H_3(CH_3)(OH)(C_3H_7)$ 1:3:4] occurring in the volatile oil of *Thymus vulgaris* Linné, and in some other volatile oils. It should be kept in well-stoppered bottles.

Preparation.—Thymol has been made synthetically and is obtained from the volatile oils of several plants by fractional distillation, by which terpenes are separated. The portion distilling above 190° C. (374° F.) is collected, agitated with solution of sodium hydroxide to separate more of the terpenes, and cooled; the compound of thymol with sodium hydroxide is then decomposed by hydrochloric acid. Thymol is recrystallized from an alcoholic solution. It has been obtained from *Monarda didyma* Linn., *M. punctata, Ammi copticum, Ocymum basilicum*, and *Ptychotis ajowan.* The phenol of the oil of *Thymus serpyllum* Linn. closely resembles thymol, but differs from it in not congealing at 10° C. (50° F.), in its solution in diluted alcohol turning green with ferric chloride, and in the potassium salt with its sulpho-acid being amorphous.

Official Description.—Large, colorless, translucent, rhombic prisms.

Odor and Taste.—Aromatic, thyme-like odor, and a pungent, aromatic taste, with a very slight caustic effect upon the lips.

Specific Gravity.—As a solid, 1.030 at 25° C. (77° F.), but when liquefied by fusion it is lighter than water.

Solubility.—*Water.* In about 1100 parts at 25° C. (77° F.).

Alcohol. In less than its own weight of alcohol.

Other solvents. In less than its own weight of ether or chloroform; in glacial acetic acid and fixed and volatile oils.

Tests for Identity.—It melts at 50° to 51° C. (122° to 123.8° F.), remaining liquid at considerably lower temperatures. When triturated with about equal quantities of camphor, menthol, or hydrated chloral, it liquefies.

Its alcoholic solution is optically inactive.

If a very small crystal of Thymol be dissolved in 1 Cc. of glacial acetic acid, and then 6 drops of sulphuric acid and 1 drop of nitric acid be added, the liquid will assume by reflected light a deep bluish-green color.

If 1 Gm. of Thymol be heated in a test-tube, in a water-bath, with 5 Cc. of a 10 percent. solution of sodium hydroxide, a clear, colorless, or very slightly reddish solution should be formed, which becomes darker on standing, but without the separation of oily drops.

If to this solution a few drops of chloroform be added and the mixture agitated, a violet color will be produced.

An alcoholic solution of Thymol should not be colored by ferric chloride T.S.

Impurity and Test.—*Inorganic impurities.* When a crystal of Thymol is heated in an open dish, or in a watch-glass, on a water-bath, it should gradually volatilize, leaving no residue.

Uses.—Thymol is a valuable antiseptic, and may be used for the same purposes as phenol. It is used in preparing cataplasm of kaolin and antiseptic solution. It liquefies if triturated with an equal amount of hydrated chloral, menthol, or camphor, and some other substances. Dose two grains (0.12 Gm.).

THYMOLIS IODIDUM. U.S. Thymol Iodide

$C_{20}H_{24}O_2I_2 = 545.76$

Dithymol-diiodide [$(C_6H_2.CH_3.C_3H_7.OI)_2$], obtained by the condensation of two molecules of thymol and the introduction of two atoms of iodine into the phenolic groups of the thymol; it contains when dried over sulphuric acid 45 percent. of iodine. Thymol Iodide should be kept in amber-colored vials, protected from the light.

It may be made by adding thymol dissolved in sodium hydroxide solution to an aqueous solution of iodine and potassium iodide.

Official Description.—A bright, chocolate-colored, or reddish-yellow, bulky powder.
Odor.—Very slight, aromatic odor.
Solubility.—*Water.* Insoluble.
Alcohol. Slightly soluble at 25°C. (77°F.).
Other solvents. Insoluble in glycerin; readily soluble in ether, chloroform, collodion, and in fixed and volatile oils, leaving a slight residue. It is not soluble in solution of sodium hydroxide, either cold or warm.
Tests for Identity.—It is decomposed when heated to the melting point.
When heated with concentrated sulphuric acid, it is decomposed with the separation of iodine.
Impurities and Tests for Impurities.—*Limit of Halogen Salts.* If 0.1 Gm. be shaken with 20 Cc. of water, the mixture, on filtering, will yield a filtrate which should not become more than opalescent on the addition of nitric acid and silver nitrate T.S.
Alkalies. If 0.5 Gm. be shaken with 10 Cc. of water, and the mixture filtered, no blue color should be imparted by the filtrate to red litmus paper.
Free iodine. If 0.5 Gm. be shaken with 10 Cc. of water, and the mixture filtered, the filtrate should not be colored blue upon the addition of starch T.S.
Limit of ash. If 0.1 Gm. of Thymol Iodide be thoroughly ignited in a porcelain crucible, it should leave not more than 0.003 Gm. of residue.

Uses.—Thymol iodide or *aristol* is used in antiseptic surgery as a substitute for iodoform, and as an external application to ulcerations and various skin affections.

RESORCINOL. U.S. Resorcinol

$C_6H_6O_2 = 109.22$

[RESORCINUM, PHARM. 1890 RESORCIN]

A diatomic phenol [metadihydroxybenzene, $C_6H_4(OH)_2$ 1:3] obtained usually by the reaction of fused sodium hydroxide upon sodium metabenzenedisulphonate. Resorcinol should be kept in dark amber-colored vials.

Preparation.—Resorcinol is usually prepared by fusing sodium metabenzenedisulphonate with sodium hydroxide; it may be made in several other ways,—by the destructive distillation of brazilin, or by the fusion of either galbanum, ammoniac, sagapenum, asafetida, or acroides with caustic potash. Resorcinol is a diatomic phenol isomeric with *pyrocatechin* and *hydroquinone.*

Official Description.—Colorless, needle-shaped crystals. It acquires a pinkish tint on exposure to light and air.
Odor, Taste, and Reaction.—Faint, peculiar odor; sweetish, followed by a bitter taste; neutral or only slightly acid reaction.
Solubility.—*Water.* In 0.5 parts at 25° C. (77° F.); very soluble in boiling water.
Alcohol. Slightly more soluble than in water; very soluble in boiling alcohol.
Other solvents. Readily soluble in ether and glycerin; very slightly soluble in chloroform, carbon disulphide, and benzene.
Tests for Identity.—When heated from 109° to 111°C. (228.2° to 231.8° F.) it melts and at a higher temperature is completely volatilized. It boils at 276.5° C. (529.7° F.) and is slightly volatile in a current of steam.
If 0.1 Gm. of Resorcinol be dissolved in 1 Cc. of potassium hydroxide T.S. and a drop of chloroform added, the mixture upon being heated will assume an intense crimson color. If a slight excess of hydrochloric acid be then added, the color will change to a pale straw-yellow.
On cautiously heating 0.05 Gm. of Resorcinol with 0.1 Gm. of tartaric acid and 10 drops of concentrated sulphuric acid, a thick carmine-red liquid will be formed, becoming pale yellow when diluted with water.
On adding a few drops of ferric chloride T.S. to 10 Cc. of an aqueous solution of Resorcinol (1 in 200), the liquid assumes a bluish-violet color, changing to brownish-yellow on the addition of ammonia water (distinction from *catechol and quinol*).
Impurities and Tests for Impurities.—*Distinction from, and absence of, catechol.* Lead acetate T.S. should produce no precipitate when added to an aqueous solution of Resorcinol.
Empyreumatic bodies. A concentrated aqueous solution of Resorcinol (1 in 2) should be colorless.
Phenol. And when gently heated should not emit the odor of *phenol.*

Uses.—Resorcinol is an antiseptic closely resembling phenol in its physiological action. It is used mainly externally in various skin diseases. The dose of resorcinol is two to three grains (0.12 to 0.2 Gm.).

ACIDUM SALICYLICUM. U.S. Salicylic Acid

$HC_7H_5O_3 = 137.01$

A monobasic organic acid [$C_6H_4(OH)COOH$ 1:2], existing naturally in combination in various plants, but generally prepared synthetically from phenol.

Preparation.—Although salicylic acid may be obtained from several natural sources, it is obtained, according to Kolbe's patent, by treating sodium phenol (or carbolate) with carbon dioxide. For this purpose, the most concentrated caustic soda solution is evaporated with the corresponding amount of phenol to a dry powder; this is then heated to 100° C. (212° F.), while a stream of dry carbon dioxide is passed over it. The temperature is gradually raised to 180° C. (356° F.), and increased to 220° C. (428° F.) as soon as phenol distils over, and finally raised to 250° C. (482° F.), until no more phenol distils. In the retort, the half of the phenol used remains as sodium salicylate, while the other half has distilled over unchanged. The reaction is as follows:

$$\underset{\substack{\text{Sodium}\\\text{Phenol}}}{2NaC_6H_5O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2} = \underset{\text{Phenol}}{C_6H_6O} + \underset{\substack{\text{Normal Sodium}\\\text{Salicylate}}}{Na_2C_7H_4O_3}$$

The sodium salt thus obtained is dissolved in water, decomposed by hydrochloric acid, and the salicylic acid filtered off, washed, and crystallized from a hot aqueous solution, or purified by sublimation in a current of superheated steam or dialyzed.

Schmitt improved Kolbe's process by acting upon sodium phenol with carbon dioxide in closed vessels at a temperature of 130° C. (266° F.); sodium-phenol carbonate is formed which passes into sodium salicylate. By this modification no separation of phenol occurs. Salicylic acid is also made from oil of gaultheria by adding to it a strong solution of potassium hydroxide whereby potassium salicylate is formed; this is then poured into diluted hydrochloric acid and the separated crystals of salicylic acid purified by recrystallization.

Official Description.—Light, fine, white, prismatic needles, or a bulky, white, crystalline powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless, or having a slight gaultheria-like odor; sweetish, afterwards acrid taste; acid reaction.

Solubility.—*Water.* In 308 parts at 25° C. (77° F.); in 14 parts of boiling water.

Alcohol. In 2 parts at 25° C. (77° F.); very soluble in boiling alcohol; soluble in absolute alcohol.

Other solvents. In ether and chloroform.

Tests for Identity.—When heated to 156° C. (312.8° F.), the Acid begins to melt, and is completely melted at 157° C. (314.6° F.); at a higher temperature it is gradually dissipated without leaving more than 0.6 percent. of fixed residue.

The saturated aqueous solution is colored intensely bluish-violet (in high dilution violet-red) by ferric chloride T.S.

On adding to a small portion of Salicylic Acid, in a test-tube, about 1 Cc. of concentrated sulphuric acid, then, cautiously, about 1 Cc. of methyl alcohol in drops, and heating the mixture to boiling, methyl salicylate will be produced, which may be recognized by its odor.

Impurities and Tests for Impurities.—*Iron, phenol, or coloring matter.* On allowing a saturated alcoholic solution of the Acid to evaporate spontaneously in a glass or porcelain evaporating dish, in a place protected from dust, a perfectly white, crystalline residue should remain.

Phenol. If 1 Gm. of the Acid be dissolved in an excess of cold sodium carbonate T.S., the liquid agitated with an equal volume of ether, and the ethereal solution allowed to evaporate spontaneously, the residue, if any, should be free from the odor of *phenol.*

Readily carbonizable, organic impurities. On treating about 0.5 Gm. of Salicylic Acid, in a clean test-tube, with 10 Cc. of concentrated sulphuric acid, no color should be imparted to the latter within fifteen minutes.

Hydrochloric acid. A solution of 0.5 Gm. of the Acid in 10 Cc. of alcohol, mixed with a few drops of nitric acid, should remain unaffected upon the addition of a few drops of silver nitrate T.S.

Uses.—Salicylic acid is an important product. It is used as an antipyretic, in doses of seventy-five grains, given in divided doses until the temperature is lowered. Its principal use is in rheumatism and gout, the dose being eight grains (0.5 Gm.). Seven solid salts of the acid are official,—ammonium, phenyl, quinine, strontium, sodium, lithium, and physostigmine salicylates; methyl salicylate is an official liquid. The sodium salt is very valuable, and is generally relied upon for the internal administration of the acid.

PHENYLIS SALICYLAS. U.S. Phenyl Salicylate

$C_{13}H_{10}O_3 = 212.47$

[Salol, Pharm. 1890]

The salicylic ester [$C_6H_4(OH)COOC_6H_5$ 1 : 2] of phenyl.

Preparation.—Phenyl salicylate is prepared by heating salicylic acid with phenol in the presence of certain acid chlorides (phosphoryl chloride or carbonyl chloride); the elements of water are withdrawn by this action, and the phenyl group is caused to unite with the salicylic radical.

Official Description.—A white, crystalline powder.

Odor and Taste.—Faint, aromatic odor; slight, characteristic taste.

Solubility.—*Water.* In 2333 parts at 25° C. (77° F.).

Alcohol. In 5 parts at 25° C. (77° F.); very soluble in hot alcohol.

Other solvents. Very soluble in ether, chloroform, and fixed and volatile oils.

Tests for Identity.—When heated to 42° C. (107.6° F.) it melts, and at a higher temperature is consumed, leaving no weighable residue.

If to the alcoholic solution be added diluted ferric chloride T.S., a violet color is produced.

If 0.2 to 0.3 Gm. of Phenyl Salicylate be dissolved in a little warm sodium hydroxide T.S., and the solution be then acidified with hydrochloric acid, salicylic acid separates, and the odor of phenol is recognizable.

Impurities and Tests for Impurities.—*Free acids.* Phenyl Salicylate should not redden moistened blue litmus paper.

Limit of uncombined phenol or salicylic acid. If 1 Gm. of Phenyl Salicylate be shaken with 50 Cc. of water, the liquid filtered, and 5 drops of ferric chloride T.S., previously diluted with 20 volumes of water, be added, the filtrate should show either no color, or at most a trace.

Sulphates and chlorides. If portions of the same filtrate be tested separately with barium nitrate T.S. and silver nitrate T.S., they should show no turbidity.

Uses.—Phenyl salicylate is used as an internal antiseptic, it being decomposed in the small intestine, when in contact with alkaline fluids, into phenol and salicylic acid. It is also used pharmaceutically to coat pills by rolling them in the salol, fused at a low temperature. The dose is from eight to thirty grains (0.5 to 2 Gm.).

ACETPHENETIDINUM. U.S. Acetphenetidin

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

A phenol derivative [Acetparaphenetidin, $C_6H_4(OC_2H_5).NH.CH_3.CO$ 1 : 4], the product of the acetylization of para-amidophenetol.

Acetphenetidin is made by treating paraphenetidin $C_6H_4(NH_2)OC_2H_5$ with glacial acetic acid, which introduces the acetyl group, and acetparaphenetidin $C_6H_4(NHC_2H_3O)OC_2H_5$ is formed.

Official Description.—White, glistening, crystalline scales or fine crystalline powder.

Odor and Taste.—Odorless and tasteless.

Solubility.—*Water.* In 925 parts at 25° C. (77° F.); in 70 parts of boiling water.

Alcohol. In 12 parts at 25° C. (77° F.); in 2 parts of boiling alcohol.

Other solvents. In 63 parts of ether and 20 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—Heated to between 134° and 135° C. (273.2° and 275° F.) it melts, and at a higher temperature burns without leaving a weighable residue.

It dissolves without color in sulphuric acid, but if shaken with nitric acid it is colored yellow, which color persists when heated.

If 0.1 Gm. of Acetphenetidin be boiled for 1 minute with 1 Cc. of concentrated hydrochloric acid and the solution diluted with 10 Cc. of water, cooled and filtered, it should yield on the addition of 3 drops of an aqueous solution of chromium trioxide (1 in 30) a ruby red color.

Impurities and Tests for Impurities.—*Acetanilide.* On heating 0.1 Gm. of Acetphenetidin with 5 Cc. of a concentrated solution of potassium hydroxide (1 in 4), the odor of aniline should not be perceptible.

If 0.1 Gm. of Acetphenetidin be boiled with 10 Cc. of water it should yield a solution which, when cooled and filtered, should not become turbid upon the addition of bromine T.S. in slight excess.

Acetanilide. If 0.1 Gm. of Acetphenetidin be boiled for one minute with 3 Cc. of solution of sodium hydroxide (1 in 2), the solution cooled, and then agitated with 5 Cc. of a solution of chlorinated soda, there should be produced a clear yellow liquid, and not a purplish-red or brownish-red cloudy liquid or precipitate.

Paraphenetidin. A mixture of 0.3 Gm. of Acetphenetidin with 1 Cc. of 90 percent. alcohol should not acquire a red tint when diluted with three times its volume of water and boiled with one drop of tenth-normal iodine V.S.

Uses.—Acetphenetidin, or *phenacetin*, is a valuable antipyretic and analgesic, the absence of paraphenetidin in the product should be assured, the dose is from five to fifteen grains (0.3 to 1 Gm.).

METHYLTHIONINÆ HYDROCHLORIDUM. U.S. Methylthionine Hydrochloride Methylene Blue

$C_{16}H_{18}N_3SCl = 317.36$

Tetramethylthionine Hydrochloride, obtained by the action of hydrogen sulphide upon an oxidation product of para-amido-dimethylaniline.

Preparation.—It is made by treating an acid solution of dimethylparaphenylene diamine with hydrogen sulphide and ferric chloride.

Official Description.—A dark green, crystalline powder, or in the form of prismatic crystals having a bronze-like lustre.

Solubility.—*Water.* Readily.

Alcohol. Somewhat less readily in alcohol, the solutions having a deep blue color.

Tests for Identity.—The addition of hydrochloric acid to its aqueous solution changes the color to a lighter shade of blue.

The addition of sodium hydroxide T.S. to the aqueous solution changes the color to a purplish shade, and if added in excess, produces a precipitate having a dull violet color.

The dry powder dissolved in sulphuric acid containing powdered zinc produces a solution which, upon standing, is gradually decolorized.

Impurities and Tests for Impurities.—*Commercial dye and other mineral impurities.* Two Gm. of Methylthionine Hydrochloride, when ignited, should leave not more than 0.008 Gm. of residue, which should be free from zinc oxide.

Arsenic. Two Gm. of Methylthionine Hydrochloride ignited with dry sodium carbonate and potassium nitrate should leave a residue which should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—Methylene blue, as it is usually called, is used in rheumatic affections and in gonorrhœa. Its intense and persistent color makes it a difficult substance to dispense easily. It is administered most satisfactorily in capsules in doses of four grains (0.25 Gm.).

ACETANILIDUM. U.S. Acetanilide

$C_8H_9NO = 134.09$

The monacetyl derivative $[C_6H_5NH(CH_3.CO)]$ of aniline.

Acetanilide or *antifebrin*, is made by heating a mixture of aniline and glacial acetic acid to the boiling point; the cooled, congealed residue is purified by sublimation or recrystallization.

Official Description.—Colorless, shining, micaceous, crystalline laminæ, or a crystalline powder; permanent in the air.
Odor, Taste, and Reaction.—Odorless; slightly burning taste; neutral reaction.
Solubility.—*Water.* In 179 parts at 25° C. (77° F.); in 18 parts of boiling water.
Alcohol. In 2.5 parts at 25 C. (77° F.); in 0.4 part of boiling alcohol.
Other solvents. In 12 parts of ether and in 5 parts of chloroform at 25° C. (77° F.).
Tests for Identity.—When heated to 113° C. (235.4° F.) Acetanilide melts, and at 295° C. (563° F.) it boils without decomposition.
Upon ignition it is consumed without leaving a weighable residue.
If 0.5 Gm. of Acetanilide be agitated with 5 Cc. of colorless sulphuric acid in a clean test-tube, it dissolves without imparting color to the liquid.
On heating 0.1 Gm. of Acetanilide with 5 Cc. of concentrated solution of potassium hydroxide (1 in 4), the characteristic odor of aniline becomes noticeable. On now adding 1 Cc. of chloroform, and again heating, the disagreeable odor of phenyl isocyanide (a poisonous product) is evolved (distinction from *methyl-acetanilide* or *antipyrine*).
On boiling 0.1 Gm. of Acetanilide for several minutes with 2 Cc. of hydrochloric acid, a clear solution results, which, when mixed with 3 Cc. of an aqueous solution of phenol (1 in 20), and afterwards with 5 Cc. of a filtered, saturated solution of chlorinated lime, acquires a brownish-red color, becoming deep blue upon supersaturation with ammonia water.
On heating 0.1 Gm. of Acetanilide with 10 Cc. of water, filtering the solution when cold, and adding bromine T.S., drop by drop, to the filtrate, a whitish precipitate of *parabromacetanilide* is formed (distinction from *antipyrine* or *acetphenetidin*).
Impurity and Test.—*Aniline salts and various allied substances.* A cold saturated, aqueous solution of Acetanilide added to ferric chloride T.S. should not affect the color of the latter.

Uses.—Acetanilide is an antipyretic, reducing temperature, and in moderate doses producing diaphoresis. When in very fine powder it is used as an antiseptic application to burns, wounds, ulcers, etc. It is largely employed in popular headache remedies, but it should always be used with caution. The dose is from five to ten grains (0.3 to 0.6 Gm.).

Official Preparation

Pulvis Acetanilidi Compositus Compound Acetanilide Powder	Made by mixing 70 Gm. of acetanilide, 10 Gm. of caffeine, and 20 Gm. of sodium bicarbonate (see page 1185). Dose, eight grains (0.5 Gm.)

ANTIPYRINA. U. S. Antipyrine

$C_{11}H_{12}N_2O = 186.75$

Phenyldimethylpyrazolon $[C_3HN_2O(CH_3)_2.C_6H_5]$, obtained by the condensation of phenylhydrazine with aceto-acetic ether, and methylation of the product.

Antipyrine is made by Knorr's process by acting on phenylhydrazine with aceto-acetic ether when phenylmethylpyrazolon is formed; this is methylated by treatment with methyl-iodide, resulting in the formation of phenyldimethylpyrazolon or antipyrine.

Official Description.—A colorless, crystalline powder or in tabular crystals.
Odor, Taste, and Reaction.—Almost odorless; slightly bitter taste; neutral reaction.
Solubility.—*Water.* In less than 1 part of water at 25° C. (77° F.).
Alcohol. In 1 part at 25° C. (77° F.).
Other solvents. In 1 part of chloroform and in 30 parts of ether at 25° C. (77° F.).
Tests for Identity.—When heated to 113° C. (235.4° F.) it melts. Upon ignition it is consumed without leaving a weighable residue.
Antipyrine unites directly with acids to form salts.

If to an aqueous solution of Antipyrine, tannic acid T.S. be added, an abundant white precipitate (tannate) is formed.

If 0.1 Gm. of sodium nitrite and 12 Cc. of an aqueous solution of Antipyrine (1 in 100) be mixed, a nearly colorless liquid is obtained, which, upon the addition of 1 Cc. of diluted sulphuric acid, develops a deep green color (formation of *isonitroso-antipyrine*).

If to 2 Cc. of a dilute aqueous solution of Antipyrine (1 in 1000) 1 drop of ferric chloride T.S. be added, a deep red color is produced, which upon the addition of 10 drops of sulphuric acid is changed to light yellow.

Impurities and Tests for Impurities.—*Acetanilide.* On warming 0.1 Gm. of Antipyrine with sodium hydroxide T.S., and again warming after the addition of chloroform, the disagreeable odor of phenyl-isocyanide should not be developed.

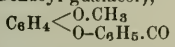
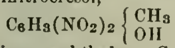
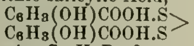
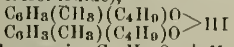
Two Cc. of an aqueous solution of Antipyrine (1 in 100) mixed with an equal volume of nitric acid assumes a yellowish color, passing to crimson on warming (distinction from *acetanilide* and *acetphenetidin*).

Uses.—Antipyrine was one of the first of the modern antipyretics and analgesics to come into successful use; it has been largely superseded by other antipyretics, mainly on account of its dangerous action upon the heart even when given in moderate doses. The dose is five grains (0.3 Gm.).

Unofficial Products obtained from Coal Tar and Allied Substances

Acetylphenylhydrazin, $C_6H_5NH—NHCH_3CO$ (Pyrodin, Hydracetin)	Antipyretic. Powerful remedy. Dose, one-half to one grain (0.03 to 0.065 Gm.) per day
Agathin, $C_6H_4(OH)CH = N.N(CH_3)C_6H_5$ Salicyl-alpha-methyl-phenyl-hydrazone	Antiseptic and anti-neuralgic. Dose, eight to ten grains (0.5 to 0.6 Gm.)
Alpha-oxynaphthoic Acid, $C_{10}H_6\left\{\begin{matrix}OH\\COOH\end{matrix}\right.$	Antizymotic, disinfectant. Used in the form of a 5 percent. ointment
Alphol (Alphanaphthol Salicylate)	A reddish-white powder, soluble in alcohol and ether. It is used in doses of from eight to fifteen grains (0.5 to 1 Gm.) in rheumatism and as an internal antiseptic
Alumnol (Betanaphthol-disulphonate of Aluminum), $(C_{10}H_5(OH)(SO_3)_2)_3Al_2$	A white powder, soluble in water and glycerin, slowly soluble in alcohol. It is used as an antiseptic and astringent; mixed with from 5 to 10 parts of starch in the form of a dusting powder and, in from 1 to 5 percent. solution, as a wash
Aniline, $C_6H_5.NH_2$	Prepared by treating an alcoholic solution of nitro-benzene with ammonia and hydrogen sulphide until a precipitation of sulphur takes place. The brown liquid is again saturated with hydrogen sulphide until sulphur ceases to be deposited. The liquid is then mixed with excess of acid, filtered, boiled, and then distilled with excess of caustic potash. A colorless, limpid, oily, inflammable liquid, of a peculiar wine-like odor and burning, aromatic taste. It is used chiefly in the preparation of aniline dyes
Antisepsin (Asepsin, Monobromacetanilide, Parabromacetanilide), $C_6H_4Br.NH(C_2H_3O)$	Antipyretic, analgesic, and antiseptic. Dose, six to seven grains (0.40 to 0.46 Gm.)
Antithermin (Phenylhydrazin-levulinic Acid), $C(CH_3).C_6H_5N_2H.C_3H_5O_2$	In colorless crystals, insoluble in cold water. Dose, three grains (0.2 Gm.)
Apolysin (Monophenetidine Citric Acid), $C_6H_4<\begin{matrix}OC_2H_5\\NH.CO.C_3H_4(OH)(COOH)_2\end{matrix}$	A yellowish-white, crystalline powder, sparingly soluble in water and glycerin. It resembles phenacetin chemically and medicinally, being used as an antipyretic and analgesic in doses of from eight to thirty grains (0.3 to 2 Gm.)
Asaprol (Beta-naphthol-alpha-mono-sulphonate of Calcium, Abrastol), $(C_{10}H_6.OH.SO_3)_2Ca + 3H_2O$	A colorless, pale-reddish powder without odor, soluble in about 2 parts of water and 3 parts of alcohol. Used as an antipyretic and analgesic in acute muscular rheumatism in doses of five to fifteen grains (0.3 to 1 Gm.)
Benzanilide (Phenylbenzamide, Benzoylanilide) $C_6H_5NHCOC_6H_5$	Obtained by the action of benzoyl chloride on aniline in the presence of sodium hydroxide. A pinkish powder, soluble in alcohol, insoluble in water. Used as an antipyretic for children in doses of one-half to five grains (0.03 to 0.3 Gm.)

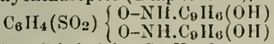
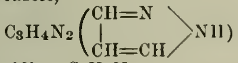
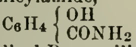
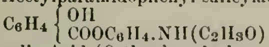
Unofficial Products obtained from Coal Tar, etc.—*Continued*

Benzene (Benzol, Benzole) C_6H_6	Obtained by subjecting coal tar to fractional distillation. A thin, colorless, very inflammable liquid, having an aromatic odor. Nearly insoluble in water; soluble in alcohol, ether, etc. It is a valuable solvent. (See Reagents)
Benzonaphthol (Benzoylnaphthol, Benzoate of Naphthol, Betanaphthol Benzoate) $C_6H_5CO_2—C_{10}H_7$	Antiseptic. Dose, four to eight grains (0.26 to 0.5 Gm.), repeated frequently.
Benzosol (Guaiacol Benzoate, Benzoyl-guaiacol),  $C_6H_4<\begin{matrix}O.CH_3\\O–C_6H_5.CO\end{matrix}$	White, crystalline powder, odorless and tasteless, soluble in alcohol, but insoluble in water. It contains about 54 percent. of guaiacol and is used as an internal antiseptic in phthisis, in doses of from four to ten grains (0.25 to 0.6 Gm.)
Betol (Naphthalol, Naphthosalol, Salinaphthol, Betanaphthol Salicylate), $C_6H_4(OH)COO.C_{10}H_7$	White, odorless, tasteless powder insoluble in water, but soluble in alcohol and ether. It is used as an internal antiseptic and antirheumatic in doses of from four to ten grains (0.25 to 0.6 Gm.)
Borophenol	Disinfectant. A combination of borax and phenol
Chinoline, C_9H_7N Quinoline	By mixing aniline, nitrobenzene, glycerin, and sulphuric acid, heating, then diluting with water and distilling to drive off nitrobenzene; on rendering the residue alkaline and distilling with steam, chinoline passes over. A colorless, mobile liquid, having a pungent, somewhat bitter-almond odor, and a bitter taste. Sp. gr. 1.081
Chlorphenol, Monochlorphenol, $C_6H_4Cl.OH$	Germicide and antiseptic. Used by inhalation, and as a local application
Creolin	Said to be an emulsion of cresol obtained by means of rosin soap
Cresol Iodide (Losophan), $C_6HI_3(CH_3)OH$	A yellow powder, containing 80 percent. of iodine. Soluble in alcohol, insoluble in water. Used as an external application in skin diseases, in the form of a solution or of an ointment
Cresol-Naphtol	A brown, viscous, tar-like liquid, having active germicidal properties
Cresotinic Acid (Cresotic Acid), $C_6H_3.COOH.OH.CH_3$	The para-acid is used as an antipyretic and antirheumatic
Dinitrocresol,  $C_6H_3(NO_2)_2\left\{\begin{matrix}CH_3\\OH\end{matrix}\right.$	"Saffron Substitute" is a mixture of the potassium salts of dinitro-, ortho-, and para-cresols
Dioxynaphthalene, $C_{10}H_8O_2$	Tonic. Dose, three grains (0.2 Gm.) a day
Di-phenyl-methyl-pyrazole	A substitute for antipyrine in the form of white needles, not very soluble in water or ether; easily soluble in alcohol and glacial acetic acid
Dithio-salicylic Acid,  $\begin{matrix}C_6H_3(OH)COOH.S\\C_6H_3(OH)COOH.S\end{matrix}>$	Antirheumatic. Dose, three grains (0.2 Gm.)
Eosin, $C_{20}H_8Br_4O_5$	A bronze-colored, crystalline powder, obtained from the action of phthalic acid upon phenols. Eosin is largely used as a dye, and for making a brilliant red ink, by dissolving 5 grains in a fluidounce of water in which 10 grains of acacia have been dissolved
Eudoxin (Tetra-iodo-phenolphthalein Bismuth)	A bismuth salt of nosophen containing about 52.9 percent. of iodine and 14.5 percent. of bismuth. Odorless, tasteless, insoluble powder, used as an intestinal antiseptic in doses of three to eight grains (0.2 to 0.5 Gm.)
Euphorin (Phenyl-urethane), $C_6H_5NH–CO–OC_2H_5$	Colorless, crystalline powder, soluble in alcohol and ether, slightly soluble in water. Used as an antipyretic, antirheumatic, and anodyne in doses of two to eight grains (0.125 to 0.5 Gm.)
Europhen (Di-isobutyl-ortho-cresol-iodide),  $\begin{matrix}C_6H_3(CH_3)(C_4H_9)O\\C_6H_3(CH_3)(C_4H_9)O\end{matrix}>HI$	A yellow, amorphous powder having an aromatic odor, soluble in alcohol, ether, and fixed oils, but insoluble in water. Used as antiseptic dusting powder or in 5 to 10 percent. ointments. (Similar to thymol iodide)
Fluorescein, $C_{20}H_{12}O_5 + H_2O$	Yellowish-red or dark red powder. Soluble in alcohol with yellow-red color and green fluorescence
Fuchsin (Rosaniline), $C_{20}H_{19}N_3$	A non-volatile, colorless, bitter substance, produced whenever a mixture of aniline and toluidine is heated to about 180° C. with an oxidizing agent of moderate power, as, for example, arsenic trioxide. The solutions of some of its acid salts are used largely for dyeing silk and wool a magnificent crimson

Unofficial Products obtained from Coal Tar, etc.—*Continued*

Gallacetophenone, $C_6H_2\left\{\begin{matrix}(OH)_3\\CH_3CO\end{matrix}\right.$	Proposed as a substitute for pyrogallol as a local application
Geosote (Guaiacol Valerate)	The guaiacol ester of valeric acid, yellow, oily liquid of smoky odor and burning taste. Used as an antitubercular and intestinal disinfectant in three to ten minim (0.2 to 0.6 Cc.) doses
Guaethol (Ajacol, Thanatol, Pyrocatechin-mono-ethyl-ether), $C_6H_4{<}\begin{matrix}OC_2H_5\\OH\end{matrix}$	An oleaginous fluid, congealing to a crystalline mass at low temperatures, soluble in alcohol and ether. Similar to guaiacol in medicinal properties. Dose two to four grains (0.12 to 0.25 Gm.)
Hydro-quinone, Hydrochinone, $C_6H_4(HO)_2$ 1:4	Prepared by oxidizing aniline with chromium trioxide mixture. Dose, five to ten grains (0.3 to 0.6 Gm.)
Hypnone (Acetophenone), C_8H_8O or $C_6H_5.CO.CH_3$	A colorless liquid, having an almond-like odor, insoluble in water or glycerin, soluble in alcohol and ether. Used as an hypnotic in doses of ten to twenty minims (0.65 to 1.2 Cc.)
Ichthalbin (Ichthyol Albuminate)	A grayish-brown, odorless powder, insoluble in ordinary solvents, but soluble in alkaline solutions, as the intestinal secretions. Used as an intestinal antiseptic, and antiphlogistic in doses of ten to thirty grains (0.6 to 2 Gm.); also as an antiseptic dusting powder for wounds, etc.
Ichthoform (Ichthyol-formaldehyde)	A blackish-brown, insoluble powder, with little odor or taste. Used as an antiseptic, in surgical practice, for dusting on wounds, etc., and as an intestinal antiseptic in doses of fifteen to thirty grains (1 to 2 Gm.)
Ichthyol (Ammonium ichthyol-sulphonate), $C_{28}H_{36}S_3O_6(NH_4)_2$	A tarry-looking substance, obtained from a brownish mineral, containing animal residues of fish, etc., found in Sufeld, in Tyrol. Purified by distillation and treatment with sulphuric acid. Ichthyol has a herb-like odor, and is faintly alkaline. Used for skin diseases. Dose, ten to fifteen grains (0.6 to 1 Gm.)
Iodantifebrin, Iodacetanilide, $C_6H_4INH(C_2H_3O)$	In rhombic flakes. Melting at 181.5° C. Very slightly soluble in cold water, readily soluble in alcohol
Iodophenacetin (Iodophenine)	A powerful germicide
Loretin (Meta-iodo-ortho-oxychinolin-ana-sulphonic acid), $C_9H_4IOH-SO_3H-N$	A yellow, odorless powder; almost insoluble in water, and insoluble in ether and oils. Used as a dusting powder to replace iodoform and in 5 to 10 percent. ointments
Nosophen (Iodophen, Tetra-iodo-phenolphthalein), $(C_6H_2I_2.OH)_2.C{<}\begin{matrix}C_6H_4CO\\O\end{matrix}$	A yellow, odorless, tasteless powder, insoluble in water and alcohol. It contains about 60 percent. of iodine, and is used as an antiseptic dusting powder and as an intestinal antiseptic, in doses of five to eight grains (0.3 to 0.5 Gm.)
Oleum Succini Oil of Amber	Amber is a fossil resin of an extinct coniferous wood, found principally upon the Baltic coast. By destructive distillation an acid liquor containing succinic acid is produced, together with crude oil of amber; the latter is redistilled, and rectified oil of amber is the product. It is a pale, yellow liquid, having an empyreumatic odor and a warm, acrid taste. Sp. gr. 0.920. It is soluble in alcohol, and when mixed with fuming nitric acid acquires a red color, and is subsequently converted into a brown resinous mass known as *artificial musk*
Orcin, Dihydroxytoluene, $C_6H_3(CH_3)(OH_2)$	Antiseptic, antipyretic. Poisonous
Orexin, Phenyldihydrochinazolin Hydrochlorate, $C_6H_4\left\{\begin{matrix}CH_2N.C_6H_5\\N=CH\,HCl+2H_2O\end{matrix}\right.$	Stomachic. Dose, four to seven grains (0.26 to 0.42 Gm.) two to three times a day
Orphol (Basic Betanaphthol Bismuth, Bismuth Naphtholate) $(C_{10}H_7O)_3Bi+3H_2O$	Fawn colored, almost odorless, and tasteless powder. It splits, in the intestines, into betanaphthol and bismuth. Used as an intestinal astringent and antiseptic in about five- to eight-grain (0.3 to 0.5 Gm.) doses.
Orthin, Orthohydrazin-paraoxybenzoate, $C_6H_3.OH.COOH.NH.NH_2$	A feeble antipyretic

Unofficial Products obtained from Coal Tar, etc.—*Continued*

Orthoform (Methyl-para-amido-meta-oxybenzoate), $C_6H_3(OH)(NH_2)COOCH_3$	Methyl ester of meta-amido para-oxybenzoic acid. A white, odorless, tasteless powder, slightly soluble in water, soluble in alcohol or ether. It is used as an antiseptic and local anesthetic in wounds, ulcers, burns, etc., and as an intestinal antiseptic in doses of eight to fifteen grains (0.5 to 1 Gm.)
Oxychinaseptol (Diaphtherin),  $C_6H_4(SO_2)\begin{cases}O-NH.C_9H_6(OH)\\O-NH.C_9H_6(OH)\end{cases}$	A powerful antiseptic
Phenolphthalein, $C_{20}H_{14}O_4$	Prepared by digesting 10 parts of phenol, 5 parts phthalic anhydride, and 4 parts concentrated sulphuric acid for several hours at 120° to 130° C., then boiling the residue with water to remove soluble matter. The resinous substance so left is boiled in benzene for purification. It is a yellowish-brown powder. The test solution used as an indicator is prepared by dissolving 1 Gm. of phenolphthalein in 50 Cc. of alcohol and diluting to 100 Cc. with water
Phenylhydrazine, $C_6H_5.NH.NH_2$	Poisonous. Used as a test for sugar in urine
Phthalic Acid, $C_8H_6O_4$	Produced by heating salicylic acid with a mixture of sulphuric acid and potassium ferrocyanide, and, when the reaction is ended, treating the resulting mass with ether, which extracts the phthalic acid. It occurs in nacreous laminæ or shining monoclinic prisms. Soluble in alcohol, ether, and benzene
Picric Acid, $C_6H_3N_3O_7$	Prepared by dissolving crystallized phenol in strong sulphuric acid, and adding nitric acid to the resultant sulphophenic acid. It is purified by neutralizing with sodium carbonate and filtering to separate resin, then adding to the filtrate excess of sodium carbonate, when sodium picrate is precipitated. This salt is decomposed by sulphuric acid, and the picric acid crystallized. It is much employed for dyeing wool and silk yellow, also for staining wood
Pyramidon, (Di-methyl-amido-phenyl-dimethyl-pyrazolon, Dimethylamido-antipyrine)	A yellowish-white, tasteless powder, similar to antipyrine in action, but milder, more gradual and lasting in its influence. Used as an antipyretic and analgesic in doses of 3 to 10 grains (0.2 to 0.6 Gm.)
Pyrazole,  $C_3H_4N_2\left(\begin{matrix}CH{=}N\\ \vert\\ CH{=}CH\end{matrix}\right\rangle NH)$	Dose, fifteen to thirty grains (1 to 2 Gm.) daily
Pyridine, C_5H_5N	Remedy for asthma. Five to twenty drops in two ounces of water may be used in an atomizer, or five drops may be inhaled directly. Dose, six drops, gradually increased to twenty-five, daily
Pyridine Nitrate, $C_5H_5N.HNO_3$	Colorless needles. Easily soluble in water, less so in alcohol
Pyridine Sulphate, $(C_5H_5N)_2.H_2SO_4$	Crystalline. Very soluble in water or in alcohol
Rosolic Acid (Corallin)	Obtained by acting on commercial phenol with oxalic and sulphuric acids
Salicylamide,  $C_6H_4\begin{cases}OH\\CONH_2\end{cases}$	Analgesic and antipyretic. Dose, three grains (0.2 Gm.)
Salicyl Bromanilide (Antinervine)	Antipyretic and analgesic. Dose, five to ten grains (0.32 to 0.65 Gm.)
Saliformin (Formin Salicylate, Hexamethylenetetramine Salicylate, Urotropine Salicylate), $(CH_2)_6N_4.C_6H_4(OH)COOH$	A white powder, having a sour taste, soluble in alcohol and water. Used as a urinary antiseptic and as a solvent for uric acid deposits. Dose, fifteen to thirty grains (1 to 2 Gm.)
Salipyrine, Antipyrine Salicylate $C_{11}H_{12}N_2O.C_7H_6O_3$	Antipyretic, antirheumatic, antineuralgic. Dose, seven to fifteen grains (0.45 to 1 Gm.), in capsule or tablet
Salol-Camphor	A local anæsthetic, a mixture of phenylsalicylate and camphor
Salophen, Acetylparamidophenyl-salicylate,  $C_6H_4\begin{cases}OH\\COOC_6H_4.NH(C_2H_3O)\end{cases}$	Antirheumatic and intestinal antiseptic. Dose, forty-five to seventy-five grains *during the day* (3 to 5 Gm.)
Sozolic Acid (Orthophenolsulphonic Acid), $C_6H_4(HSO_3)OH$	Antiseptic. A 33⅓ percent. solution is called *aseptol*
Succinic Acid, $C_4H_6O_4$	Used with advantage in delirium tremens

Unofficial Products obtained from Coal Tar, etc.—*Continued*

Sulpho-Carbolic Acid (Sulphophenic Acid), $C_6H_6SO_4$	This substance is produced by the direct action of concentrated sulphuric acid upon phenol. It is soluble in water and in alcohol. The acid is a decided antiseptic, and its solutions coagulate albumin
Tetrahydrobetanaphthylamine, $C_{10}H_7.H_4.NH_2$	A local mydriatic, used in from 1 to 5 percent. solution
Thalline (Tetrahydroparaquinanisol), $C_9H_6H_4N(OCH_3)$	An antipyretic. The sulphate and tartrate are most used. The dose of either is from two to five grains (0.1 to 0.3 Gm.)
Thiocol (Potassium Guaiacol-Sulphonate)	A fine, white powder, soluble in water, containing about 60 percent. of guaiacol. Antitubercular and anticatarrhal. Dose, five to twenty grains (0.3 to 1.3 Gm.)
Tribromphenol, $C_6H_2Br_3.OH$ Bromol	Antiseptic.
Trichlorphenol, $C_6H_2Cl_3OH$	Used in erysipelas, in the form of a glycerite containing 5 to 10 percent., applied to the parts twice daily
Tropæolin	Dye-color used as an indicator in volumetric analysis
Tumenol	Used as a local application in eczema, in a 10 percent. solution
Tussol (Antipyrine Phenylglycolate, Antipyrine Mandelate), $C_{11}H_{12}N_2O.C_6H_5CH(OH)COOH$	This salt is said to be superior to antipyrine in the treatment of whooping cough. Dose, three-quarters to six grains (0.045 to 0.4 Gm.), according to age
Xeroform (Tribromphenol Bismuth, Tribromocarbolate of Bismuth), $(C_6H_2Br_3O)_2BiOH + Bi_2O_3$	A yellowish-green, insoluble powder, containing about 50 percent. of tribromphenol and about 50 percent. of Bi_2O_3. Used as an intestinal antiseptic in doses of eight to fifteen grains (0.5 to 1 Gm.). Also used as dusting powder on fresh and infected wounds
Xylol (Xylene), C_8H_{10}	By treating the oily liquid separating from diluted crude wood spirit and from the light oil of wood tar or coal tar, first with sulphuric acid, and afterwards subjecting these liquids to fractional distillation, collecting only that portion which distils between 136° and 140° C. (277° and 286° F.). A thin, colorless liquid, resembling benzene. It has a burning taste. Soluble in alcohol. Dose, twenty to thirty minims (1.2 to 2 Cc.)

CHAPTER L

AMYLACEOUS AND MUCILAGINOUS PRINCIPLES AND THEIR PRODUCTS

STARCH has the same chemical composition as cellulose, $C_6H_{10}O_5$, and is closely allied to it in its properties. Starch is stored up in plants in anticipation of future usefulness in the formation of their cell-walls, growing tissues, or other constituents. It exists in the form of granules, the shape of which may be described as spherical, ellipsoidal, ovoid, lenticular, polygonal, or irregular, and it is possible to identify the varieties of starch obtained from various plants, with the aid of the microscope, by the shape and size of the granules.

The granules consist of layers of different densities, arranged concentrically around a central point termed the hilum, which is usually at one end of the granule. Corn starch is official.

AMYLUM. U.S. Starch Corn Starch

The starch grains obtained from the fruit of *Zea Mays* Linné (Fam. *Gramineæ*).

In fine powder or irregular, angular white masses, consisting of somewhat spherical, but usually polygonal grains, about 0.010 to 0.025 Mm. in diameter, with a lenticular, circular, or triangular central fissure ; inodorous and tasteless ; insoluble in cold water or alcohol ; forming a whitish jelly when boiled with water, which when cool gives a deep blue color with iodine T.S. ; triturated with cold water, showing neither acid nor alkaline reaction with litmus paper ; when completely incinerated, leaving not more than 1 percent. of ash.

When freed from water by careful drying in a current of warm air, Starch should show not less than 95 percent. of hydrolyzable carbohydrate.

Starch is present in many drugs, and is an important constituent of many vegetable foods.

Preparation.—Starch is made from potatoes by first grating them, and then pressing the soft mass upon a sieve, which separates the cellular substances and permits the starch granules to fall through. These must be thoroughly washed, the quality of starch depending largely upon the purity of the water that is used in washing it. In making starch from wheat or corn the gluten must be separated. This is generally done by permitting it to become sour and disintegrated through acetous fermentation, stopping the fermentation before the starch is affected. Upon the small scale, starch may be made from wheat flour by placing it in a fine linen bag and kneading it while a small stream of water trickles upon it. The starch is carried off with the water, while the *gluten* remains as a soft mass in the bag ; the latter may be purified and used in making *gluten suppositories.* The quality of commercial starch largely depends upon the purity of the water used in its manufacture.

Starch by the action of diluted acids, diastase, or heat, is converted into *dextrin*, a substance resembling gum in appearance and properties. Dextrin is largely dissolved by water, hot or cold, and forms a mucilaginous solution, from which it is precipitated by alcohol. Large quantities of dextrin are now made both in America and abroad, and employed for various purposes in the arts, under the name of *artificial gum* or *British gum*. It is found in the market in the form of a white, brilliant powder, or in small masses or fragments resembling natural gum. It may be distinguished from gum arabic by the taste and smell of potato oil which it always possesses.

Starch is dissolved by glycerin and partially by boiling water. *Inulin*, $C_{12}H_{20}O_{10}$, is a substance closely allied to starch. It is found particularly in the plants belonging to the family Compositæ, as Inula, Taraxacum, Pyrethrum, Lappa, etc. It has also been found, according to Kraus, in plants of the Campanulaceæ, Goodeniaceæ, Lobeliaceæ, and Stylidaceæ. It differs from starch in the following particulars: it is colored yellow by iodine, does not gelatinize with water, and is not found in plants in the form of granules having concentric layers like starch.

Uses.—Starch was made official for use in making glycerite of starch and sulphurated lime. It is used externally as an absorbent, and is applied to the skin by dusting.

Official Preparation

Glyceritum Amyli Glycerite of Starch	Starch jelly, made with 10 Gm. of starch, 10 Cc. of water, and 80 Gm. of glycerin (see page 307)

Unofficial Amylaceous Substances and Derivatives

Acorn	From the genus *Quercus*. Acorns contain besides starch a peculiar saccharine substance, *quercite*
Bean	From *Faba vulgaris* and *Phaseolus vulgaris*
Barley	*Hordeum distichon*. Contains 60 to 68 percent. of starch, also gluten, gum, and sugar
Canna	From the rhizome of *Canna edulis*. Fam. Marantaceæ, Cannæ. Indigenous to Peru and Brazil. The starch granules are very large, and exhibit a glistening or satiny appearance. It forms a cloudy but very tenacious jelly with boiling water
Cassava Tapioca Manioc	From the root of *Manihot utilissima*. Fam. Euphorbiaceæ. Habitat, Tropical America. The starch granules are about half the size of the potato granules, in somewhat translucent pieces, inodorous, having an insipid taste
Curcuma Turmeric	From the rhizome of *Curcuma longa*. Fam. Zingiberaceæ. Habitat, Southern Asia, cult. The starch granules are rather larger than those of maranta
Maranta Arrowroot	From the rhizome of *Maranta arundinacea*. Fam. Marantaceæ. Indigenous to West Indies and tropical America. Prepared by removing the scales from the rhizome, mashing and grinding in a mill until reduced to a pulp, then suspending this in water, and separating the fibrous portion, either by hand or sieve; lastly, washing thoroughly, and drying with a gentle heat. The yield is from 13 to 20 percent. of fecula. It forms an opaque jelly with concentrated hydrochloric acid
Oats	From *Avena sativa*. Fam. Gramineæ. Habitat, Asia, cult. The grain contains 64 to 66 percent. of starch, besides protein compounds, fat, salts, etc.
Pea	From *Pisum sativum*. It yields about 37 percent. of starch
Potato	From the tubers of *Solanum tuberosum*. Fam. Solanaceæ. Habitat, Europe and America. Prepared by drenching washed and rasped potatoes in a sieve with a continuous stream of cold water, allowing the liquid to stand for a short time, and repeatedly washing the granules which collect at the bottom of the liquid; lastly, drying carefully. The yield is about 20 percent. It is largely used as an adulterant
Sweet Potato	From *Convolvulus Batatus*. The yield of starch is about 16 percent.
Rice	From *Oryza sativa*. Prepared by heating rice with weak soda-lye, which dissolves the nitrogenous impurities and leaves pure starch, then adding a solution of borax to facilitate the separation of the starch from the gluten. The yield is about 88 percent.
Rye	From *Secale cereale*. The yield of starch is about 64 percent.
Sago	From the pith of *Metroxylon Sagu*. Fam. Palmæ. Prepared by powdering the pith of the tree, washing with water to remove woody tissue and other impurities; lastly, drying carefully and granulating
Wheat	From *Triticum vulgare*. Fam. Gramineæ. Formerly official, now replaced by corn starch

MALTUM. U.S. Malt

The grain of barley, *Hordeum distichon* Linné (Fam. *Gramineæ*), partially germinated artificially, then dried.

Yellowish or amber-colored grains, shading to brown; crisp when fractured, the interior surface whitish, or tinged with brown if the grains have been heated sufficiently to cause caramelization. It should have an agreeable, characteristic odor, and a sweet taste due to the conversion of the starch in the seed into maltose, through the action of the diastase. Malt should float on cold water.

The solid soluble constituents of Malt, obtained by evaporating an aqueous infusion to dryness, should weigh not less than 70 percent. of the dried Malt from which they are derived.

The acidity of Malt (calculated as lactic acid), should not exceed 0.3 percent.

When barley is steeped for two or three days in water, it swells, becomes somewhat tender, and the water is colored reddish-brown. If the water is drained off, and the barley is spread about two feet thick upon a floor (a stone floor is generally used), it heats spontaneously, and germination begins, the radicle making its appearance first. The growth of the grain is partially stopped at this stage by spreading it more thinly, and turning it over for two days. It is then raked into heaps and allowed to stand a day, when it becomes hot, and is subsequently thoroughly dried in a kiln by a slow, regulated heat. This is malt, and it differs in quality according as it is more or less soaked, drained, germinated, dried, or baked. It is distinguished by its color,-being pale, amber, brown, or black malt, according to the degrees of heat used in drying it. The object of converting grain into malt is to change the *starch*, naturally present in the grain, into *maltose*, a peculiar kind of sugar, and dextrin. This is effected through the presence of *diastase*, a peculiar and powerful ferment, which is developed during the partial germination to which the grain is subjected in malting. A portion of the starch is always left unchanged by the process of germination, its conversion into maltose being completed during the heating in the kiln. The diastase which is developed is capable of converting into maltose much more starch than is contained in the grain in which it is produced; hence, if good malt be added to a certain quantity of unmalted grain, the starch in the latter may be also converted into maltose. Malt seldom contains diastase in larger proportion than two parts in a thousand. Diastase is obtained by bruising malt, adding about half its weight of water, expressing strongly, treating the viscid liquid thus obtained with sufficient alcohol to destroy its viscidity, then separating the coagulated albumen, and adding a fresh portion of alcohol, which precipitates the diastase in an impure state. To render it pure, it must be redissolved as often as three times in water, and precipitated by alcohol. Diastase is solid, white, tasteless, soluble in water and in weak alcohol, but insoluble in the latter fluid when concentrated. Though without action upon gum and sugar, it has the extraordinary property, when mixed, in the proportion of only one part to two thousand, with starch suspended in water, and maintained at a temperature of about 71.1° C. (160° F.), of converting that principle into dextrin and *maltose*. Although malt has been manufactured in large quantities for centuries for brewing purposes, it has only recently been employed in medicine, in the form of extracts of malt, malt foods, etc. Its usefulness in this connection is due to the fact that the amount of diastase present in good malt has the power of *rendering starchy substances which are taken into the stomach as food soluble ;* and good preparations of malt are not only easily digested food products themselves, but also actively aid in the digestion of other substances. Some of the commercial malt extracts consist of glucose colored with caramel and slightly flavored with extract of malt.

Official Preparation

Extractum Malti Extract of Malt	Made by macerating 1000 Gm. of malt with 1000 Cc. of water for 6 hours, then adding 4000 Cc. of water and digesting at 55° C. (131° F.) for one hour, straining the mixture, and evaporating the strained liquid in a vacuum or at a low temperature to the consistence of thick honey

CHONDRUS. U.S. Chondrus

[IRISH MOSS]

The dried plant of *Chondrus crispus* (Linné) Lyngbye (Fam. *Gigartinaceæ*).

Usually in light yellow or yellowish-white matted masses; the plant consisting of a slender, somewhat flattened base about one-half the length of the entire frond, which after repeated forking terminates in a number of palmately branching, somewhat enlarged, commonly emarginate or two-lobed segments; translucent, sometimes with fruit bodies embedded near the apex of the segments; somewhat cartilaginous; having a slight sea-weed odor and a mucilaginous, somewhat saline taste.

One part of Chondrus boiled for ten minutes with 30 parts of water yields a solution which gelatinizes on cooling, and is not colored blue by iodine T.S.

This alga grows in the Atlantic Ocean. It contains 70 percent. of a mucilaginous principle, which has been termed *carrageenin.* This differs from *gum* by not precipitating with alcohol, from *starch* by not becoming blue upon the addition of iodine, and from *pectin* by not being precipitated by lead subacetate.

Uses.—Chondrus is used principally to form a "sick diet" jelly, one part being sufficient to form a jelly with sixty parts of water. It should be previously soaked in a small quantity of water, to dissolve adherent salts, and this water thrown away.

Gums and Mucilaginous Substances

The proximate principle *arabin* (formerly termed gum) may be described as a vegetable substance, which forms with water a thick glutinous liquid, is insoluble in alcohol, and, when treated with nitric acid, is converted into mucic and oxalic acids. Three proximate principles are found in gums: 1. *Arabin*, or arabic acid, $C_{12}H_{22}O_{11}$, the soluble form, found largely in acacia. 2. *Bassorin*, $C_{12}H_{20}O_{10}$, or insoluble gum, found in tragacanth. 3. *Cerasin* (insoluble), found in cherry gum.

Some exudations are composed of both soluble and insoluble gum. Vegetable mucilage and insoluble gum are carbohydrates usually produced by the disorganization of a portion of the cell-wall of plants or by changes in the cell contents. *Gums* differ from *starch*, or *cellulin*, by being soluble in water, or by swelling up in contact with it. They differ from sugars by being incapable of vinous fermentation with yeast. There will be frequent occasion to refer to the uses of gum in the subsequent chapters.

ACACIA. U.S. Acacia

[GUM ARABIC]

A gummy exudation from *Acacia Senegal* Willdenow, and other species of *Acacia* (Fam. *Leguminosæ*).

In roundish tears of various sizes, or broken into angular fragments; whitish or yellowish-white, translucent; very brittle, with a glass-like, sometimes iridescent fracture; nearly inodorous; taste insipid, mucilaginous; insoluble in alcohol; slowly and completely soluble in water, forming an odorless, mucilaginous liquid, which shows an acid reaction with blue litmus paper, yields a gelatinous precipitate with basic lead acetate T.S., ferric chloride T.S., and concentrated solution of sodium borate. It is not colored blue (absence of *starch*) or red (absence of *dextrin*) by iodine T.S., nor does it yield a brownish-black precipitate with ferric chloride T.S., or reduce alkaline cupric tartrate V.S.

The powder contains few, or no starch grains or fragments of vegetable tissues, and yields not more than 4 percent. of ash.

This valuable gum consists mainly of arabic acid, or arabin, combined with lime, potassium, or magnesium, and hence it may be called calcium, potassium, or magnesium arabate. It is bleached by exposure to the sun. In powder it is always white. The specific gravity varies from 1.31 to 1.525 for the dried gum.

One hundred parts of diluted alcohol containing 22 per cent. of alcohol by volume dissolve fifty-seven parts of gum, diluted alcohol containing 40 percent. of alcohol takes up ten parts, while 50 percent. alcohol dissolves only four parts.

Neutral lead acetate does not precipitate its aqueous solution, but the basic acetate forms a precipitate even in very dilute solution. Soluble silicates, borates, and ferric salts render a solution of the gum turbid, or thicken it to a jelly. No alteration is produced by silver salts, mercuric chloride, or iodine. Gum arabic dissolves in an ammoniacal solution of cupric oxide.

Uses.—In pharmacy, acacia is extensively used for the suspension of insoluble substances in water, and for the formation of pills and troches. Two kinds of powdered acacia are used, one a coarse powder called *granulated*, the other *finely dusted*. The granulated dissolves more readily in water, because it has lost during desiccation only a part of its moisture, while in preparing the "finely dusted" powder the high heat necessarily used to dry it thoroughly, drives off nearly all the water. Its easy solubility and its absence of tendency to form "lumps" cause the coarse powder to be preferred for solutions, emulsions, etc. Acacia is used as a binding agent in emulsions, pills, troches, etc., and in the following:

Official Preparations

Mucilago Acaciæ Mucilage of Acacia	Made by dissolving 340 Gm. of acacia in 330 Gm. of lime water and enough water to make 1000 Gm. Preferably made by circulatory solution (see Fig. 263, page 191)
Syrupus Acaciæ Syrup of Acacia	Made by dissolving 100 Gm. of acacia (in tears) in 430 Cc. of distilled water, dissolving in the liquid 800 Gm. of sugar with the aid of a gentle heat, straining and adding enough distilled water to make 1000 Cc. (see page 289)

TRAGACANTHA. U.S. Tragacanth

A gummy exudation from *Astragalus gummifer* Labillardière, or from other species of *Astragalus* (Fam. *Leguminosæ*).

It is officially described as "In ribbon-shaped bands varying in size and from 1 to 3 Mm. thick, or in irregular pieces of the same, long and linear, straight or spirally twisted; externally whitish, marked by more or less pronounced longitudinal or excentric lines or ridges; translucent, horny, fracture short, tough, rendered more easily pulverizable by a heat of 50° C. (122° F.).

"On treating Tragacanth with 50 parts of water, it swells and gradually forms a cloudy, gelatinous mass, which, on warming with solution of sodium hydroxide on a water-bath, becomes yellow and is tinged blue on the addition of iodine T.S.; the addition of alcohol to the fluid portion causes a precipitate, but the liquid is not colored blue by iodine T.S."

This gum upon analysis was found to consist of 33 percent. of bassorin, or insoluble gum, 53 percent. of soluble gum (not arabin), 11 percent. of water, and 3 percent. of impurities. Its specific gravity is 1.384. Introduced into water, it absorbs a certain proportion of that liquid, swells very much, and forms a soft adhesive paste, but does not dissolve. If agitated with an additional quantity of water, this paste forms a uniform mixture; but in the course of one or two days the greater part separates, and is deposited, leaving a portion dissolved in the supernatant fluid. Tragacanth is wholly insoluble in alcohol. It appears to be composed of two different constituents, one soluble in water and resembling acacia, the other swelling in water, but not dissolving. The former differs from acacia in affording no precipitate with potassium silicate or ferric chloride.

Uses.—Tragacanth, in the form of a glycerite, affords an excellent pill excipient; the powder itself is often used to stiffen a pill mass and render it adhesive. It is used officially in the emulsion of chloroform, Blaud's pills, in a number of troches, and in the following:

Official Preparation

Mucilago Tragacanthæ Mucilage of Tragacanth	Made by mixing 18 Gm. of glycerin with 75 Cc. of water, heating to boiling, adding 6 Gm. of tragacanth, macerating, making the weight up to 100 Gm., and then straining forcibly through muslin (see page 301)

ULMUS. U.S. Elm

[SLIPPERY ELM]

The dried bark of *Ulmus fulva* Michaux (Fam. *Ulmaceæ*), deprived of its periderm.

It is officially described as "In flat pieces varying in length and width, 3 to 4 Mm. thick; outer surface light brown, with occasional dark brown patches of the periderm; inner surface yellowish-brown; fracture fibrous and somewhat mealy; odor slight but distinct; taste mucilaginous.

"Ground Elm contains a few nearly spherical starch grains from 0.005 to 0.010 Mm. in diameter."

This bark contains a mucilage which is capable of being precipitated from its aqueous solution by alcohol and lead acetate. It is much used as a demulcent.

Official Preparation

Mucilago Ulmi Mucilage of Elm	Made by digesting 6 Gm. of bruised elm in 100 Cc. of water (see page 301)

SASSAFRAS MEDULLA. U.S. Sassafras Pith

The dried pith of *Sassafras variifolium* (Salisbury) O. Kuntze (Syn. *Sassafras Sassafras* (Linné) Karsten) (Fam. *Lauraceæ*).

It is officially described as "In more or less cylindrical, often curved or coiled pieces of variable length and about 5 Mm. in diameter, whitish, very light, with a slight odor and a mucilaginous taste."

This pith contains a delicate mucilage, which is not precipitated from its aqueous solution by alcohol. It is used for making the official mucilage, which is principally employed as an eye wash.

Official Preparation

Mucilago Sassafras Medullæ Mucilage of Sassafras Pith	Made by macerating 2 Gm. of sassafras pith in 100 Cc. of water during three hours and straining without expression (see page 300)

ALTHÆA. U.S. Althæa

[MARSHMALLOW]

The dried root of *Althæa officinalis* Linné (Fam. *Malvaceæ*), collected from plants of the second year's growth, and deprived of the periderm.

It is officially described as in "Slenderly tapering, 15 to 30 Cm. long, rarely exceeding 20 Mm. in diameter; externally whitish, traversed longitudinally by several broad, shallow furrows, and covered with loosened bast fibres; fracture of bark fibrous, of wood short and granular; internally yellowish-white; odor faint; taste sweetish, mucilaginous.

"The powder contains rosette-shaped crystals of calcium oxalate, about 0.025 Mm. in diameter, and ellipsoidal starch grains from 0.010 to 0.020 Mm. in diameter."

This root, which is generally imported from Europe, contains a large quantity of mucilage, $C_{12}H_{20}O_{10}$, associated with *asparagin*, sugar, and starch. It is used as a demulcent, and officially in mass of mercury, pills of ferrous carbonate, and pills of phosphorus as an adhesive diluent.

LINUM. U.S. Linseed Flaxseed

The ripe seed of *Linum usitatissimum* Linné (Fam. *Linaceæ*).

It is officially described as follows: Ovate or oblong-lanceolate, flattened, 4 or 5 Mm. long, obliquely pointed at one end; externally chestnut-brown, very smooth and glossy, covered with a transparent, mucilaginous outer wall which swells in water; embryo whitish or greenish, with two large, plano-convex and oily cotyledons, embedded in a thin perisperm; odor slight; taste mucilaginous, oily.

Ground Linseed (Linseed Meal or Flaxseed Meal) should be recently prepared and free from unpleasant or rancid odor. It is a grayish-yellow powder containing brownish fragments, and when exhausted by carbon disulphide should yield not less than 30 percent. of a fixed oil, all of which is saponifiable.

If 0.1 Gm. of ground Linseed be mixed with 20 Cc. of water and the mixture heated to boiling, then cooled and diluted with cold water to 100 Cc., the addition of 0.5 Cc. of iodine T.S. should not produce more than a pale blue color (limit of *starch*).

Linseed contains 15 percent. of mucilage, $C_{12}H_{20}O_{10}$, in the epithelium, and from 20 to 35 percent. of fixed oil in the nucleus, besides resin, sugar, wax, etc. The mucilage is soluble in water, but more readily in hot water, forming a thick, viscid liquid. Alcohol and lead subacetate precipitate it from its aqueous solution. The mucilage is an important constituent; the seed is used in its unground state for making a demulcent infusion. Ground flaxseed is very useful to the pharmacist for making lutes, and, medicinally, it is used for making poultices. The fixed oil is very valuable in the arts because of its drying properties. (See Oleum Lini.)

Unofficial Mucilaginous Substances

Bael-fruit	The dried, half ripe fruit of *Ægle Marmelos.* Fam. Aurantiaceæ. Habitat, Himalaya Mountains. Used principally in dysentery. Dose of fluidextract, 1 to 2 fluidrachms
Baobab	From *Adansonia digitata.* Fam. Sterculiaceæ. Habitat, Tropical Africa. Used as a tonic
Benne Leaves	From *Sesamum Indicum.* Fam. Pedaliaceæ. Habitat, India. Used as a stimulant
Blue-weed	From *Echium vulgare.* Habitat, Europe. Used chiefly as an emollient and protective
Borage	From *Borago officinalis.* Fam. Boraginaceæ. Habitat, Southern Europe. Used chiefly as an emollient and protective
Cashew-nut	From *Anacardium occidentale.* Fam. Terebinthaceæ. Habitat, Tropical America. Used externally and as a vermifuge
Comfrey-root	The root of *Symphytum officinale.* Fam. Boraginaceæ. Habitat, Europe. Used as a demulcent and astringent
Cydonium, Quince Seed	The seed of *Cydonia vulgaris.* Fam. Rosaceæ. Used for *Mucilago Cydonii,* 2 percent. quince seed, 98 percent. water
Evening Primrose	From *Œnothera biennis.* Fam. Onagraceæ. Habitat, North America
Fenugreek	The seeds of *Trigonella Fœnum-græcum.* Fam. Leguminosæ. Habitat, Western Asia. Used as an emollient, and in condition powders
Hog Gum	From *Rhus metopium.* Habitat, South America. Used as a demulcent
Hound's Tongue	From *Cynoglossum officinale.* Habitat, Europe and United States. Used as an emollient and protective
Jujube Berries	The fruit of *Zizyphus vulgaris.* Fam. Rhamnaceæ. Habitat, Asia Minor. Used as a laxative
Laminaria	From *Laminaria Cloustoni.* Fam. Algæ. Habitat, North Atlantic Ocean
Lungwort	From *Pulmonaria officinalis.* Habitat, Europe
Maidenhair	The fronds of *Adiantum Capillus-Veneris.* Fam. Filices. Used as a demulcent and stimulant
Mezquite Gum	From *Algarobia glandulosa.* Habitat, Texas
Mullein	The leaves and flowers of *Verbascum Thapsus.* Fam. Scrophulariaceæ. Habitat, North America. Used as a demulcent
Okra	From *Hibiscus esculentus.* Habitat, Africa
Salep	From the tubers of *Orchis mascula.* Is very mucilaginous, only four grains being sufficient to make one fluidounce of water gelatinous
Virginia Lungwort	From *Pulmonaria Virginica.* Habitat, United States
Willow Herb	From *Epilobium angustifolium.* Fam. Onagraceæ. Used as a tonic and demulcent

CHAPTER LI

SUGARS AND SACCHARINE SUBSTANCES

SUGARS may be defined as organic bodies having a sweet taste, generally of vegetable origin and crystallizable, of a neutral reaction, soluble in water, their solutions being optically active to polarized light. The term sugar is popularly applied to but one product, saccharose, the sweet substance obtained from sugar cane, beets, sorghum, sugar maple, etc. There are, however, many sugars varying not only in external appearance and properties, but also in chemical composition. They may be divided into two classes: 1. Fermentable sugars. 2. Non-fermentable sugars.

1. Fermentable Sugars.—This is by far the more important class, as it embraces the sugars which are largely consumed in food products. It will be found convenient to divide this class into two subclasses: *Glucoses*, or sugars *directly* subject to vinous fermentation, and *Saccharoses*, sugars *indirectly* subject to vinous fermentation. The following table shows these in detail:

Glucoses, $C_6H_{12}O_6$

Glucose (Sucro-dextrose, Dextro-glucose, or Dextrose), $C_6H_{12}O_6 + Aq$	Rotates the plane of polarization strongly to the right. Obtained by treating starch with diluted sulphuric acid, neutralizing the acid with lime, separating the calcium sulphate, and evaporating the solution; found also in honey, sweet fruits, and diabetic urine
Grape Sugar (Starch Sugar or Crystallized Glucose)	Obtained by crystallizing the above named solution
Levulose (Sucro-levulose, Mucoid Sugar, and Fructose or Fruit Sugar, Lævo-glucose)	Rotates the plane of polarization strongly to the left. Found in the sugar cane, and may be obtained from molasses; found in honey and in fruits; obtained pure by the action of diluted acids on inulin
Dulcitose	Obtained by oxidizing dulcite with nitric acid
Mannitose	Found in muscular flesh and made by the oxidation of mannite
Galactose	Made by treating milk sugar with diluted sulphuric acid
Arabinose, pectinose	Made by the action of diluted acid on arabin
Inosite, inosol, phaseomannite	Found in muscle, kidney beans, cochineal, etc.
Scyllite	Found in kidney, liver, etc., of cartilaginous fishes
Sorbinose, sorbin	Found in ripe mountain ash berries
Eucalyptose, eucalyn, $C_6H_{12}O_6 + H_2O$	Made by the action of the diluted acids on, or fermentation of, mellitose

Saccharoses, $C_{12}H_{22}O_{11}$

Fermentable only after being converted into a sugar belonging to the class of glucoses

Maltose, $C_{12}H_{22}O_{11}$	Made by the action of diastase on starch
Cane Sugar (Saccharose, Sucrose)	Obtained from sugar cane, beets, etc. (see Saccharum)
Parasaccharose	Produced by spontaneous fermentation of cane sugar
Milk Sugar (Lactose, Lactin), $C_{12}H_{22}O_{11} + H_2O$	Obtained from milk (see Saccharum Lactis)
Mycose, $C_{12}H_{22}O_{11} + 2H_2O$	Obtained from ergot, mushrooms, and Trehala manna; identical with trehalose
Melezitose	Obtained from manna found in Tasmania and Persia, and from the larch
Melitose, Eucalypton, $C_{12}H_{22}O_{11} + 3H_2O$	Obtained from various species of Eucalyptus, and from cotton seed
Trehalose	Obtained from the cocoons of *Larinus maculatus*
Synanthrose	Obtained from the Jerusalem artichokes, and from *Dahlia variabilis*

2. **Non-fermentable Sugars.**—These are sometimes termed *saccharoids.* Some of them have the chemical composition of glucose.

Mannite, Mannitol, or Alpha-Hexone alcohol, $C_6H_{14}O_6$	Obtained from Manna and many other plants, and from the reduction of glucose
Dulcite, or Dulcitol, or Beta-Hexone alcohol, $C_6H_{14}O_6$	Also called Melampyrite. Obtained from *Melampyrum memorosum*, and by the action of nascent hydrogen on galactose
Quercitose, $C_6H_{12}O_6$	By decomposing quercitrin with diluted sulphuric acid
Sorbite, $C_6H_{14}O_6 + \frac{1}{2}H_2O$	From *Sorbus aucuparia,*—mountain ash berries
Erythromannite, $C_4H_{10}O_4$	Obtained from *Protococcus vulgaris*, also called *Phycite*
Isodulcite, $C_6H_{14}O_6$	From quercitrin, by the action of diluted acids
Pinite, $C_6H_{12}O_5$	From *Pinus Lambertiana*
Quercite, $C_6H_{12}O_5$	Obtained from acorns
Persite, or Persitol, $C_6H_{14}O_6$	Obtained from *Laurus persea*
Raffinose, $C_6H_{14}O_7$	Obtained from beet root
Hesperidin sugar, $C_6H_{14}O_6$	

Glucose, $C_6H_{12}O_6$, may be obtained from candied honey, from grapes, and from many other sources, but it is prepared from starch upon an immense scale by the action of very weak sulphuric acid. The term glucose is applied to the syrupy product of this process, while the name *grape sugar* is applied to the solid product from the same source. The process is as follows: The corn is first soaked in warm water, and is then ground on specially prepared stones with a stream of water. The meal is next passed into a trough, the bottom of which is made of fine bolting cloth. Here the starch is washed through and led to large tanks, where it is allowed to settle. It is next beaten up with caustic soda to separate the gluten, and the starch is again allowed to settle in long shallow troughs. The starch, washed from all adhering alkali, is next beaten up with water into a cream, and conducted into the converting tubs. Here the starch cream is treated with diluted sulphuric acid, and steam is allowed to bubble up through the mixture. This process of conversion, which is called "open conversion," is completed in about two hours. Another method is called "close conversion." The substances are enclosed in stout copper cylinders and subjected to the action of superheated steam. This process occupies about fifteen minutes. After conversion, the liquid is treated with marble dust and animal charcoal. After neutralization, the liquid is filtered through cloth and animal charcoal, and is then conveyed to the vacuum pan. When glucose syrup alone is desired, the process of conversion is stopped when the starch has disappeared, so that the syrup contains both glucose and dextrin, while, when solid grape sugar is desired, the conversion is carried further to the change of dextrin into dextrose. Glucose can be obtained as an hydroxide in small and laminated crystals from aqueous solution, and anhydrous in hard crystalline masses either from alcoholic solution or from very concentrated aqueous solution. It is less sweet than cane sugar. It is also less soluble in water, and much more soluble in alcohol. It has the specific gravity 1.54 to 1.57 when anhydrous. Strong mineral acids hardly act on grape sugar, but destroy cane sugar with facility. On the other hand, grape sugar is destroyed by alkalies, with which cane sugar forms definite compounds. Dissolved in water and subjected to prolonged ebullition, grape sugar undergoes very little alteration. Its solution rotates the plane of polarization of polarized light to the right, and is capable of undergoing the vinous fermentation directly, without passing through any intermediate state. It is characterized, also, in boiling solution, by reducing alkaline cupric tartrate (see Volumetric Solution of Alkaline Cupric Tartrate), producing a reddish precipitate. Manufactured glucose may sometimes contain calcium sulphate; it may be detected by adding a solution of barium chloride, which produces a white precipitate of barium sulphate.

SACCHARUM. U.S. Sugar

$C_{12}H_{22}O_{11} = 339.6$

[CANE SUGAR]

The refined sugar obtained from *Saccharum officinarum* Linné, and from various species or varieties of *Sorghum* (Fam. *Gramineæ*); also from one or more varieties of *Beta vulgaris* Linné (Fam. *Chenopodiaceæ*).

Preparation.—Sugar is prepared commercially from the sugar cane, beet root, and sorghum. Formerly, sugar cane was the only source; but at present the root of *Beta vulgaris* is largely used in Europe for making cane sugar, and from the rapid growth of this industry in this country and elsewhere, there is a prospect of its supplanting all others. To prepare sugar the sugar cane is crushed, and the juice, amounting to about 80 percent., is expressed; this is then heated, a little lime and calcium bisulphite added, strained, and the liquid quickly evaporated, cooled, and stirred. The thick liquid is transferred to casks perforated at the bottom, and the crystals drained. Sugar made in this way is called "open pan" sugar. It is now almost completely displaced by "vacuum pan" sugar.

In the production of raw sugars by the vacuum pan process, the juice, after "defecation" with lime and removal of excess of lime by carbonic acid gas, is run through large filters of bone black, and then into the vacuum pan for concentration. The vacuum pan is a large evaporating pan, closed above by a dome-like top, which connects with an exhausting steam pump, so that the liquid can be concentrated under very reduced pressure. The heat is supplied by coils of steam pipes which run through the interior of the pan. The saccharine juice is evaporated in this until it begins to crystallize, and even after this fresh portions are added, so that the crystals already formed grow by accretion of fresh material. After the crystallization is complete, the warm mixture of crystals and syrup is run into "centrifugals," to which a rapid revolution is given, and the crystals thus drained and dried.

Beet root sugar is made in a similar manner, but is more troublesome to purify than that made from sugar cane. The best sugar for pharmaceutical uses is known technically as "granulated." Loaf-sugar is generally pure, but if kept in a damp atmosphere it is liable to absorb moisture, and if kept in a very dry air it will lose weight. For making troches, *lozenge sugar*, a very pure, finely powdered sugar, may be had through dealers in confectioners' supplies. "*Pulverized*" *sugar*, as it is called, is unfitted for such a purpose.

When sugar is crystallized in regular large monoclinic prisms, it is called *rock-candy*, and has the specific gravity 1.606. The official test excludes sugar which contains ultramarine; this is often added by refiners to save the expense of using bone-black. A sugar not entirely free from yellow color can be blued by ultramarine, and the fault thus covered up, so that most consumers remain ignorant of the deception; when solution is attempted, however, it is discovered, for the syrup is never colorless, and a sediment is deposited. Sugar in dilute aqueous solution is converted into alcohol, carbon dioxide, and eventually acetic acid, if exposed to warm air.

Cane sugar may be distinguished from grape sugar by Trommer's test, which consists in the use of copper sulphate and caustic potash. If a solution of cane sugar be mixed with a solution of copper sulphate, and potassium hydroxide be added in excess, a deep blue liquid is obtained, which on being heated deposits, after a time, a little red powder. A solution of grape sugar, similarly treated, yields, by heat, a copious greenish precipitate, which rapidly changes to scarlet, and eventually to dark red. When heated to 185° C. (365° F.), cane sugar melts into a viscid, colorless liquid, which on being suddenly cooled forms a transparent amorphous mass, called *barley sugar*. At a higher temperature, between 204.4° and 215.5° C. (400° and 420° F.), it loses two molecules of water, and is converted into a very thick, black liquid, called *caramel*, which is used largely for coloring aqueous or hydro-alcoholic liquids. At a still higher heat it yields combustible gases, carbonic acid, empyreumatic oil, and acetic acid, and there remains one-fourth of its weight of charcoal, which burns without residue.

The valuation of sugars and syrups is now easily made through the use of the polariscope. A clear solution of sugar (26.048 Gm. in 100 Cc.) is poured into a tube of definite length; this is placed in the instrument and a ray of light caused to pass through it from end to end; if the sugar is dextrogyre or dextrorotatory, it deviates the plane of polarization to the right; if lævogyre or lævorotatory, to the left; the extent of the deviation is read off from the circular scale on the polariscope, and the table of percentages gives at once the amount of pure sugar in the sample.

Official Description.—White, dry, hard, distinctly crystalline granules; permanent in the air.

Odor, Taste, and Reaction.—Odorless; purely sweet taste; neutral reaction.

Specific Gravity.—The aqueous solution, saturated at 25° C. (77° F.), has a specific gravity of about 1.340.

Solubility.—*Water.* In 0.46 part at 25° C. (77° F.); in 0.2 part of boiling water.

Alcohol. In 137.2 parts at 25° C. (77° F.), and in 28 parts of boiling alcohol; also soluble in 80 parts of boiling absolute alcohol.

Other solvents. Insoluble in ether, chloroform, or carbon disulphide.

Tests for Identity.—The aqueous solution, saturated at 25° C. (77° F.) is miscible with water in all proportions, should be colorless, and is dextrogyrate.

Impurities and Tests for Impurities.—*Insoluble salts, ultramarine, Prussian blue, etc.* Both the aqueous and the alcoholic solution of Sugar should be clear and transparent. When kept in large, well-closed and completely filled bottles, the solutions should not deposit a sediment on prolonged standing.

Glucose and more than a slight amount of inverted sugar. If 1 Gm. of Sugar be dissolved in 10 Cc. of boiling water, the solution mixed with 4 or 5 drops of silver nitrate T.S., then about 2 Cc. of ammonia water added, and the liquid quickly brought to the boiling point, not more than a slight coloration, and no black precipitate, should appear in the liquid after standing at rest for five minutes.

Uses.—Sugar is used principally in pharmacy for making syrups, troches, masses, confections, etc., as already noted.

Saccharures are preparations made by saturating sugar with tinctures, drying it, and then reducing the mixture to a fine powder.

Oleo-saccharures (Elæosacchara) are similar preparations made by incorporating one drop of a volatile oil with thirty grains of sugar. They form convenient modes of administering remedies to children.

Aromatic sugars may be prepared by pouring an alcoholic tincture of the spice drugs—cinnamon, cloves, etc.—over granulated sugar, and drying the product by exposing it to the air.

MEL. U.S. Honey

A saccharine secretion deposited in the honey-comb by the bee, *Apis mellifera* Linnè.

It is not known whether honey is secreted by the bee, or whether it exists ready formed in plants. The nectaries of flowers contain a sweet substance, which is extracted by the insect. Large quantities of honey are obtained from California, the Southern States, and the West Indies. A still larger amount, however, is manufactured by flavoring and coloring artificial glucose. The official test ingeniously detects this adulteration through the barium chloride test. Artificial glucose nearly always contains a trace of calcium sulphate, which produces a slight precipitate of barium sulphate (see below).

Official Description.—A syrupy liquid of a light yellowish to yellowish-brown color, translucent when fresh, but gradually becoming opaque and crystalline.

Odor, Taste, and Reaction.—Characteristic, aromatic odor, and a sweet, faintly acrid taste. Fainty acid reaction upon litmus paper.

Specific Gravity.—When recent Honey is diluted with twice its weight of water, the resulting liquid should be almost clear, not stringy, and should have a specific gravity not lower than 1.099 (corresponding to a specific gravity of 1.370 for the original Honey).

Test for Identity.—When Honey is incinerated in small portions at a time in a platinum crucible, it should not leave more than 0.3 percent. of ash.

Honey is lævogyrate.

Impurities and Tests for Impurities.—*Limit of chlorides.* If 5 Gm. of Honey be dissolved in 20 Gm. of water, a clear or nearly clear solution will result, which should not be rendered more than faintly opalescent by a few drops of silver nitrate T.S.

Limit of sulphates. Or of barium chloride T.S.

Starch sugar. If 2 Cc. of filtered solution of the Honey (1 in 4) be placed in a test-tube 1 Cm. in diameter, and 1 Cc. of absolute alcohol be allowed to flow down the walls of the tube held in an inclined position, so as to form an overlying layer, this should remain clear, and the line of contact should not show more than barely noticeable opalescence, which soon disappears; a permanent milky zone should not be produced.

Cane sugar. If 2 Cc. of pure concentrated sulphuric acid be placed in a test-tube of 1 Cm. diameter, and 0.5 Cc. of a solution of Honey (1 in 4) be allowed to flow upon it so as to form a distinct upper layer, no colored line of contact should show at once, and at the end of one hour the zone of contact should be at most yellowish or clear brown; a brownish color becoming nearly black at the end of half an hour should not develop.

Starch. On boiling 1 part of Honey with 5 parts of water, the resulting solution, when cold, should not be rendered blue or green on the addition of iodine T.S.

Uses.—Honey is used pharmaceutically in the class Mellita (page 299), and as a vehicle and excipient. Owing to the difficulty of obtaining pure honey in large cities and towns, its place in many official preparations has been filled by substituting syrup or glycerin. Purified honey is official as Mel Depuratum (see page 299).

MANNA. U.S. Manna

The concrete saccharine exudation of *Fraxinus Ornus* Linné (Fam. *Oleaceæ*).

It is officially described as, "In irregular, more or less elongated, flattish, 3-sided pieces; externally yellowish-white; friable, somewhat waxy; internally whitish, porous and crystalline; odor suggestive of maple sugar; taste sweet, slightly bitter and faintly acrid.

This substance, which is found in commerce of varying quality, is, when pure, soluble in three parts of cold water and in its own weight of boiling water. It separates in crystalline masses from a boiling, saturated, aqueous solution. It is soluble in alcohol ; boiling alcohol will often dissolve fifteen percent. of it, and upon cooling deposit beautiful crystals of mannite.

The principal constituent of manna is *mannite*, a peculiar, sweet principle, which is also found in many other plants.

Mannite is white, inodorous, crystallizable in semi-transparent needles, of a sweetish taste, soluble in five parts of cold water, scarcely soluble in cold alcohol, but readily dissolved by that liquid when hot, and deposited when it cools. Its composition is $C_6H_{14}O_6$, and it is considered as belonging to the class of *hexatomic alcohols.* It may be obtained by boiling manna in alcohol, allowing the solution to cool, and redissolving the crystalline precipitate. Pure mannite is then deposited. Mannite is found in many plants, and may be converted by oxidation into mannose, a fermentable sugar.

Uses.—Manna is used as a laxative, and often added to senna leaves to make a cathartic infusion. The dose is from one-half to two ounces (16 to 64 Gm.).

GLYCYRRHIZA. U.S. Glycyrrhiza Licorice Root

[LIQUORICE ROOT]

The dried rhizome and root of *Glycyrrhiza glabra* Linné (Spanish Licorice), or of *Glycyrrhiza glandulifera* Waldstein and Kitaibel (Russian Licorice) (Fam. *Leguminosæ*).

Spanish Licorice.—Cylindrical, usually cut into pieces 14 to 20 Cm. or more long, 5 to 15 Mm. thick ; longitudinally wrinkled, grayish-brown or dark-brown, pliable ; fracture coarsely fibrous ; internally tawny-yellow ; bark 1 to 3 Mm. thick ; wood porous, in narrow wedges ; odor slight ; taste sweetish and slightly acrid.

Russian Licorice.—Somewhat tapering, frequently 1 M. or more in length, 1 to 5 Cm. in diameter, deprived of the outer corky layer, when it is externally pale yellow ; internally of a lighter yellow ; wood rather soft ; taste less sweet than that of the Spanish Licorice. Any blackened, knotty, bitter portions should be removed.

This well known root contains the sweet principle *glycyrrhizin*, or *glycyrrhizic acid*, $C_{44}H_{63}NO_{18}$. This was found by Roussin to exist in the root in combination with ammonia. There is also present an oleoresinous substance which communicates to the root a slight acridity. If alcohol is used as a menstruum for the root and the preparation not treated to deprive it of acridity, it will have a disagreeable aftertaste.

Uses.—Glycyrrhiza is valuable in pharmacy solely on account of the sweet principle. It is one of the most efficient substances known for masking the taste of bitter substances, like quinine sulphate. Besides the following official preparations it is used in a number of the official processes ; in making ammoniated glycyrrhizin, as a diluent in powdered extracts, as an addition to the compound fluidextract of sarsaparilla, the aromatic fluidextract of cascara sagrada, the tincture of aloes, the tincture of aloes and myrrh, and in several pills and powders, and in one mass.

Official Preparations

Extractum Glycyrrhizæ Extract of Glycyrrhiza	The commercial extract of the root, prepared by evaporating an aqueous extract and forming it into cylindrical rolls about six inches long (see page 446)
Extractum Glycyrrhizæ Purum Pure Extract of Glycyrrhiza	Made by percolating glycyrrhiza with dilute solution of ammonia, evaporating the percolate to a pilular consistence, and incorporating with it 5 percent. of its weight of glycerin (see page 446)
Pulvis Glycyrrhizæ Compositus Compound Powder of Glycyrrhiza	Made by mixing together 180 Gm. senna, 236 Gm. glycyrrhiza, 4 Gm. of oil of fennel, 80 Gm. washed sulphur, and 500 Gm. sugar, all in fine powder.
Fluidextractum Glycyrrhizæ Fluidextract of Glycyrrhiza	Made by percolating 1000 Gm. of glycyrrhiza with boiling water, after maceration with cold water, until exhausted, evaporating the percolate to 450 Cc., adding an equal volume of alcohol, setting aside for twenty-four hours, filtering, distilling off the alcohol, and mixing the residue with 250 Cc. of glycerin, 50 Cc. of ammonia water, 200 Cc. of alcohol, and enough water to make 1000 Cc. (see page 398)

GLYCYRRHIZINUM AMMONIATUM. U.S. Ammoniated Glycyrrhizin

	Metric	Old form
* **Glycyrrhiza,** in No. 20 powder	**500 Gm.**	25 oz. av.
Water,		
Ammonia Water,		
Sulphuric Acid, each, a sufficient quantity		

Mix 475 Cc. [old form 23 fl. oz.] of Water with 25 Cc. [old form 1 fl. oz. and 1 fl. dr.] of Ammonia Water, and, having moistened the powder with the mixture, macerate for twenty-four hours. Then pack it moderately in a conical glass percolator, and gradually pour Water upon it until 500 Cc. [old form 24 fl. oz.] of percolate are obtained. Add Sulphuric Acid slowly to the percolate, with constant stirring, so long as a precipitate is produced. Collect this on a strainer, wash it with cold Water until the washings no longer have an acid reaction, redissolve it in Water with the aid of Ammonia Water, filter, if necessary, and again add Sulphuric Acid so long as a precipitate is produced. Collect this, wash it, dissolve it in a sufficient quantity of Ammonia Water previously diluted with an equal volume of Water, and spread the clear solution upon plates of glass, so that, when dry, the product may be obtained in scales.

The introduction of this preparation is the result of the very important researches of Z. Roussin, who noticed that *glycyrrhizin*, the sweet principle of licorice root, was insipid when compared with the root itself, and inferred that it existed in a modified form in the root. Experiment showed that alkalies developed the sweet taste, and he ultimately proved that the alkali with which it was combined in the root was ammonia, and that glycyrrhizin played the part of an acid. Licorice root which has lost a portion of its sweetness through fermentation and the development of acetic acid and precipitation of insoluble glycyrrhizin can be restored to its former sweetness if allowed to remain a sufficient length of time in an ammoniacal atmosphere.

Official Description.—Dark brown or brownish-red scales.
Odor and Taste.—Without odor, and having a very sweet taste.
Solubility.—*Water.* Readily soluble.
Alcohol. Soluble.
Tests for Identity.—The aqueous solution, when heated with potassium hydroxide T.S., evolves ammonia.

If the aqueous solution be supersaturated with an acid, there will be produced a precipitate (glycyrrhizin) which, when dissolved in hot water, forms a jelly on cooling. This substance, after being washed with diluted alcohol and dried, appears as an amorphous, yellow powder, having a strong, bitter-sweet taste, and an acid reaction.

Upon incineration, Ammoniated Glycyrrhizin should not leave more than a trace of ash.

Uses.—This compound is useful when mixed with bitter or disagreeable powders to mask their taste.

TRITICUM. U. S. **Triticum**

[Couch-grass]

The dried rhizome of *Agropyron repens* (Linné) Beauvois (Fam. *Gramineæ*), gathered in the spring.

Of horizontal growth, subcylindrical, 1 to 2 Mm. in diameter, usually cut into sections 5 to 8 Mm. long; externally brownish-yellow to straw-colored, nearly smooth; hollow in the centre; odor slight; taste distinctly sweet.

Triticum is usually found in the market cut into small sections. It contains *triticin*, a principle resembling inulin, also glucose, levulose, etc.

Uses.—It is used as a diuretic and for special action on the urinary organs in the dose of one hundred and twenty grains (8 Gm.).

Official Preparation

Fluidextractum Tritici Fluidextract of Triticum	Made with boiling water, concentrated by evaporation and preserved by the addition of a mixture of 1 volume of alcohol for each 3 volumes of the concentrated percolate (see page 422)

CHAPTER LII

DERIVATIVES OF SUGARS THROUGH THE ACTION OF FERMENTS

Fermentation.—When certain organic bodies are subjected to the action of water, air, and a warm temperature, decomposition takes place. This is accompanied by the presence of microscopic organisms, and the result is the formation of new products. When decomposition is followed by the production of worthless or offensive substances, it is termed *putrefaction;* when useful products are formed, the process is called *fermentation.*

Two prominent theories accounting for the phenomena of fermentation have been advanced,—one, in which the action is regarded as a chemical process, the presence of the microscopic bodies being considered unimportant; the other (which is now universally accepted) that fermentation is caused by the presence of the organisms.

Ferments may be divided into two classes: 1. Organized or physiological ferments, which may be subdivided into three classes,—(*a*) mould growths, represented by *Penicillium glaucum*; (*b*) yeast plants, or saccharomyces; (*c*) bacteria, constituting a very numerous class. 2. Unorganized or soluble nitrogenous ferments, like diastase, synaptase, myrosin, invertin, emulsin, pepsin, pancreatin, etc. Fermentation which is produced by the latter class has been termed *false fermentation*, and the ferments themselves called *cryptolytes.*

Vinous Fermentation.—Cane sugar, as before stated, is capable of being decomposed by this process and converted into alcohol and carbon dioxide, but it will not undergo the vinous fermentation by itself. It requires to be dissolved in water, subjected to the influence of a ferment, and kept at certain temperatures, 18° to 35° C. (64.4° to 95° F.). Accordingly, sugar, water, the presence of a ferment, and the maintenance of an adequate temperature must be deemed the prerequisites of the vinous fermentation. The water acts by giving fluidity, and the ferment and temperature by commencing and maintaining the chemical changes. The precise manner in which the ferment operates has not been positively determined.

Beginning with the simple substances cellulose and starch, it will be found that, through the action of dilute acids and ferments, they may be converted into alcohol or acetic acid:

$$\underset{\text{Cellulose or Starch}}{(C_6H_{10}O_5)_3} + \underset{\text{Water}}{H_2O} = \underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + \underset{\text{Starch}}{C_6H_{10}O_5}$$

then

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + \underset{\text{Starch}}{C_6H_{10}O_5} + \underset{\text{Water}}{2H_2O} = \underset{\text{Glucose}}{(C_6H_{12}O_6)_3}$$

then

$$\underset{\text{Glucose}}{C_6H_{12}O_6} = \underset{\text{Alcohol}}{(C_2H_5HO)_2} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{2CO_2}$$

And if the action is not arrested, the acetous fermentation begins, resulting in the conversion of the alcohol into acetic acid through oxidation :

$$\underset{\text{Alcohol}}{C_2H_5HO} + \underset{\text{Oxygen}}{O_2} = \underset{\text{Acetic Acid}}{C_2H_4O_2} + \underset{\text{Water}}{H_2O}$$

The most important derivative of sugar through the action of a ferment is alcohol. This is usually obtained from whisky by distillation. The distilled product of vinous liquors forms the different ardent spirits of commerce. When obtained from wine, it is called *brandy;* from fermented molasses, *rum;* from cider,[1] malted barley, or rye, *whisky;* from malted barley and rye-meal, with hops, and rectified from juniper berries, *Holland gin;* from malted barley, rye, or potatoes, and rectified from turpentine, *common gin;* and from fermented rice, *arrack.* These spirits are of different strengths,—that is, contain different proportions of alcohol,—and have various peculiarities by which they are distinguished by the taste.

The compounds derived from sugars will be considered under the following sub-heads : 1. Ethyl hydroxide and oxide and their preparations. 2. Preparation of the esters of the ethyl, methyl, and amyl series. 3. Aldehyde, its derivatives and preparations.

Ethyl Hydroxide and Oxide and their Preparations

The compounds containing the radical ethyl are the most important of those derived from organic substances, alcohol being the source of all.

Alcohol is regarded chemically as the type of a class of carbon compounds called alcohols, of which there are many important members. *They are hydroxides of the alcohol radicals* (ethyl hydroxide, ethyl alcohol ; amyl hydroxide, amyl alcohol), just as slaked lime, or calcium hydroxide, is the hydroxide of the metal calcium.

Ethers are the *oxides of these radicals,* just as lime, or calcium oxide, is the oxide of the metal calcium.

Esters, formerly called *compound ethers,* are analogous to the salts of the metals, being formed by the decomposition of their alcohols by acids,—*i.e.*, ethyl nitrite, ethyl acetate, amyl nitrite,—just as potassium nitrate, sodium acetate, and calcium sulphate may be produced by decomposing the hydroxides of their respective metals with acids. In each case water is formed as one of the results of the decomposition.

This may be shown by the reactions :

$$\underset{\substack{\text{Sodium}\\\text{Hydroxide}}}{NaHO} + \underset{\substack{\text{Acetic}\\\text{Acid}}}{C_2H_4O_2} = \underset{\substack{\text{Sodium}\\\text{Acetate}}}{NaC_2H_3O_2} + \underset{\text{Water}}{H_2O}$$

$$\underset{\substack{\text{Alcohol or}\\\text{Ethyl Hydroxide}}}{C_2H_5HO} + \underset{\substack{\text{Acetic}\\\text{Acid}}}{C_2H_4O_2} = \underset{\text{Ethyl Acetate}}{C_2H_5C_2H_3O_2} + \underset{\text{Water}}{H_2O}$$

SPIRITUS FRUMENTI. U.S. Whisky

An alcoholic liquid obtained by the distillation of the fermented mash of grain,—such as Indian corn, rye, wheat, and barley, or their mixtures.

Owing to the immense production of grain in this country, the cheapest sources of starch (corn, wheat, and rye) are used in making

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[1] The name whisky is properly applied only to the distilled product obtained from rye, wheat, barley, corn, or other grain. See *Spiritus Frumenti* above.

alcoholic liquids. The operations by which whisky is obtained from grain are technically termed,—1. *Mashing*, by which the starch is converted into sugar. 2. *Fermentation*, or the production of the alcohol. 3. *Distillation*, or the separation of the crude spirit.

The crushed grain, mixed with malt, is added to water at 15.4° C. (60° F.), and allowed to stand, to permit the conversion of the starch into maltose, through the action of the diastase. The liquid is now termed the *wort*. This is caused to ferment by the addition of yeast, and alcohol is gradually formed, carbon dioxide escaping. The liquor is then distilled, the distillate being termed *low wines*. This is again distilled, and *raw whisky* is the product. This, upon keeping, especially in a warm room, improves in quality through the formation of esters, which are supposed to communicate an agreeable flavor to the liquid.

Official Description.—An amber-colored liquid. Whisky should be at least four years old.

Odor, Taste, and Reaction.—Distinctive odor and taste, and a slightly acid reaction.

Specific Gravity.—Not more than 0.945, nor less than 0.924 at 15.6° C. (60° F.), corresponding, approximately, to an alcoholic strength of 37 to 47.5 percent. by weight, or 44 to 45 percent. by volume, of absolute alcohol (see Alcohol Tables, page 765).

Impurities and Tests for Impurities.—If 50 Cc. of Whisky be shaken vigorously in a stoppered flask with 25 Gm. of kaolin, and, after standing half an hour, be filtered, the color of the filtrate should not be much lighter than that of the Whisky before treatment.

Not more than a trace of fusel oil from grain. If 100 Cc. of Whisky be very slowly evaporated in a tared dish on a water-bath, the last portions volatilized should not have a harsh or disagreeable odor.

Added sugar, glycerin, and aromatic substances. The residue when dried at 100° C. (212° F.), should not weigh more than 0.5 Gm. This residue should have no sweet or distinctly spicy taste.

More than traces of oak tannin from casks. The above residue should almost completely dissolve in 10 Cc. of cold water, forming a solution which is colored not deeper than light green by a few drops of ferric chloride T.S. diluted with 10 volumes of water.

Limit of free acid. To render 100 Cc. of Whisky distinctly alkaline to litmus, not more than 1.2 Cc. of normal potassium hydroxide V.S. should be required.

Uses.—Crude or "raw" whisky is used as the source of alcohol. When purified and mellowed by age, it is used as a stimulant.

ALCOHOL. U.S. Alcohol

A liquid composed of about 92.3 percent., by weight, or about 94.9 percent., by volume, of absolute Ethyl Alcohol [$C_2H_5.OH = 45.70$], and about 7.7 percent., by weight, of water. It should be kept in well-closed vessels, in a cool place, remote from lights or fire.

ALCOHOL ABSOLUTUM. U.S. Absolute Alcohol

Ethyl Alcohol [$C_2H_5.OH = 45.70$], containing not more than 1 percent., by weight, of water. It should be kept in well-stoppered bottles or tin cans, in a cool place, remote from lights or fire.

Preparation.—The natural sources of alcohol are starch and sugar as they exist in various plants, and alcohol, if pure, is the same from whatever source it is derived. It is generally made by distilling whisky, and redistilling and rectifying the distillate in an apparatus termed an alcohol column and still. The yield of alcohol, sp. gr. 0.835, obtained from good whisky is about 58 percent. by volume. The principal impurity is *fusel oil*, or amylic alcohol. Alcohol may be deprived of odor by treating it with potassium permanganate and redistilling. *Absolute alcohol* is the name given to the strongest alcohol which can be made, and which is intended to be absolutely free from water. This is a difficult preparation to make, owing to the very strong affinity existing between the two liquids. The strongest alcohol that can be made by simple distillation contains 11 percent. of water. An alcohol of about 92 percent. strength, by weight, may be obtained by the use of a column and still, but in order to free it from the last 5 to 8 percent. of water it is necessary to use some substance having a still stronger affinity for water. This is found in recently burned lime, and the method employed is to percolate the strongest and purest alcohol attainable through the lime, out of contact with air, and then to redistil the percolate in vacuo. In this way alcohol may be obtained having a specific gravity as low as 0.79355 at 15.6° C. (60° F.). (Squibb.) Absolute alcohol is a transparent, colorless, mobile, and volatile liquid, of a characteristic, rather agreeable odor and a burning taste. Very hygroscopic. It is not congealed by a cold of 202° F. below zero. Absolute alcohol should be free from fusel oil. The presence of water in alcohol may be detected by dropping into it a crystal of potassium permanganate; a pink color appears if it contains as little as 0.5 percent.

It burns with a pale flame without residue, the products being carbon dioxide and water. Absolute alcohol consists of two atoms of carbon, six of hydrogen, and one of oxygen. Its empirical formula is, therefore, C_2H_6O. It is recognized as the hydroxide of the radical ethyl (C_2H_5), so that its structural formula would be $C_2H_5.OH$.

The official description and tests for Absolute Alcohol are as follows: Specific gravity, not higher than 0.797 at 15.6° C. (60° F.); or 0.790 at 25° C. (77° F.) In other respects, Absolute Alcohol has the properties, and should respond to the reactions and tests, of Alcohol (see *Alcohol*).

Alcohol is official in three forms: absolute alcohol, sp. gr. 0.797 at 15.6° C. (60° F.), 0.790 at 25° C. (77° F.); alcohol, sp. gr. 0.816 at 15.6° C. (60° F.), 0.809 at 25° C. (77° F.); diluted alcohol, sp. gr. 0.936 at 15.6° C. (60°F.), 0.930 at 25° C. (77° F). The temperature at which the specific gravity of alcohol is taken for official preparations is exceptional, the old temperature 15.6° C. (60° F.) being retained because the United States government uses this temperature for their standards.

Deodorized alcohol was official in the U. S. P. 1890, but owing to improved methods of purifying alcohol the tests for its purity are in the U. S. P. (8th Rev.) applied to Alcohol, so that practically it may be said that the present official alcohol is the deodorized product. The description of alcohol, U. S. P. (8th Rev.), is as follows:

Official Description.—A transparent, colorless, mobile, and volatile liquid.

Odor, Taste, and Reaction.—Slight, agreeable odor; burning taste; neutral reaction.

Specific Gravity.—About 0.816 at 15.6° C. (60° F.), the standard temperature for Alcohol, or 0.809 at 25° C. (77° F.).

Solubility.—*Water.* Miscible in all proportions, and without any trace of cloudiness.

Other solvents. Miscible with ether or chloroform.

Tests for Identity.—It is readily volatilized, even at low temperatures, and boils at 78° C. (172.4° F.). It is inflammable, and burns with a pale blue, smokeless flame.

Color or weighable residue. If 50 Cc. of Alcohol be evaporated in a clean glass vessel, no *color* or *weighable residue* should remain.

Impurities and Tests for Impurities.—*Fusel oil constituents.* If 10 Cc. of Alcohol be mixed with 5 Cc. of water and 1 Cc. of glycerin, and the mixture allowed to evaporate spontaneously from a piece of clean, odorless blotting paper, *no foreign odor* should become perceptible when the last traces of the Alcohol leave the paper.

Amyl alcohol, or non-volatile, carbonizable, organic impurities, etc. If 25 Cc. be allowed to evaporate spontaneously in a porcelain evaporating dish, carefully protected from dust, until the surface of the dish is barely moist, no red or brown color should be produced upon the addition of a few drops of colorless, concentrated sulphuric acid.

Aldehyde or oak tannin. If 10 Cc. of Alcohol be mixed in a test-tube with 5 Cc. of potassium hydroxide T.S., the liquid should not at once assume a yellow color.

Limit of organic impurities, amyl alcohol, aldehyde, etc. If 20 Cc. of Alcohol be shaken in a clean, glass-stoppered vial with 1 Cc. of silver nitrate T.S., the mixture should not become more than faintly opalescent, or acquire more than a faint brownish tint when exposed for six hours to diffused daylight.

Methyl Alcohol Test.—Into a test-tube of the capacity of about 40 cubic centimeters, 1 Cc. of the Alcohol or spirit to be tested should be poured, and, if it be undiluted, enough distilled water added to make the liquid measure 10 Cc. If the alcohol be already diluted, a correspondingly larger volume of it should be taken and diluted to 10 Cc., so that the proportion of alcohol in the liquid shall not be more than about 10 percent., by volume. A copper wire spiral (made by winding 1 meter of No. 18 clean copper wire closely around a glass rod 7 millimeters thick, making a coil about 3 centimeters long, the end of the wire being formed into a handle) should be heated to redness in a flame free from soot, and plunged steadily quite to the bottom of the liquid in the test-tube and held there for a second or two, then withdrawn and dipped into water to cool. This treatment with red-hot copper should be repeated five or six times, immersing the test-tube in cold water to keep down the temperature of the liquid. The contents of the test-tube should now be filtered into a wide test-tube and boiled very gently. If the odor of acetaldehyde be perceptible, the boiling is to be continued until the odor ceases to be distinguished clearly. The liquid is now cooled, and to it should be added 1 drop of a solution containing 1 part of resorcinol in 200 parts of water. A portion of this liquid is then poured cautiously into a second tube containing pure sulphuric acid, in such a way that the two liquids shall not mix, the tube being held in an inclined position; this tube is allowed to stand for three minutes, and then slowly rotated. No rose-red ring should show at the line of contact of the two layers (absence of more than 2 percent. of *methyl alcohol*).

Uses.—Alcohol is used in pharmacy principally for its solvent powers (see pages 191, 336). It is used as the source of many important compounds, like ether, chloroform, iodoform, etc., and as an antiseptic. The cologne spirit is generally a purified product, and cleaner than ordinary alcohol. A specially fine brand of alcohol can now be had which is rectified particularly for perfumers' use. It is said to be made by diluting the cologne spirit with sufficient water to bring it to about the strength of diluted alcohol, passing this through bone black, and then redistilling and concentrating it again to the proper strength in the rectifying column and still.

ALCOHOL DILUTUM. U.S. Diluted Alcohol

A liquid composed of about 41.5 percent. by weight, or about 48.9 percent., by volume, of absolute Ethyl Alcohol [$C_2H_5.OH = 45.7$], and about 58.5 percent. by weight, of water. It should be kept in well-closed vessels, in a cool place, remote from lights or fire.

	Metric	Old form
* **Alcohol**	500 Cc.	1 pint
Distilled Water	500 Cc.	1 pint

Mix them.

If the two liquids be measured at the temperature of 25° C. (77° F.), the mixture, when cooled to the same temperature, will measure about 970 Cc.

Diluted alcohol may also be prepared in the following manner:

	Metric	Old form
* **Alcohol**	408 Gm.	40 oz. av. 350 gr.
Distilled Water	500 Gm.	50 oz. av.

Mix them.

When alcohol and water are mixed together, a rise in temperature and a contraction in volume take place. In small operations the contraction is generally disregarded; in larger operations the loss is very apparent. If 55 gallons of alcohol be mixed with 45 gallons of water, the product will not be 100 gallons of diluted alcohol, but only $96\frac{1}{4}$ gallons, showing a loss of $3\frac{3}{4}$ gallons. United States *Proof Spirit* differs from diluted alcohol and is stronger; it contains 50 percent. (or, more exactly, 49.5) *by weight of absolute alcohol.*[1]

Official Specific Gravity.—About 0.936 at 15.6° C. (60° F.), the standard temperature for Alcohol, and about 0.930 at 25° C. (77° F.).

Tests for Identity.—It should respond to the reactions and tests given under *Alcohol.*[2]

Uses.—Diluted alcohol is used as a menstruum in making tinctures, fluidextracts, extracts, etc. Its properties have been already fully described in connection with the various preparations. Its value consists not only in antiseptic properties, but also in its possessing the solvent powers of both water and alcohol.

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[1] If spirits have a specific gravity lighter than 0.920 (that of proof spirit) they are said to be *above proof;* if heavier, *below proof;* and the percentage of water or of alcohol, of the specific gravity of 0.825, necessary to be added to any sample of spirit to bring it to the standard of proof spirit, indicates the number of degrees the given sample is above or below proof.

Thus, if 100 volumes of a spirit requires 10 volumes of water to reduce it to proof spirit, it is said to be "10 over proof." If, on the other hand, 100 volumes of a spirit require 10 volumes of alcohol of 0.825 specific gravity to raise it to proof, it is said to be "10 under proof."

[2] **Official Rules for making an Alcohol of any required lower Percentage from an Alcohol of any given higher Percentage:** I. BY VOLUME.—Designate the volume percentage of the stronger alcohol by V, and that of the weaker alcohol by v.

Rule.—Mix v volumes of the stronger alcohol with distilled water to make V volumes of product. Allow the mixture to stand until full contraction has taken place, and until it has cooled, then make up the deficiency in the V volumes by adding more distilled water.

Example.—An alcohol of 30 percent. by volume is to be made from an alcohol of 94.9 percent. by volume.—Take 30 volumes of the 94.9 percent. alcohol, and add enough distilled water to produce 94.9 volumes.

II. BY WEIGHT.—Designate the weight-percentage of the stronger alcohol by W, and that of the weaker alcohol by w.

Rule.—Mix w parts by weight of the stronger alcohol with distilled water to make W parts by weight of product.

Example.—An alcohol of 50 percent. by weight is to be made from an alcohol of 92.3 percent. by weight.—Take 50 parts by weight of the 92.3 percent. alcohol, and add enough distilled water to produce 92.3 parts by weight.

It is evident that when percentage by volume is specified the liquids should be *measured,* and when percentage by weight is used the liquids in all cases should be *weighed.* The alcohol table gives the various percentages *both* by *weight* and by *volume,* and an examination will show clearly that there is considerable difference between weight and volume percentage. When alcohol is sold by percent. valuation, unscrupulous dealers sometimes take advantage of the unwary when the buyer does not specify whether he wants "percent. by volume" or percent. by weight. It is much more satisfactory in buying alcohol to indicate clearly the strength that is wanted by inserting the specific gravity at the official temperature. Thus, an order for "Alcohol, sp. gr. 0.816 at 60° F.," cannot be susceptible of two meanings.

Pile's Rules for diluting Alcohol.—1. To reduce alcohol to any required strength. To as many parts of the given alcohol as are indicated by the percentage required, add sufficient water to make the number of parts of the mixture equal to the percentage of the given alcohol. Example: It is desired to make an alcohol of 30 percent. from one of 95 percent. Take 30 fluidounces of the alcohol and add a sufficient amount of water to make 95 fluidounces.

2. To make any required quantity of any percentage. As the percentage of the alcohol given is to that of the alcohol required, so is the quantity desired to the quantity of the alcohol to be taken. And to this quantity of alcohol sufficient water must be added to make up the required quantity. Example: It is desired to make 80 fluidounces of 75 percent. alcohol from that of 95 percent. As 95 : 75 : : 80 : $63\frac{3}{19}$. This represents the number of fluidounces of 95 percent. alcohol that is to be made up to 80 fluidounces by the addition of water.

By these rules no allowance is made for any subsequent contraction, and a mixture after being made should be allowed to stand for a short time for such contraction to take place, when a final amount of water is to be added to make up the full measure.

Alcoholmetrical Table

Based on the Relation between Absolute Alcohol (Sp. Gr. 0.7938) and Pure Water at 15.6° C. (60° F.).—Abridged from Dr. E. R. Squibb's Table

Percentage		Specific Gravity	Weight of One pint		Weight of One Gallon, Avordupois			Percentage		Specific Gravity	Weight of One Pint		Weight of One Gallon, Avordupois		
By wt.	By vol.		In Gms.	In Grs.	Lbs.	Oz.	Grs.	By wt.	By vol.		In Gms.	In Grs.	Lbs.	Oz.	Grs.
		1.0000	472.39	7290	8	5	132		31	0.9643	455.53	7030	8	0	238
	1	0.9985	471.68	7279	8	5	44	26		0.9638	455.30	7026	8	0	209
1		0.9981	471.49	7276	8	5	22		32	0.9631	454.96	7021	8	0	168
	2	0.9970	470.98	7268	8	4	395	27		0.9623	454.58	7015	8	0	121
2		0.9965	470.74	7264	8	4	366		33	0.9618	454.35	7011	8	0	92
	3	0.9956	470.31	7258	8	4	313	28	34	0.9609	453.93	7005	8	0	40
3		0.9947	469.89	7251	8	4	261			0.9602	453.59	7000	7	15	436
	4	0.9942	469.66	7248	8	4	232			0.9595	453.26	6995	7	15	395
4	5	0.9930	469.09	7239	8	4	162	29	35	0.9593	453.17	6993	7	15	383
5	6	0.9914	468.33	7227	8	4	68			0.9587	452.88	6989	7	15	348
6	7	0.9898	467.58	7216	8	3	413	30	36	0.9578	452.46	6982	7	15	296
	8	0.9890	467.19	7210	8	3	366			0.9572	452.18	6978	7	15	261
7		0.9884	466.91	7205	8	3	331		37	0.9565	451.84	6973	7	15	220
	9	0.9878	466.63	7201	8	3	296	31		0.9560	451.61	6969	7	15	191
8	10	0.9869	466.21	7194	8	3	243			0.9555	451.38	6966	7	15	162
9	11	0.9855	465.54	7184	8	3	161		38	0.9550	451.14	6962	7	15	133
10	12	0.9841	464.89	7174	8	3	81	32		0.9544	450.86	6958	7	15	98
11	13	0.9828	464.27	7165	8	3	5			0.9539	450.61	6954	7	15	68
	14	0.9821	463.94	7159	8	2	401		39	0.9535	450.43	6951	7	15	45
12	15	0.9815	463.65	7155	8	2	366	33		0.9528	450.09	6946	7	15	4
13	16	0.9802	463.04	7146	8	2	290		40	0.9519	449.67	6939	7	14	390
		0.9794	462.67	7140	8	2	244	34		0.9511	449.29	6933	7	14	343
14	17	0.9789	462.42	7136	8	2	214		41	0.9503	448.91	6928	7	14	296
		0.9784	462.19	7132	8	2	185			0.9495	448.54	6922	7	14	250
15	18	0.9778	461.90	7128	8	2	150	35	42	0.9490	448.30	6918	7	14	221
		0.9775	461.77	7126	8	2	123			0.9475	447.59	6907	7	14	133
		0.9772	461.62	7124	8	2	115	36	43	0.9470	447.36	6904	7	14	104
16	19	0.9766	461.34	7119	8	2	80			0.9465	447.12	6900	7	14	75
	20	0.9760	461.05	7115	8	2	45	37	44	0.9452	446.51	6890	7	13	437
17	21	0.9753	460.72	7110	8	2	4			0.9446	446.22	6886	7	13	401
		0.9749	460.54	7107	8	1	418	38	45	0.9434	445.66	6877	7	13	331
		0.9743	460.25	7103	8	1	383			0.9426	445.28	6871	7	13	284
18	22	0.9741	460.16	7101	8	1	373	39	46	0.9416	444.81	6864	7	13	226
		0.9737	459.97	7098	8	1	348			0.9405	444.29	6856	7	13	162
		0.9732	459.73	7095	8	1	319	40	47	0.9396	443.86	6850	7	13	109
19	23	0.9728	459.55	7092	8	1	297			0.9391	443.62	6846	7	13	75
		0.9720	459.16	7086	8	1	249		48	0.9381	443.15	6839	7	13	22
20	24	0.9716	458.98	7083	8	1	227	41		0.9376	442.92	6835	7	12	431
		0.9714	458.88	7081	8	1	214			0.9373	442.77	6833	7	12	413
	25	0.9709	458.65	7078	8	1	186	**41.48**	**48.95**	**0.9364**	**442.34**	**6827**	**7**	**12**	**360**[1]
21		0.9704	458.41	7074	8	1	157	42		0.9356	441.97	6820	7	12	314
	26	0.9698	458.13	7070	8	1	122			0.9352	441.78	6818	7	12	291
		0.9693	457.90	7066	8	1	92		50	0.9343	441.35	6811	7	12	238
22	27	0.9691	457.80	7065	8	1	81	43		0.9335	440.98	6805	7	12	192
		0.9683	457.42	7059	8	1	33			0.9329	440.70	6801	7	12	157
23	28	0.9678	457.18	7055	8	1	5		51	0.9323	440.42	6796	7	12	122
		0.9671	456.85	7050	8	0	401			0.9318	440.18	6793	7	12	93
24	29	0.9665	456.57	7046	8	0	366	44		0.9314	439.99	6790	7	12	69
		0.9658	456.24	7041	8	0	325			0.9306	439.61	6784	7	12	23
25	30	0.9652	455.95	7036	8	0	290		52	0.9303	439.47	6782	7	12	5
		0.9645	455.63	7031	8	0	250	45		0.9292	438.95	6774	7	11	379

[1] Official diluted alcohol

Alcoholmetrical Table—*Continued*

Percentage		Specific Gravity	Weight of One Pint		Weight of One Gallon, Avoirdupois			Percentage		Specific Gravity	Weight of One Pint		Weight of One Gallon, Avoirdupois		
By wt.	By vol.		In Gms.	In Grs.	Lbs.	Oz.	Grs.	By wt.	By vol.		In Gms.	In Grs.	Lbs.	Oz.	Grs.
	53	0.9283	438.52	6767	7	11	326		79	0.8664	409.28	6316	7	3	216
46		0.9270	437.91	6758	7	11	251	73		0.8649	408.57	6305	7	3	129
	54	0.9262	437.53	6752	7	11	204		80	0.8639	408.10	6298	7	3	71
47		0.9249	436.92	6742	7	11	128	74		0.8625	407.44	6288	7	2	426
	55	0.9242	436.58	6737	7	11	87		81	0.8611	406.78	6277	7	2	344
		0.9236	436.30	6733	7	11	51	75		0.8603	406.40	6272	7	2	298
48		0.9228	435.93	6727	7	11	6			0.8599	406.21	6269	7	2	274
	56	0.9221	435.60	6722	7	10	402	76	82	0.8581	405.36	6255	7	2	169
		0.9212	435.17	6715	7	10	349			0.8566	404.65	6245	7	2	82
49		0.9206	434.88	6711	7	10	314	77	83	0.8557	404.22	6230	7	2	29
	57	0.9200	434.60	6707	7	10	279			0.8539	403.38	6225	7	1	361
50		0.9184	433.85	6695	7	10	186	78		0.8533	403.09	6220	7	1	327
	58	0.9178	433.56	6691	7	10	151		84	0.8526	402.77	6215	7	1	287
51	59	0.9160	432.71	6678	7	10	46			0.8516	402.29	6208	7	1	227
		0.9150	432.24	6670	7	9	425	79		0.8508	401.92	6202	7	1	182
52	60	0.9135	431.53	6659	7	9	338		85	0.8496	401.35	6194	7	1	112
		0.9124	431.01	6651	7	9	273	80		0.8483	400.73	6184	7	1	36
53	61	0.9113	430.49	6643	7	9	210		86	0.8466	399.93	6172	7	0	374
		0.9100	429.88	6634	7	9	133	81		0.8459	399.60	6167	7	0	333
54	62	0.9090	429.41	6627	7	9	76	82	87	0.8434	398.42	6148	7	0	187
		0.9075	428.69	6616	7	8	425			0.8415	397.52	6134	7	0	76
55	63	0.9069	428.41	6611	7	8	390	83	88	0.8408	397.19	6129	7	0	35
		0.9062	428.09	6606	7	8	350			0.8396	396.62	6121	6	15	402
56	64	0.9047	427.37	6595	7	8	262	84		0.8382	395.96	6110	6	15	322
		0.9036	426.86	6587	7	8	198		89	0.8373	395.53	6104	6	15	269
57	65	0.9025	426.34	6579	7	8	134	85		0.8357	394.78	6092	6	15	176
58	66	0.9001	425.20	6562	7	7	432		90	0.8340	393.98	6080	6	15	77
59		0.8979	424.17	6546	7	7	304			0.8336	393.79	6077	6	15	53
	67	0.8973	423.88	6541	7	7	269	86		0.8331	393.55	6073	6	15	24
		0.8966	423.55	6536	7	7	227			0.8317	392.89	6063	6	14	380
60		0.8956	423.07	6529	7	7	169	87	91	0.8305	392.33	6054	6	14	310
	68	0.8949	422.75	6524	7	7	129			0.8298	391.99	6049	6	14	269
61		0.8932	421.94	6511	7	7	29	88		0.8279	391.09	6035	6	14	158
	69	0.8925	421.62	6506	7	6	426		92	0.8272	390.76	6030	6	14	117
		0.8910	420.90	6495	7	6	338			0.8259	390.14	6021	6	14	41
62		0.8908	420.81	6494	7	6	326	89		0.8254	389.91	6017	6	14	12
	70	0.8900	420.43	6488	7	6	280		93	0.8237	389.11	6005	6	13	351
		0.8897	420.29	6486	7	6	262	90		0.8228	388.69	5998	6	13	299
63		0.8886	419.77	6478	7	6	198	91	94	0.8199	387.32	5977	6	13	130
	71	0.8875	419.25	6470	7	6	134	92		0.8172	386.04	5957	6	12	409
64		0.8863	418.68	6461	7	6	64	**92.3**	**94.92**	**0.8160**	**385.47**	**5949**	**6**	**12**	**339**[1]
	72	0.8850	418.07	6452	7	5	426	93		0.8145	384.77	5938	6	12	252
65		0.8840	417.60	6444	7	5	368		96	0.8125	383.82	5923	6	12	135
	73	0.8825	416.88	6433	7	5	279	94		0.8118	383.49	5918	6	12	94
66		0.8816	416.46	6427	7	5	228	95		0.8089	382.12	5897	6	11	363
	74	0.8799	415.66	6414	7	5	129		97	0.8084	381.88	5893	6	11	334
67		0.8793	415.38	6410	7	5	94	96		0.8061	380.79	5876	6	11	200
68	75	0.8769	414.25	6393	7	4	391		98	0.8041	379.85	5862	6	11	83
69	76	0.8745	413.11	6375	7	4	251	97		0.8031	379.38	5855	6	11	25
		0.8739	412.83	6371	7	4	216	98		0.8001	377.96	5833	6	10	287
70	77	0.8721	411.98	6358	7	4	111		99	0.7995	377.68	5828	6	10	252
71	78	0.8696	410.79	6339	7	3	403	99		0.7969	376.45	5809	6	10	100
		0.8678	409.94	6326	7	3	297			0.7946	375.37	5793	6	9	404
72		0.8672	409.66	6322	7	3	263	100	100	0.7938	374.98	5787	6	9	357

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[1] Official alcohol

ÆTHER. U.S. Ether

[STRONGER ETHER]

A liquid composed of about 96 percent., by weight, of absolute Ether or Ethyl Oxide [$(C_2H_5)_2O = 73.52$], and about 4 percent. of alcohol containing a little water. Ether should be kept in partially filled, well-stoppered containers, preferably tin cans, in a cool place, remote from lights or fire.

But one ether is now official, in place of the two in the U. S. P. 1880, known as Æther and Æther Fortior; the old Æther, sp. gr. 0.750, was dropped altogether, the name Æther being now applied to what was formerly known as Æther Fortior, or "stronger ether."

Preparation.—The Pharmacopœia of 1870 contained a process for the preparation of Ether. It was rarely or never used, because this is one of the liquids which cannot be safely or profitably made upon the small scale with the usual facilities afforded by the pharmacist's laboratory. Ether is made by acting on alcohol with sulphuric acid between the temperatures of 130° and 137.7° C. (266° and 280° F.). The sulphuric acid is not consumed in the process, but is regenerated, so that the making of ether is continuous. This will be understood when the reactions are explained. Ether is the oxide of the monad radical ethyl, C_2H_5. Alcohol, as has been already stated, is the hydroxide, C_2H_5OH; now,

$$\underset{\text{Alcohol}}{C_2H_5OH} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\substack{\text{Ethylsulphuric}\\\text{Acid}}}{C_2H_5HSO_4} + \underset{\text{Water}}{H_2O}$$

then

$$\underset{\substack{\text{Ethylsulphuric}\\\text{Acid}}}{C_2H_5HSO_4} + \underset{\text{Alcohol}}{C_2H_5OH} = \underset{\text{Ether}}{(C_2H_5)_2O} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4}$$

Formerly it was believed that the sulphuric acid acted by catalysis, and that it dehydrated the alcohol through its affinity for water; but, the presence of ethylsulphuric acid, which was formed during the process, having been proved, this simple theory had to be abandoned.

Official Description.—A transparent, colorless, mobile liquid.

Odor, Taste, and Reaction.—Characteristic odor; burning and sweetish taste.

The color of light blue litmus paper moistened with water should not be changed to red when the paper is immersed in Ether for ten minutes.

Specific Gravity.—0.716 to 0.717 at 25° C. (77° F.).

Solubility.—*Water.* In about 10 times its volume at 25° C. (77° F.), with slight contraction of volume.

Alcohol. Miscible in all proportions.

Other solvents. Miscible in all proportions with chloroform, petroleum benzin, benzene, fixed and volatile oils.

Tests for Identity.—Ether boils at about 35.5° C. (96° F.), and it should, therefore, boil when a test-tube, containing some broken glass and half filled with it, is held for some time closely grasped in the hand.

Ether is highly volatile and inflammable. Its vapor, when mixed with air and ignited, explodes violently.

Impurities and Tests for Impurities.—*Residue.* Upon evaporation, Ether should leave *no residue.*

Foreign odor. If 10 Cc. of it be poured, in portions, upon clean, odorless blotting paper, and allowed to evaporate spontaneously, *no foreign odor* should become perceptible when the last traces of Ether leave the paper.

Undue amount of alcohol or water. When 20 Cc. of Ether are shaken, in a graduated tube, with 20 Cc. of water, just previously saturated with Ether, the ether-layer, upon separation, should measure not less than 19.2 Cc.

Aldehyde. If 10 Cc. of Ether be shaken occasionally, during one hour, with 1 Cc. of potassium hydroxide T.S., no color should be developed in either liquid.

Uses.—Ether is used principally as an anæsthetic, and, notwithstanding the many efforts made to supplant it, continues to be the best agent yet discovered for producing insensibility to pain in surgical operations. It is also used as a solvent. It dissolves iodine and bromine freely, and sulphur and phosphorus sparingly. Its power to dissolve corrosive sublimate makes it a useful agent in the manipulations for detecting that poison. It is also a solvent of volatile and fixed oils, many resins and balsams, tannic acid, caoutchouc, and most of the alkaloids.

Ether should be kept in well-stoppered bottles, or in soldered tins, in a cool place remote from lights and fire. Especial care should be observed in pouring ether from one vessel to another by gas light. The vapor is heavy,—two and a half times as heavy as air,—and it will at once take fire with explosive force on contact with flame.

SPIRITUS ÆTHERIS. U.S. Spirit of Ether

	Metric	Old form
* **Ether**	325 Cc.	4 fl. oz.
Alcohol	675 Cc.	8 fl. oz. 120 min.
To make	1000 Cc.	12¼ fl. oz.

Mix them.

Uses.—This simple mixture of ether and alcohol is used as a diffusible stimulant in doses of one to three fluidrachms (4 to 12 Cc.).

SPIRITUS ÆTHERIS COMPOSITUS. U.S. Compound Spirit of Ether

	Metric	Old form
* **Ether**	325 Cc.	8 fl. oz.
Alcohol	650 Cc.	16 fl. oz.
Ethereal Oil	25 Cc.	295 min.
To make about	1000 Cc.	24½ fl. oz.

Mix them.

Commercial *Hoffmann's anodyne* is usually bought by the pharmacist and substituted for this preparation. It differs from the official liquid in containing variable proportions of light and heavy oil of wine, ether, and alcohol. It is obtained as a supplementary product by the manufacturing chemist.

During the rectification of crude ether, the distillation is continued as long as ether of the proper specific gravity comes over; after which the receiver is changed, and an additional distillate is obtained, consisting of ether and alcohol impregnated with a little ethereal oil. It is this second distillate, variously modified by the addition of alcohol, ether, or water, so as to make it conform in taste, smell, opalescence, etc., to a standard preparation kept by the manufacturer, that is sold as Hoffmann's anodyne.

The expensiveness of the ethereal oil is alleged to be the cause of this substitution. The cheap commercial liquid may be known by adding it to water; it usually mixes without causing milkiness. The official compound spirit of ether produces a slight opalescence when forty drops are added to a pint of water, and the peculiar odor of ethereal oil is distinctly noticed; but castor oil is sometimes added by dishonest manufacturers to circumvent this test. This fraud may be detected by mixing equal parts of the suspected liquid and water, and collecting the oil which separates on a piece of filtering paper and exposing it to heat. A permanent greasy stain indicates a fixed oil, while an ethereal oil stain disappears on heating.

Uses.—Compound spirit of ether is used as an anodyne, in doses of thirty minims to two fluidrachms (2 to 8 Cc.). It is sometimes given in combination with laudanum.

Preparations of the Esters of the Ethyl and Amyl Series

OLEUM ÆTHEREUM. U.S. Ethereal Oil

A volatile liquid consisting of equal volumes of heavy oil of wine and ether.

	Metric	Old form
* **Alcohol**	1000 Cc.	2 pints
Sulphuric Acid	1000 Cc.	2 pints
Distilled Water	25 Cc.	384 minims
Ether, a sufficient quantity		

Add the Sulphuric Acid slowly to the Alcohol, mix them thoroughly, and allow the mixture to stand, in a closed flask, for twenty-four hours, or until the liquid is clear; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure, so that the bulb shall be deeply immersed in the liquid, and, having connected the retort with a well cooled condenser, and also having connected with the receiver a bent glass tube for conducting the uncondensed gases into water, distil, by means of a sand-bath, at a temperature between 150° and 160° C. (302° and 320° F.), until oily drops cease to come over, or until a black froth, which forms on the surface, begins to rise in the retort. Separate the yellow, ethereal liquid from the distillate, and expose it to the air for twenty-four hours, in a shallow dish. Then transfer it to a wet filter, and, when the aqueous portion has drained off, wash the oil which is left on the filter with the Distilled Water, which should be as cold as possible. When this also has drained off, transfer the oil to a graduated measure, and add to it an equal volume of Ether. Keep the product in small, glass-stoppered vials, in a cool place.

Esters, as already explained, are produced by the action of acids on alcohols (page 760). Ethereal oil is a mixture of esters.

If alcohol is distilled with a large excess of sulphuric acid, there are formed toward the close of the distillation heavy oil of wine, sulphurous acid, olefiant gas, and empyreumatic products. The product of the distillation is generally in two layers, one consisting of water holding sulphurous acid in solution, and the other, of ether containing the heavy oil of wine. After separation, the latter liquid is exposed for twenty-four hours to the air, in order to dissipate the ether by evaporation, and the oil which is left is washed with water to deprive it of all traces of sulphurous acid.

In the early stage of the distillation of a mixture of sulphuric acid and alcohol, ethylsulphuric acid, $C_2H_5HSO_4$, is formed. During its progress this is decomposed so as to yield ether. When, however, the alcohol is distilled with a large excess of sulphuric acid, the ethylsulphuric acid is decomposed so as to form a small quantity of the *heavy oil of wine.* This is a mixture of ethyl sulphate, $(C_2H_5)_2SO_4$, ethyl sulphite, $(C_2H_5)_2SO_3$ (the sulphurous acid having been formed by reduction of sulphuric acid), with polymeric forms of ethylene, C_2H_4. Ethereal oil is a "transparent, nearly colorless, volatile liquid, of a peculiar, aromatic, ethereal odor, a pungent, refreshing, bitter taste, and a neutral reaction to dry litmus paper. Specific gravity 0.905 at 25° C. (77° F.)."

Uses.—Ethereal oil is used solely as an ingredient in compound spirit of ether.

SPIRITUS ÆTHERIS NITROSI. U.S. Spirit of Nitrous Ether

[SWEET SPIRIT OF NITRE]

An alcoholic solution of Ethyl Nitrite [$NO.OC_2H_5 = 74.51$], yielding, when freshly prepared, and tested, by the process given below, not less than 4 percent. of the ethyl nitrite.

	Metric	Old form
* **Sodium Nitrite**	100.0 Gm.	3 oz. av. 231 gr.
Sulphuric Acid	40.0 Cc.	1 fl. oz. 169 min.
Monohydrated Sodium Carbonate	0.6 Gm.	9 grains
Potassium Carbonate, completely deprived of water by drying	3.0 Gm.	46 grains
Alcohol,		
Water, each, a sufficient quantity		

Mix the Sulphuric Acid with 120 Cc. [old form $4\frac{1}{4}$ fl. oz.] of Water, cool the liquid, add 85 Cc. [old form 2 fl. oz. 7 fl. dr.] of Alcohol previously diluted with an equal volume of Water, and introduce the solution into a 1000 Cc. flask, surrounded by a mixture of ice and water. Dissolve the Sodium Nitrite in 280 Cc. [old form $9\frac{1}{2}$ fl. oz.] of Water, filter, and, having poured the filtrate into a separatory funnel, allow the liquid to slowly drop into the flask containing the acid mixture. When all has been added and the reaction is complete, allow any crystals which may have formed to settle at the bottom of the flask, and decant the cold mixture of ethyl nitrite and aqueous solution quickly to the previously cleaned separatory funnel, and draw off and discard the aqueous liquid. Wash the separated ethyl nitrite, first, with 20 Cc. [old form $5\frac{1}{2}$ fl. dr.] of ice-cold Water, and then remove any traces of acid by washing it with 15 Cc. [old form 4 fl. dr.] of ice-cold Water, in which the Monohydrated Sodium Carbonate has previously been dissolved. Carefully separate the ethyl nitrite from the aqueous liquid, and agitate it in a well-stoppered vial, with the Potassium Carbonate to remove traces of water. Then cool the liquid, decant, and pour the ethyl nitrite immediately into a tared bottle containing 500 Gm. [old form 17 oz. av. 279 gr.] of Alcohol. Ascertain the weight of the ethyl nitrite poured into the Alcohol by noting the increase in weight of the tared bottle and contents, and then add enough Alcohol to make the mixture weigh *22 times* the weight of the ethyl nitrite added. Lastly, transfer the product to small, well-stoppered, dark amber-colored vials, and keep these in a cool place, remote from lights or fire.

The object of the process is to form ethyl nitrite, an ester produced by substituting the acid radical for the hydrogen of the hydroxyl in the alcohol. This is then preserved from decomposition by the addition of sufficient alcohol.

The U. S. P. (8th Rev.) process differs from that formerly official in the method of obtaining the nitrous radical. The use of nitric acid was abandoned in the 1890 process, and sodium nitrite introduced, so as to avoid the production of aldehyde, and to furnish a more easily controlled process than the one previously employed. In the Eighth Decennial Revision of the U. S. P. the distillation process was supplanted by the simple "cold" method of separating the two immiscible liquids, after the reaction (which has been carried out in a cooled flask) is complete. The ethyl nitrite is washed, freed from water, and then diluted with the required amount of alcohol. The sulphuric acid decomposes the sodium nitrite, the nitrous radical combining with the ethyl of the alcohol to form ethyl nitrite. The dilution of the sulphuric acid and the use of a solution of sodium nitrite prevent too rapid action. Experience with the new process has demonstrated its advantages.

$$\underset{\text{Alcohol}}{2C_2H_5OH} + \underset{\substack{\text{Sodium}\\\text{Nitrite}}}{2NaNO_2} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{H_2SO_4} = \underset{\text{Ethyl Nitrite}}{2C_2H_5NO_2} + \underset{\substack{\text{Sodium}\\\text{Sulphate}}}{Na_2SO_4} + \underset{\text{Water}}{2H_2O}$$

Pure ethyl nitrite is pale yellow, has the smell of apples, boils at 18° C. (64.4° F.), and has the specific gravity 0.900 at 15.6° C. (60° F.). The density of its vapor is 2.627. Litmus is not affected by it. It is soluble in forty-eight parts of water, and in all proportions in alcohol or rectified spirit. It is highly inflammable, and burns with a white flame without residue. Mixed with an alcoholic solution of potassium hydroxide it becomes dark brown, showing the presence of aldehyde. When kept, it becomes acid in a short time, as shown by litmus, and nitric oxide is given off, which often causes the bursting of the bottle. Its tendency to become acid is rendered greater by the action of the air, and depends on the absorption of oxygen by the aldehyde which is converted into acetic acid. These facts show the necessity of preserving this ether in small, strong bottles, kept full and in a *cool place*, and, in warm weather, of cooling a bottle thoroughly before opening it.

The U. S. P. (8th Rev.) describes spirit of nitrous ether as follows:

Official Description.—A clear, mobile, volatile, and inflammable liquid of a pale yellowish or faintly greenish-yellow tint.

Odor, Taste, and Reaction.—Fragrant, ethereal, and pungent odor free from acridity; sharp, burning taste. When freshly prepared, or even after being kept for some time with but little exposure to light and air, it is neutral to litmus paper. When long kept, or after having been freely exposed to air and light, it acquires an acid reaction, but it should not effervesce when a crystal of potassium bicarbonate is dropped into it.

Specific Gravity.—About 0.823 at 25° C. (77° F.).

Test for Identity.—If a test-tube be half filled with the Spirit, and put into a water-bath heated to 65° C. (149° F.) until it has acquired this temperature, the Spirit should boil distinctly upon the addition of a few small pieces of broken glass.

Impurity and Test.—*Limit of aldehyde.* If 10 Cc. of the Spirit be mixed with 5 Cc. of potassium hydroxide T.S., previously diluted with 5 Cc. of water, the mixture will assume a yellow color which should not turn decidedly brown within twelve hours.

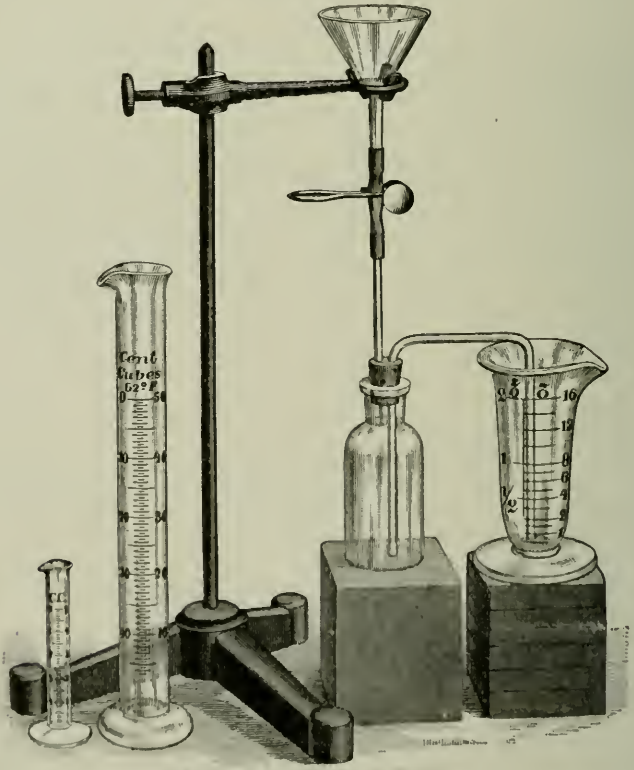
Assay for Ethyl Nitrite.—Transfer about 30 Gm. of the Spirit of Nitrous Ether, which has been previously shaken with 0.5 Gm. of potassium bicarbonate, to a tared 100 Cc. measuring flask, and weigh it accurately. Add sufficient alcohol to bring the volume to exactly 100 Cc., and mix thoroughly. Introduce into a nitrometer (see Gasometric Estimations) exactly 10 Cc. of the alcoholic solution, followed by 10 Cc. of potassium iodide T.S., and afterwards by 10 Cc. of normal sulphuric acid V.S. When the volume of gas has become constant (within 30 to 60 minutes), note the volume of gas collected. Multiply this volume in Cc. by 0.307, and divide the product by one-tenth the weight of the Spirit of Nitrous Ether taken. At standard temperature and pressure, the quotient will represent the percentage of ethyl nitrite in the liquid. The temperature correction is one-third of one percent. of the total percentage just found for each degree, additive if temperature is below, subtractive if above, 25° C. (77° F.). The barometric correction is four-thirtieths of one percent. for each millimeter, additive if above, subtractive if below, 760.

When assayed according to the above method, Spirit of Nitrous Ether should yield not less than 4 percent. of ethyl nitrite.

Spirit of nitrous ether is never quite free from aldehyde, and, if made by distillation and the heat too long continued, it is apt to contain a good deal of this liquid, which afterwards becomes acetic acid by absorbing oxygen. The change goes on rapidly if the preparation be insecurely kept. Aldehyde, if in considerable proportion, may be detected by imparting a pungent odor and acrid flavor, and by the preparation assuming a brown tint on the addition of a weak solution of potassium hydroxide, owing to the formation of aldehyde resin. The official potassium hydroxide test, with the best specimens, produces a straw-yellow tint within twelve hours.

Specific gravity cannot be relied upon as a test of the quantity of ethyl nitrite present, because both it and water are heavier specifically than the diluting liquid, alcohol. The specific gravity of alcohol being 0.809 at 25° C. (77° F.), and that of spirit of nitrous ether 0.823 at 25° C. (77° F.), it follows that the heavier specific gravity of the latter should be caused by the addition of ethyl nitrite, sp. gr. 0.900 at

FIG. 447



Nitrometer for druggists' use (Squibb)

15.6° C. (60° F.), but the specific gravity may be increased and the product cheapened by substituting water (sp. gr. 1.000), or by using alcohol of the specific gravity 0.823, and this is a common practice with adulterators.

The nitrometer test is regarded as the only reliable one to determine the quantity of ethyl nitrite in this spirit, and the very practical apparatus shown in Fig. 447 has been devised by Dr. Squibb for the use of pharmacists who do not possess a nitrometer. This consists of a small glass funnel, a section of rubber tubing, spring pinchcock, straight glass tube, one tube bent twice at right angles, not over $\frac{1}{12}$ inch bore, a cork with two holes for the tubes, a three ounce vial, and some wooden blocks. In using this for testing, the bottle is filled with mercury nearly to the lip. The cork holding the tubes is then pushed into the bottle, which causes the mercury to flow into the tube; the cork is now coated with melted paraffin to prevent leakage, and the funnel connected with the upright tube and the pinchcock closed, then about 20 minims of mercury are poured into the funnel and cautiously allowed to flow into the vial by slowly opening the pinchcock until the bent tube is entirely filled with mercury. There must, of course, be no leakage in the apparatus. One fl. dr. (about 48.7 grains) of spirit of nitrous ether is measured into the funnel and allowed to flow into the vial, followed by 162 minims of potassium iodide T.S. (see official test, above), and then 162 minims of normal sulphuric acid V.S. and the pinchcock tightly closed. As these liquids are added to the mercury in the bottle they displace an amount of mercury equal to their own volume (384 minims), and this must be deducted from the total amount of mercury in the receiving vessel after the reaction is over, to obtain the volume which has been displaced by the generated gas. The reaction soon begins, but it should be allowed to continue for at least ten minutes before reading the result. When the reaction is over, the receiving measure may be taken away and the quantity of mercury read off; the mercury remaining in the tube runs back into the bottle as it should. If the measure of mercury, in minims, displaced by the gas, be multiplied by 0.307 and the product divided by the 48.7 grains of spirit of nitrous ether originally taken, the result will be the percentage of ethyl nitrite in the sample tested.

(It should be understood that this method yields only approximately correct results; whenever possible the official assay should be followed.)

Uses.—Spirit of nitrous ether is a valuable diaphoretic and diuretic. The dose is thirty minims to one fluidrachm (2 to 4 Cc.).

ÆTHER ACETICUS. U.S. Acetic Ether

A liquid compound of about 90 percent., by weight, of Ethyl Acetate [$CH_3CO.OC_2H_5 = 87.40$], and about 10 percent. of alcohol containing a little water. It should be kept in well-stoppered bottles, in a cool and dark place, remote from lights or fire.

Hager's process may be used for making this ester: 440 Gm. of official sulphuric acid are added slowly to 250 Gm. of official alcohol, contained in a flask, and the mixture allowed to stand for two or three days to permit the formation of ethylsulphuric acid; then 325

Gm. of sodium acetate, previously dried by heating it at a temperature of 130° C. (266° F.), until its weight remains constant, are introduced into a retort connected with a well cooled receiver; the acid and alcohol mixture is slowly added, heat carefully applied, and the distillation continued as long as vapors of ethyl acetate come over.

$$\underset{\substack{\text{Sodium}\\\text{Acetate}}}{NaC_2H_3O_2} + \underset{\substack{\text{Ethylsulphuric}\\\text{Acid}}}{C_2H_5HSO_4} = \underset{\text{Ethyl Acetate}}{C_2H_5C_2H_3O_2} + \underset{\substack{\text{Acid Sodium}\\\text{Sulphate}}}{NaHSO_4}$$

Ethylsulphuric acid is formed through the action of the sulphuric acid and heat upon the alcohol. This is then decomposed by contact with sodium acetate, while ethyl acetate and acid sodium sulphate are produced.

Official Description.—A transparent, colorless liquid.
Odor, Taste, and Reaction.—Fragrant and refreshing, slightly acetous odor; peculiar acetous and burning taste; should not immediately redden blue litmus paper.
Specific Gravity.—0.883 to 0.895 at 25° C. (77° F.).
Solubility.—*Water.* In about 9 parts at 25° C. (77° F.).
Alcohol. Miscible in all proportions.
Other solvents—Miscible in all proportions with ether and fixed and volatile oils.
Test for Identity.—Boiling point, from 72° to 77° C. (161.6° to 170.6° F.).
Acetic Ether is readily volatilized, even at a low temperature. It is inflammable, burning with a yellowish flame and an acetous odor.
Upon evaporation, Acetic Ether should leave no residue.
Impurities and Tests for Impurities.—*Butylic and amylic derivatives.* If a portion be allowed to evaporate spontaneously from clean, odorless blotting paper, the final odor should not resemble that of pineapple.
Undue proportion of alcohol or water. When 25 Cc. of Acetic Ether are shaken, in a graduated tube, with 25 Cc. of water just previously saturated with Acetic Ether, upon separation the etherial layer should not measure less than 22.5 Cc.
Readily carbonizable, organic impurities. When a small portion of Acetic Ether is carefully poured upon concentrated sulphuric acid, no dark ring should be developed at the point of contact of the two layers.

Uses.—Acetic ether is sometimes employed as an anæsthetic. Its odor is frequently noticed in old tinctures and extemporaneous mixtures which have once contained alcohol and acetic acid. Dose, fifteen minims (1 Cc.).

ÆTHYLIS CHLORIDUM. U. S. Ethyl Chloride

A haloid derivative [Monochlor-Ethane, $C_2H_5Cl = 64.00$], prepared by the action of hydrochloric acid gas upon absolute ethyl alcohol.

On account of its extreme volatility, it should be preserved in hermetically sealed glass tubes, and kept in a cool place, remote from lights or fire.

Ethyl chloride may be made by distilling a mixture of equal measures of concentrated hydrochloric acid and alcohol, passing the vapor through a wash bottle to separate water, and finally condensing the vapor with the aid of ice or snow surrounding the receiver.

Official Description.—A colorless, mobile, very volatile liquid.
Odor and Taste.—Characteristic, rather agreeable odor; burning taste.
Specific Gravity.—From 0.911 to 0.916 at 8° C. (46.4° F.).
Solubility.—*Water.* Slightly.
Alcohol. Readily.
Tests for Identity.—It boils at a temperature of 12.5° to 13° C. (54.5° to 55.4° F.), and at its ignition temperature burns with a smoky, green-edged flame, with the production of gaseous hydrochloric acid.
When liberated, at ordinary room-temperatures, from its sealed glass tube, Ethyl Chloride vaporizes at once; the gas is very inflammable, and consequently it should not be used in proximity to a gas flame or fire.
Impurities and Tests for Impurities.—*Hydrochloric acid.* If 10 Cc. of Ethyl Chloride, while cold, be dissolved in alcohol, and a few drops of silver nitrate T.S. be added, no turbidity should be produced.

Alcohol. If 10 Cc. of Ethyl Chloride be agitated with 10 Cc. of cold water, and the supernatant stratum of Ethyl Chloride be evaporated spontaneously, and if a few drops of potassium dichromate T.S. be added to the remaining aqueous liquid, followed by some diluted sulphuric acid, and the mixture be boiled, no odor of aldehyde should be developed, and a greenish or purplish color should not be produced in the liquid.

Sulphur compounds, etc. On allowing Ethyl Chloride to evaporate from clean, odorless blotting paper which has been saturated with it, no unpleasant odor should remain upon the paper.

Uses.—Ethyl chloride is used as a local anæsthetic by freezing; its great volatility requires special methods for dispensing; hermetically sealed tubes are used, so made that when the end is broken off, and the tube held in the hand, the expansion drives the liquid out in a fine stream which is directed against the part to be anæsthetized.

ÆTHYLIS CARBAMAS. U.S. Ethyl Carbamate

$C_3H_7NO_2 = 88.42$

An ester of carbamic acid $[CO(OC_2H_5)NH_2]$ obtained by the reaction of ethyl alcohol upon urea (carbamide) or one of its salts. It should be kept in well-stoppered bottles.

Preparation.—It is made by acting upon *urea nitrate* with alcohol in excess, in closed vessels at a temperature of 120° to 130° C. (248° to 266° F.); ammonia is liberated.

Official Description.—Colorless, columnar crystals or scales.

Odor and Taste.—Odorless; cooling, saline taste.

Solubility.—*Water.* In less than 1 part at 25° C. (77° F.).

Alcohol. In 0.6 part at 25° C. (77° F.).

Other solvents. In 1 part of ether, 1.3 parts of chloroform, and 3 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—When heated between 47.5° and 50° C. (117.5° and 122° F.) it melts, and at a higher temperature is decomposed, burning without leaving a weighable residue.

If 1 Gm. of Ethyl Carbamate be added to 5 Gm. of sulphuric acid and gently heated, it is decomposed with the evolution of carbon dioxide, while alcohol and acid ammonium sulphate remain in solution.

If 1 Gm. of Ethyl Carbamate be heated with 5 Cc. of concentrated potassium hydroxide solution, ammonia gas is given off, recognizable by the usual tests.

If 0.5 Gm. of Ethyl Carbamate be dissolved in 5 Cc. of water with 1 Gm. of dry sodium carbonate and 0.01 Gm. of iodine, and the solution warmed, yellow crystals of iodoform should separate on cooling.

Impurities and Tests for Impurities.—*Distinction from, and absence of, urea or carbamide.* If 6 Gm. of Ethyl Carbamate be dissolved in 6 Cc. of water, and the solution be divided into 3 equal parts, the addition severally of 5 Cc. of nitric acid, of mercuric nitrate T.S., or of oxalic acid T.S. should not produce a white precipitate.

Uses.—Ethyl carbamate or *urethane* is used as an hypnotic in doses of fifteen grains (1 Gm.).

SULPHONMETHANUM. U.S. Sulphonmethane

$C_7H_{16}S_2O_4 = 226.55$

Diethylsulphonedimethylmethane $[(CH_3)_2C(SO_2C_2H_5)_2]$, the product of the oxidation of the mercaptol obtained by the condensation of acetone with ethylmercaptan. It should be preserved in well-stoppered vials.

Preparation.—Sulphonmethane or *Sulphonal* may be made by agitating mercaptol, obtained by the condensation of acetone with ethylmercaptan, with a 5 percent. solution of potassium permanganate until the color of the solution remains unchanged, thus showing that the oxidation is completed. The crystals are purified by redissolving in water or alcohol, and evaporating the solution, collecting, and drying the product.

Official Description.—Colorless, prismatic crystals, or crystalline powder.
Odor, Taste, and Reaction.—Inodorous, and nearly tasteless; neutral reaction.
Solubility.—*Water.* In 360 parts at 25° C. (77° F); in 15 parts of boiling water.
Alcohol. In 47 parts at 25° C. (77° F.); in 2 parts of boiling alcohol.
Other solvents. In 45 parts of ether, and in 16 parts of chloroform at 25° C. (77° F.); soluble in benzene.
Tests for Identity.—When heated to 125.5° C. (258° F.), it melts, and at a red heat it is consumed, evolving vapors of sulphur dioxide and leaving no weighable residue.
If 0.1 Gm. of Sulphonmethane be heated with 0.1 Gm. of powdered charcoal in a dry test-tube, the characteristic unpleasant odor of mercaptan will be developed.
If 0.1 Gm. be gradually heated with dry sodium acetate, hydrogen sulphide will be evolved.
Impurities and Tests for Impurities.—*Sulphates and chlorides.* Its solution in boiling water should develop no odor. This solution, after cooling and filtering, should show no turbidity upon the addition of either barium nitrate T.S. or silver nitrate T.S.
Readily oxidizable organic impurities. If 1 drop of potassium permanganate T.S. be added to an aqueous solution of Sulphonmethane, the liquid should not be immediately decolorized.

Uses.—Sulphonmethane is used as an hypnotic and sedative in doses of fifteen grains (1 Gm.).

SULPHONETHYLMETHANUM. U.S. Sulphonethylmethane

$C_8H_{18}S_2O_4 = 240.46$

Diethylsulphonemethylethylmethane [$(CH_3)(C_2H_5)C(SO_2C_2H_5)_2$], a product of the oxidation of the mercaptol obtained by the condensation of methylethylketone with ethylmercaptan. It should be preserved in well-stoppered vials.

Preparation.—Sulphonethylmethane or *Trional* is made by the same process as that employed in making sulphonal (see page 775), except that in making the mercaptol, acetone is replaced by methylethylketone, thus substituting an ethyl for a methyl group.

Official Description.—Colorless, lustrous, crystalline scales.
Odor, Taste, and Reaction.—Odorless; bitter taste in aqueous solution; neutral reaction.
Solubility.—*Water.* In 195 parts of water at 25° C. (77° F.); more readily in boiling water
Alcohol. Readily.
Other solvents. Readily in ether.
Tests for Identity.—When heated to 76° C. (168.8° F.), it melts, and at a red heat is consumed, evolving sulphur dioxide and leaving no weighable residue.
If 0.1 Gm. of Sulphonethylmethane be heated with 0.1 Gm. of powdered charcoal in a dry test-tube, the characteristic unpleasant odor of mercaptan will be developed.
If 0.1 Gm. be gradually heated with dried sodium acetate, hydrogen sulphide will be evolved.
Impurities and Tests for Impurities.—*Sulphates and chlorides.* One Gm. dissolved in 50 Cc. of boiling water should develop no odor. This solution, when cooled and filtered, should show no turbidity on the addition of barium nitrate T.S. or silver nitrate T.S.
Readily oxidizable organic impurities. One drop of potassium permanganate T.S. added to the aqueous solution of Sulphonethylmethane should not be immediately decolorized.

Uses.—Sulphonethylmethane is used as an hypnotic and sedative in doses of fifteen grains (1 Gm.).

AMYLIS NITRIS. U.S. Amyl Nitrite

[AMYL NITRIS, PHARM. 1890]

A liquid containing about 80 percent. of Amyl (chiefly Iso-amyl) Nitrite [$C_5H_{11}NO_2 = 116.24$], when assayed by the process given below. It should be kept in hermetically sealed glass bulbs, or in dark, amber-colored, glass-stoppered vials, in a cool and dark place.

Preparation.—This ester may be made by acting on amyl alcohol with nitric acid. The latter is deoxidized into nitrous acid, which acts on amyl alcohol, as shown in the reaction:

$$\underset{\substack{\text{Amyl}\\\text{Alcohol}}}{C_5H_{11}OH} + \underset{\substack{\text{Nitrous}\\\text{Acid}}}{HNO_2} = \underset{\substack{\text{Amyl}\\\text{Nitrite}}}{C_5H_{11}NO_2} + \underset{\text{Water}}{H_2O}$$

Tanner's process, which is adapted for small operations, is as follows: 10 fl. oz. of purified amyl alcohol is introduced into a large tubulated retort containing copper wire, 1 fl. oz. of strong sulphuric acid is now added, and then 1 fl. oz. of nitric acid, previously diluted with an equal bulk of water. It is gently heated to 63° C. (145.4° F.). At this temperature the reaction commences, and goes on very quietly until a bulk about equal to double the quantity of nitric acid collects in the receiver. The chemical action now ceases, and the temperature, which has risen to near 100° C. (212° F.), begins to fall. More diluted nitric acid is added, and the process carried out as before. These additions are repeated until the amyl alcohol is exhausted, which is known by the appearance of red fumes in the retort. The whole product is washed with sodium hydroxide, to remove hydrocyanic and other acids, and rectified over potassium carbonate, to free it from moisture. The portion which distils over between 95° and 100° C. (203° and 212° F.) is medicinally pure amyl nitrite.

Difficulties are experienced in rectifying amyl nitrite on account of the number of products present having similar boiling points. If strong nitric acid is used instead of diluted acid, explosions are almost sure to occur.

Official Description.—A clear, yellowish liquid.

Odor and Taste.—Peculiar, ethereal, fruity odor; pungent, aromatic taste.

Specific Gravity.—0.865 to 0.875 at 25° C. (77° F.).

Solubility.—*Water.* Almost insoluble.

Alcohol. Miscible in all proportions.

Other solvents. Miscible in all proportions with ether.

Tests for Identity.—It is very volatile, even at a low temperature, and is inflammable, burning with a yellow, luminous, and sooty flame.

Impurities and Tests for Impurities.—*Limit of free acid.* If 1 Cc. of normal potassium hydroxide V.S. and 10 Cc. of water be mixed in a test-tube with a drop of phenolphthalein T.S., then 5 Cc. of Amyl Nitrite added, and the tube inverted a few times, the red tint of the aqueous layer should still be perceptible.

Aldehyde. A mixture of 1.5 Cc. of silver nitrate T.S. and 1.5 Cc. of alcohol with a few drops of ammonia water should not become brown or black if 1 Cc. of Amyl Nitrite be added and the mixture gently heated.

Water. Amyl Nitrite should remain transparent, or nearly so, when exposed to the temperature of melting ice.

Assay.—Transfer about 3 Cc. of the Amyl Nitrite, which has been previously shaken with 0.5 Gm. of potassium bicarbonate and carefully decanted, to a tared 100 Cc. measuring flask, and weigh it accurately. Add sufficient alcohol to bring the volume to exactly 100 Cc. and mix thoroughly. Introduce into a nitrometer (see Gasometric Estimations) exactly 10 Cc. of the alcoholic solution, followed by 10 Cc. of potassium iodide T.S., and afterwards by 10 Cc. of normal sulphuric acid V.S. When the volume of gas has become constant (within 30 to 60 minutes), note the volume of gas collected. Multiply this volume in Cc., by 4.8, and divide the product by the original weight of the Amyl Nitrite.

At the standard temperature and pressure, the quotient will represent the percentage of Amyl Nitrite in the liquid. The temperature correction is one-third of one percent. of the total percentage just found for each degree,—additive if the temperature is below 25° C. (77° F.), and subtractive if it is above 25° C. (77° F.). The barometric correction is four-thirtieths of one percent. for each millimeter; additive if it is above, and subtractive if it is below, 760.

When assayed according to the above method, it should yield not less than 80 percent. of Amyl Nitrite.

Uses.—Amyl nitrite is a valuable remedy. It is exceedingly volatile, and is much used in asthma, angina pectoris, and similar complaints, by inhalation. It is a stimulant, producing an excessive action of the heart, and may be administered by dropping a small quantity on a handkerchief and inhaling the vapor, or by crushing a glass *pearl of amyl nitrite* in the handkerchief and inhaling the liquid which volatilizes.

CHAPTER LIII

ALDEHYDE, ITS DERIVATIVES AND PREPARATIONS

THE term *aldehyde*, like the terms *alcohol* and *ether*, was formerly applied to one compound. It is now used to define a class of organic bodies. The word is derived from the first syllables of the term *al*cohol *dehyd*rogenatum, which means alcohol from which hydrogen has been abstracted.

Aldehyde (*acetaldehyde*) has the composition C_2H_4O, and is made by depriving alcohol, C_2H_6O, of two hydrogen atoms. This abstraction of hydrogen may be effected by acting on ethyl alcohol with oxidizing agents, as sulphuric acid and potassium dichromate or manganese dioxide, and also in making ethyl nitrite. By the oxidation of aldehydes, acids are formed, as in making acetic acid by the beechwoods shavings process (see page 720). The addition of 2H to aldehyde, C_2H_4O, reproduces alcohol, C_2H_6O, while the addition of O to aldehyde, C_2H_4O, produces acetic acid, $C_2H_4O_2$.

PARALDEHYDUM. U.S. Paraldehyde

$C_6H_{12}O_3 = 131.10$

A polymer of acetaldehyde [$CH_3.COH = 43.70$]. Paraldehyde should be kept in well-stoppered, dark amber-colored bottles, in a cool place.

This official liquid is a product of the condensation of three molecules of ethyl, or ordinary aldehyde; it may be made by treating ethyl aldehyde with small quantities of either sulphur dioxide, hydrochloric acid, carbonyl chloride, or zinc chloride; almost complete conversion occurs, and by freezing the liquid and rectifying, pure paraldehyde is produced.

Official Description.—A colorless, transparent liquid.

Odor, Taste, and Reaction.—Strong, characteristic, but not unpleasant or pungent odor; burning and cooling taste; neutral or slightly acid reaction.

Specific Gravity.—0.990 at 25° C. (77° F.).

Solubility.—*Water.* In 8 parts of water at 25° C. (77° F.); in 16.5 parts of boiling water; the cold aqueous solution becomes turbid on being boiled.

Alcohol. Miscible in all proportions.

Other solvents. Miscible in all proportions with ether, and fixed or volatile oils.

Tests for Identity.—When cooled to near 0° C. (32° F.), Paraldehyde solidifies to a crystalline mass, which becomes liquid again at 10.5° C. (51° F.). It boils at 121° to 125° C. (249.8° to 257° F.), evolving inflammable vapors.

When distilled with a small portion of sulphuric acid, Paraldehyde is converted into acetaldehyde, boiling at about 21° C. (69.8° F.). On warming in a test-tube some silver ammonium nitrate T.S. saturated with Paraldehyde, a silver mirror will form on standing.

Impurities and Tests for Impurities.—*Impurities derived from fusel oil.* On heating some Paraldehyde on a water-bath, it should completely volatilize, without leaving any disagreeable odor.

Amyl alcohol, etc. One Cc. of Paraldehyde should form, with 10 Cc. of water, a clear solution, free from oily drops.

Hydrochloric acid. Portions of this solution, when acidulated with nitric acid, should not be affected by silver nitrate T.S.

Limit of free acid. A mixture of 8 Cc. of Paraldehyde and 8 Cc. of alcohol with one drop of phenolphthalein T.S. should acquire a pink color upon the addition of 0.5 Cc. of normal potassium hydroxide V.S.

Sulphuric acid.—Or barium chloride T.S.

Uses.—Paraldehyde is an hypnotic and a sedative. Owing to its unpleasant taste, it is usually prescribed in combination with alcoholic liquids, elixirs, etc. Dose thirty minims to one fluidrachm (2 to 4 Cc.).

LIQUOR FORMALDEHYDI. U. S. Solution of Formaldehyde

An aqueous solution, containing not less than 37 percent., by weight, of absolute Formaldehyde [H.COH = 29.79], an oxidation product of methyl alcohol. It should be kept in well-stoppered bottles, in a moderately warm place, protected from light.

Preparation.—This liquid, commonly known as *Formaldehyde*, is made by mixing the vapor of boiling methyl alcohol, which is under pressure, with air in proper quantity, and allowing the mixed vapors to pass over heated copper tubes, and then condensing the vapors by passing them into a copper tank provided with the means for cooling the temperature to 0° C. (32° F.). Sufficient water is added to the product to make it contain 37 percent. by weight of absolute formaldehyde.

Official Description.—A clear, colorless liquid; its vapor acts as an irritant upon the mucous membrane.

Odor, Taste, and Reaction.—Pungent odor; caustic taste; neutral, or only faintly acid, reaction.

Specific Gravity.—From 1.075 to 1.081 at 25° C. (77° F.).

Solubility.—Miscible in all proportions with water and alcohol.

Tests for Identity.—On standing, Solution of Formaldehyde sometimes loses its transparency, the cloudiness being due to the separation of paraformaldehyde.

If Solution of Formaldehyde be evaporated over sulphuric acid, or in a vacuum, white, solid, paraformaldehyde is rapidly formed, which is insoluble in water, and which, when heated to about 100° C. (212 F.), sublimes, and between 153° and 172° C. (307.4° and 341.6° F.) melts, gaseous formaldehyde being evolved.

If 5 Cc. of Solution of Formaldehyde be diluted with 25 Cc. of distilled water, and 3 Cc. of silver ammonium nitrate T.S. be added, a gray precipitate of finely divided metallic silver, which often adheres in part to the sides of the test-tube as a metallic mirror, will be produced.

If to 5 Cc. of sulphuric acid in which a little salicylic acid has been dissolved, 2 drops of Solution of Formaldehyde be added and the liquid very gently warmed, a permanent deep red color should immediately appear.

Impurities and Tests for Impurities.—*Limit of fixed impurities.* If 20 Cc. of Solution of Formaldehyde be evaporated to dryness on a water-bath, a white amorphous mass should remain, which, upon ignition, should leave not more than 0.05 percent. of residue.

More than 0.2 percent of formic and other acids. If 20 Cc. of Solution of Formaldehyde to which 2 drops of phenolphthalein T.S. have been added, be titrated with normal potassium hydroxide V.S., not more than 1 Cc. of the latter should be required for neutralization.

Chloride. If 20 Cc. of Solution of Formaldehyde be diluted with 60 Cc. of distilled water, and the liquid divided into four approximately equal portions, no turbidity or precipitate should be produced on the addition, severally, of silver nitrate T.S.

Sulphate. Barium chloride T.S.

Iron, lead, copper, etc. Hydrogen sulphide T.S. or potassium ferrocyanide T.S.

Calcium. Ammonium oxalate T.S.

Assay for Formaldehyde.—Transfer 3 Cc. of Solution of Formaldehyde to a well-stoppered Erlenmeyer flask, and weigh accurately. Add 50 Cc. of normal sodium hydroxide V.S., and follow this immediately, but slowly, through a small funnel, with 50 Cc. of solution of hydrogen dioxide, to which a drop of litmus T.S. has been added, and which has been neutralized with normal sodium hydroxide V.S. After the reaction has ceased and the foaming has subsided, rinse the funnel and sides of the vessel with distilled water, and, after allowing it to stand thirty minutes, titrate back with normal sulphuric acid V.S., using litmus T.S. as indicator. Subtract the number of Cc. of normal sulphuric acid V.S. consumed, from 50 (the number of Cc. of normal sodium hydroxide V.S. employed), multiply the remainder by 2.979, and divide the product by the weight of the Solution taken; the quotient represents the percentage, by weight, of absolute Formaldehyde in the liquid.

Uses.—Since the introduction of this liquid (sometimes called *Formalin*), it has been very extensively used as an antiseptic and antiferment, for preserving milk, meat, and, in fact, nearly every article of food likely to spoil through fermentation; for disinfecting apartments which have been subjected to infection, the vapor is conducted into the room from a lamp of which there are numerous forms on the market. Many proprietary preparations of formaldehyde are sold. It has been shown that the internal administration of preparations containing it is not without danger.

HEXAMETHYLENAMINA. U.S. Hexamethylenamine

$C_6H_{12}N_4 = 139.18$

A condensation product [Hexamethylene-tetramine, $(CH_2)_6N_4$], obtained by the action of ammonia upon formaldehyde. It should be kept in well-stoppered bottles.

Preparation.—It is made by passing a current of dry ammonia gas over warm trioxymethylene (paraformaldehyde), and purifying the product.

Official Description.—Colorless, lustrous crystals.
Odor and Reaction.—Odorless; the aqueous solution has an alkaline reaction upon red litmus paper.
Solubility.—*Water.* Soluble in about 1.5 parts at 25° C. (77° F.); in 1.5 parts at 100° C. (212° F.).
Alcohol. Soluble in 10 parts at 25° C. (77° F.), and in about 8 parts of hot alcohol.
Other solvents. Soluble in 228 parts of ether at 25° C. (77° F.).
Tests for Identity.—When heated to 263° C. (505.4° F.) it sublimes without melting and with partial decomposition.
If 0.1 Gm. of Hexamethylenamine be mixed with 0.1 Gm. of salicylic acid and 5 Cc. of sulphuric acid, and then heated moderately, a carmine-red color should be produced.
If an aqueous solution of Hexamethylenamine (1 in 10) be heated with diluted sulphuric acid, it is decomposed with the liberation of formaldehyde (recognized by its odor or by its darkening paper moistened with silver ammonium nitrate T.S.).
If an aqueous solution (1 in 10) be heated with diluted sulphuric acid and then supersaturated with solution of sodium hydroxide, ammonia is liberated.
If to an aqueous solution (1 in 10) tannic acid T.S. be added, a precipitate is formed. If mercuric chloride T.S. be added to an aqueous solution (1 in 10), a precipitate is produced which on standing forms crystalline needles.

Uses.—Hexamethylenamine or *urotropine* is used as a solvent for uric acid, and in the treatment of urinary affections. It is given in doses of from five to fifteen grains (0.3 to 1 Gm.).

CHLORALUM HYDRATUM. U.S. Hydrated Chloral

$C_2HCl_3O + H_2O = 164.12$

[Chloral, Pharm. 1890 Chloral Hydrate]

A crystalline solid, composed of trichloraldehyde or chloral [$CCl_3.COH$] with the elements of one molecule of water. It should be kept in amber-colored, glass-stoppered bottles, in a cool and dark place.

Preparation.—This valuable compound is made by passing dry chlorine gas, in a continuous stream, through absolute alcohol for six or eight weeks. The chlorine is led into cold alcohol at first, and when no more is absorbed, the alcohol is heated at first gently and then to 60° C. (140° F.). When saturated, the mixture formed is agitated with sulphuric acid at a temperature of 60° C. (140° F.) for several hours, during which time most of the hydrochloric acid escapes. The separated chloral is then rectified over calcium carbonate. This is anhydrous chloral, a colorless liquid, of a penetrating odor, of the specific gravity 1.502. The pure chloral so obtained is then mixed in glass flasks with the necessary amount of water, and the resulting hydrated chloral either cast into cakes or purified by crystallization. As solvents for this purpose, certain of the side products of the chloral manufacture, after being purified and rectified, are used,—for instance, ethylene and ethylidene chloride; or, in their absence, chloroform, petroleum benzin, or carbon disulphide may be employed. The name *chloral* is derived from the first two syllables of *chlor*ine and *al*cohol.

The reaction may be thus expressed:

$$\underset{\text{Alcohol}}{C_2H_4H_2O} + \underset{\text{Chlorine}}{2Cl} = \underset{\text{Acetaldehyde}}{C_2H_4O} + \underset{\text{Hydrochloric Acid}}{2HCl}$$

then

$$\underset{\text{Acetaldehyde}}{C_2H_4O} + \underset{\text{Chlorine}}{6Cl} = \underset{\text{Chloral}}{C_2HCl_3O} + \underset{\text{Hydrochloric Acid}}{3HCl}$$

Chloral is thus seen to be acetaldehyde in which three of the atoms of hydrogen have been replaced by three atoms of chlorine; hence it is termed, in systematic nomenclature, *trichloraldehyde*.

Official Description.—Separate, rhomboidal, colorless, and transparent crystals; slowly volatilized when exposed to the air.

Odor, Taste, and Reaction.—Aromatic, penetrating and slightly acrid odor; bitterish, caustic taste. A freshly prepared, aqueous solution of Hydrated Chloral (1 in 20) should be neutral to litmus paper, but it gradually acquires an acid reaction. A neutral alcoholic solution remains neutral permanently.

Solubility.—*Water.* Freely soluble.

Alcohol. Freely soluble.

Other solvents. Freely soluble in ether, chloroform, benzene, petroleum benzin, carbon disulphide, fixed and volatile oils.

Tests for Identity.—It liquefies when triturated with about an equal quantity of camphor, menthol, thymol, or phenol.

When dried and heated to about 58° C. (136.4° F.), it melts, forming a liquid having a specific gravity of about 1.575, which, at a higher temperature, should not evolve inflammable vapors. Liquefied Hydrated Chloral solidifies to a crystalline mass between 35° and 50° C. (95° and 122° F.).

Hydrated Chloral is decomposed by caustic alkalies, alkaline earths, and ammonia, chloroform and a formate of the base being produced. When warmed with a few drops of aniline and sodium hydroxide T.S., the intensely disagreeable odor of phenyl-isocyanide (isonitril reaction) should be produced.

Hydrated Chloral should be dry, and not readily attract moisture in dry air.

Impurities and Tests for Impurities.—*Hydrochloric acid and chlorides.* An aqueous solution of Hydrated Chloral (1 in 20), slightly acidulated with nitric acid, should remain unaffected by silver nitrate T.S.

Uses.—Hydrated chloral is an hypnotic. It is generally administered in a flavored syrup. Although hydrated chloral is freely soluble in alcohol the latter is not a suitable solvent, because its therapeutical action is contraindicated: hydrated chloral should not be prescribed with alkalies or alkaline salts on account of decomposition of the hydrated chloral. Dose, fifteen to thirty grains (1 to 2 Gm.).

CHLORALFORMAMIDUM. U.S. Chloralformamide

$C_3H_4Cl_3NO_2 = 190.96$

A crystalline solid [$CCl_3.CH(OH)NH.COH$], made by the direct union of formamide with anhydrous chloral. It should be kept in amber-colored, well-stoppered vials.

Preparation.—Chloralformamide is an addition product of chloral CCl_3COH and formamide $CH(OH)NH$.

Official Description.—Colorless, lustrous crystals.
Odor and Taste.—Without odor; somewhat bitter taste.
Solubility.—*Water.* Soluble in about 18.7 parts.
Alcohol. Soluble in 1.3 parts of alcohol at 25° C. (77° F.).
Other solvents. Readily soluble in ether, glycerin, acetone, and acetic ether.

Tests for Identity.—When heated with water to 60° C. (140° F.), it is hydrolized, hydrated chloral and formamide being produced.

When heated from 114° to 115° C. (237.2° to 239° F.), it melts, but at a higher temperature it is decomposed.

It is not affected by diluted acids, but it is decomposed on warming with alkali hydroxides, the solution becoming at first turbid, and then clear, while chloroform separates.

If 0.2 Gm. be heated carefully in an open dish, it should not give off inflammable vapors, and should volatilize without leaving a weighable residue (absence of *inorganic impurities* and distinction from *chloral alcoholate* and *ethyl carbamate*).

Impurities and Tests for Impurities.—*Formic, hydrochloric, and other free acids.* One Gm. of Chloralformamide dissolved in 10 Cc. of alcohol should yield a solution which does not redden moistened blue litmus paper.

Decomposition products. If 1 Gm. of Chloralformamide be dissolved in 10 Cc. of alcohol, the addition of a few drops of silver nitrate T.S. should not at once produce turbidity.

Uses.—This substance, known also as *Chloralamide*, is used as an hypnotic in insomnia, and for the same purposes as is hydrated chloral, in doses of fifteen grains (1 Gm.).

CHLOROFORMUM. U.S. Chloroform

A liquid consisting of 99 to 99.4 percent., by weight, of absolute Chloroform [$CHCl_3 = 118.45$], and 0.6 to 1 percent. of alcohol. It should be kept in dark amber-colored, well-stoppered bottles, in a cool and dark place.

Preparation.—Chloroform was formerly made by mixing six parts of chlorinated lime with twenty-five parts of water, and, after transferring the mixture to a still, adding one part of alcohol. Heat is applied, and when the temperature of 40° C. (104° F.) is reached, chloroform containing some alcohol begins to distil over. This is washed with water to separate the alcohol, and the heavy liquid is further purified by redistillation.

Chloroform, $CHCl_3$, is termed chemically *trichlormethane*, because it can be produced by substituting three atoms of chlorine for three hydrogen atoms of *methane*, marsh gas, CH_4. It may also be produced by acting on hydrated chloral with an alkali; thus:

$$\underset{\text{Hydrated Chloral}}{C_2HCl_3O.H_2O} + \underset{\substack{\text{Sodium}\\\text{Hydroxide}}}{NaHO} = \underset{\text{Chloroform}}{CHCl_3} + \underset{\substack{\text{Sodium}\\\text{Formate}}}{NaCHO_2} + \underset{\text{Water}}{H_2O}$$

But chloroform is now more profitably made by reacting on acetone with chlorinated lime; the liquid products (ketones) resulting from the decomposition of crude acetates at high temperatures may also be used. The acetone must be very pure; the yield is sometimes nearly 200 percent. The reaction is as follows:

$$\underset{\text{Acetone}}{2C_3H_6O} + \underset{\substack{\text{Calcium}\\\text{Hypochlorite}}}{6Ca(OCl)_2} = \underset{\text{Chloroform}}{2CHCl_3} + \underset{\substack{\text{Calcium}\\\text{Hydroxide}}}{2Ca(OH)_2} + \underset{\substack{\text{Calcium}\\\text{Acetate}}}{Ca(C_2H_3O_2)_2} + \underset{\substack{\text{Calcium}\\\text{Chloride}}}{3CaCl_2}$$

Absolutely pure chloroform readily decomposes upon keeping, particularly if exposed to the light, and it has long been known that the presence of a very small percentage (0.6 to 1 percent.) of alcohol will act as a preservative.

Official Description.—A heavy, clear, colorless, mobile and diffusible liquid.
Odor and Taste.—Characteristic, ethereal odor; burning, sweet taste.
Specific Gravity.—Not below 1.476 at 25° C. (77° F.).
Solubility.—*Water.* Soluble in about 200 times its volume of cold water.

Alcohol. In all proportions.

Other solvents.—In all proportions in ether, benzene, petroleum benzin, and the fixed and volatile oils.

Tests for Identity.—Chloroform is volatile even at a low temperature, and boils at 60° to 61° C. (140° to 141.8° F.). It is not inflammable, but its heated vapor burns with a green flame.

If 10 Cc. of Chloroform be poured upon a piece of clean, odorless filter paper laid flat upon a warmed glass plate, and the plate be rocked from side to side until the liquid is all evaporated, no foreign odor should become perceptible as the last portions disappear from the paper, and the paper should be left odorless.

Impurities and Tests for Impurities.—*Chloride.*—If 10 Cc. of Chloroform be well shaken with 20 Cc. of distilled water, and the liquid be allowed to separate completely, the water should be neutral to litmus paper, and should not be effected by silver nitrate T.S.

Free chlorine. Nor should the above separated aqueous liquid be colored by potassium iodide T.S.

Impurities decomposable by sulphuric acid. If 40 Cc. of chloroform be shaken with 4 Cc. of colorless, concentrated sulphuric acid in a 50 Cc. glass-stoppered cylinder during five minutes, and the liquids be then allowed to separate completely, so that both are transparent, the chloroform should remain colorless, and the acid should appear colorless, or very nearly colorless, when seen in a stratum of not less than 15 Mm. in thickness.

Odorous decomposition products. If 2 Cc. of the sulphuric acid, separated from the Chloroform, be diluted with 5 Cc. of distilled water, the liquid should be colorless and clear, and, while hot from the mixing, should be odorless, or give but a faint vinous or ethereal odor.

Chlorinated decomposition compounds. When further diluted with 10 Cc. of distilled water, it should remain clear, and should not be effected by silver nitrate T.S.

Purification.—Chloroform which fails to respond to the above tests may be purified by the following U. S. P. 1890 process:

Chloroform	400 Gm.
Sulphuric Acid	80 Gm.
Dried Sodium Carbonate	20 Gm.
Deodorized Alcohol	4 Cc.

Add the Sulphuric Acid to the Chloroform, contained in a glass-stoppered bottle, and shake them together occasionally during twenty-four hours, avoiding exposure to bright daylight. Separate the lighter Chloroform layer, add to it the Dried Sodium Carbonate, previously rendered anhydrous by heating it, in a porcelain capsule, on a sand-bath, until it ceases to give off aqueous vapor, and shake them together frequently and thoroughly during half an hour; then transfer the Chloroform to a dry retort, add to it the Alcohol, and distil, by means of a water-bath, at a temperature not exceeding 67.2° C. (153° F.), into a well-cooled receiver, until the distillate measures *two hundred and fifty-five* (255) *cubic centimeters.*

Chloroform sometimes contains a chlorinated pyrogenous oil which renders it unfit for its most important use, that of an anæsthetic, and the object of the above process is to purify it. Sulphuric acid decomposes this contaminating oil, and in turn is blackened by it. The chloroform is separated from the sulphuric acid, agitated with solution of sodium carbonate to neutralize adhering acid, then mixed with alcohol, and redistilled (preferably from lime) to separate water.

Uses.—Chloroform which corresponds to the official tests, or when purified, is used as an anæsthetic by inhalation. Taken internally, well diluted, in large doses, one to two fluidrachms (4 to 8 Cc.), it is narcotic; in small doses, five to fifteen minims (0.3 to 1 Cc.), it is carminative and sedative. Externally it is irritant, and may produce blisters.

Official Preparations

Aqua Chloroformi Chloroform Water	A saturated, aqueous solution of chloroform (see page 276)
Spiritus Chloroformi Spirit of Chloroform	Made by mixing 60 Cc. of chloroform with 940 Cc. of alcohol. (See page 314)
Emulsum Chloroformi Emulsion of Chloroform	Made by mixing 40 Cc. of chloroform with 10 Gm. of powdered tragacanth in a dry bottle, and 250 Cc. of water, then adding gradually 60 Cc. of expressed oil of almond, agitating the mixture, and then enough water to make 1000 Cc. (see page 302)
Linimentum Chloroformi Chloroform Liniment	Made by mixing 300 Cc. of chloroform with 700 Cc. of soap liniment. (See page 323)

BROMOFORMUM. U.S. Bromoform

A liquid consisting of 99 percent., by weight, of absolute Bromoform [$CHBr_3 = 250.99$], and 1 percent. of absolute alcohol. It should be kept in dark amber-colored, glass-stoppered bottles, in a cool place, protected from light.

Preparation.—Bromoform may be made by the action of bromine on alcohol in the presence of alkalies or alkali hydroxides, but it is preferably made by the reaction of sodium hypobromite upon acetone, just as chloroform is made by the "acetone process" (see page 782); sodium acetate and sodium hydroxide are by-products.

Official Description.—A heavy, transparent, colorless, mobile liquid.
Odor and Taste.—Ethereal odor; penetrating, sweet taste resembling that of chloroform.
Specific Gravity.—2.808 at 25° C. (77° F.).
Solubility.—*Water.* Very slightly.
Alcohol. In all proportions.
Other solvents. In all proportions in ether, benzene, petroleum benzin, and in the fixed and volatile oils.

Tests for Identity.—Bromoform is slightly volatile at ordinary temperatures, boils at 148° C. (298.4° F.), and solidifies at 6° C. (42.8° F.).

It is not inflammable, but when vaporized by the application of heat, its vapor may be burned.

If 10 Cc. of Bromoform be evaporated in a dish over a naked flame, no solid residue should remain.

Impurities and Tests for Impurities.—*Free acid.* If 10 Cc. of Bromoform be well shaken with 10 Cc. of distilled water, and the liquids, upon standing, be allowed to separate completely, the water removed from the layer of Bromoform should be neutral to blue litmus paper.

Limit of bromides and brominated compounds. And a portion of the above aqueous liquid should not produce more than a slight turbidity when treated with silver nitrate T.S.

Free bromine. Another portion of the above aqueous liquid treated with potassium iodide T.S. should not be tinted blue upon the addition of starch T.S.

Acetone. If 10 Cc. of Bromoform be well shaken with 10 Cc. of distilled water, and the liquids, upon standing, be allowed to separate completely, the water removed from the Bromoform, treated with an excess of ammonia water, and then with a solution of iodine and ammonium iodide, until the black precipitate of nitrogen iodide, which may sometimes form, slowly disappears, it should not become milky in appearance, due to the separation of iodoform, which may be recognized by its odor.

Uses.—Care should be taken in dispensing bromoform to see that it is colorless, free from acidity, and that it conforms strictly to the official tests (see above). It is used as a remedy in whooping cough; owing to its insolubility in water it may be administered dissolved in alcohol in proper quantity and this solution mixed with glycerin and a flavored syrup. Dose, three minims (0.2 Cc.).

IODOFORMUM. U.S. Iodoform

$CHI_3 = 390.61$

Triiodomethane, usually obtained by the action of iodine upon alcohol, in the presence of an alkali or alkali carbonate. Iodoform should be kept in well-stoppered bottles, in a cool and dark place.

Preparation.—Iodoform may be made by Filhol's process, which consists in heating, in a water-bath, one hundred parts of alcohol, two hundred parts of potassium carbonate, and one thousand parts of distilled water, and gradually adding one hundred parts of iodine in small portions. Chlorine gas is passed through the mixture to cause the separation of the iodoform, which may be filtered out. The filtrate may be concentrated and decomposed by excess of nitric acid. The collected crystals of iodoform are now well washed with the smallest quantity of cold distilled water, spread out on pieces of bibulous paper, and dried in the open air.

$$\underset{\text{Alcohol}}{C_2H_5HO} + \underset{\text{Iodine}}{8I} + \underset{\substack{\text{Acid Potassium}\\\text{Carbonate}}}{2KHCO_3} = \underset{\substack{\text{Potassium}\\\text{Iodide}}}{2KI} + \underset{\text{Iodoform}}{2CHI_3} + \underset{\text{Water}}{3H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{2CO_2}$$

It may also be made by adding a solution of chlorinated soda, by drops, to a solution of fifty grammes of potassium iodide, five grammes of sodium hydroxide, and forty grammes of acetone in 1000 Cc. of water, and collecting the crystals of iodoform which separate.

It may be obtained in very fine powder by making a concentrated solution in alcohol, acetone, or one of its other solvents, and pouring this into water, collecting, washing, and drying the precipitate.

The specific gravity of iodoform about which there has been a controversy, was determined by J. Percy Remington to be 4.000; the specific gravity of 2.000 as given in the U. S. P., 1890 was undoubtedly due to the operator taking the specific gravity of the iodoform in water and when this is done it is practically impossible to free the crystals from admixed air; the result was reached by using a saturated solution of iodoform in pure kerosene as the liquid, and by calculation obtaining the equivalent in water.

Official Description.—A fine, lemon-yellow powder or lustrous crystals.

Odor, Taste, and Reaction.—Peculiar, very penetrating, and persistent odor; unpleasant, slightly sweetish, and iodine-like taste; neutral reaction in neutral solvents.

Solubility.—*Water.* In 9391 parts of water, to which it imparts its odor and taste, at 25° C. (77° F.).

Alcohol. In 46.7 parts of alcohol at 25° C. (77° F.), and in about 12 parts of boiling alcohol.

Other solvents. In 5.2 parts of ether at 25° C. (77° F.); in chloroform and fixed and volatile oils; slightly in petroleum benzin.

Tests for Identity.—Digest in a porcelain dish 0.1 Gm. of Iodoform with 5 Cc. of an alcoholic solution of potassium hydroxide (1 in 20) until it is dissolved, evaporate to dryness on a water-bath, dissolve the residue in 5 Cc. of distilled water, add 2 Cc. of chloroform and an excess of nitric acid, and shake the mixture; the chloroform will assume an intense violet color.

Impurities and Tests for Impurities.—*Limit of fixed impurities.* Iodoform is slightly volatile, even at ordinary temperatures, and in boiling water distils slowly with the vapor of water. At about 115° C. (239° F.) it melts to a brown liquid, and at a higher temperature emits vapors of iodine, leaving behind a carbonaceous mass, which, upon full combustion, should leave not more than 0.2 percent. of residue.

On being dried over sulphuric acid, the loss in weight should not exceed 1 percent.

Soluble yellow coloring matters, picric acid, etc. If 2 Gm. of Iodoform be thoroughly shaken with 10 Cc. of water, the filtrate should be colorless and free from bitter taste.

Free acids. It should not affect the color of litmus paper.

Soluble iodides. Nor should it be rendered more than faintly opalescent by silver nitrate T.S.

Uses.—Iodoform, when given internally, is used principally as an alterative. It is also antiseptic and a local anæsthetic. It is used very largely as an external application to wounds and ulcers. The dose is one to four grains (0.065 to 0.25 Gm.).

Official Preparation

Unguentum Iodoformi Iodoform Ointment	10 Gm. of Iodoform to 90 Gm. of Lard

IODOLUM. U.S. Iodol

$C_4I_4.NH = 566.17$

Tetraiodopyrrol, a derivative of the base pyrrol, obtained by the direct action of iodine upon the base in the presence of alcohol. Iodol should be preserved in amber-colored bottles, protected from light.

Preparation.—Iodol is made by dissolving pyrrol and iodine in alcohol and allowing the liquid to stand for twenty-four hours, the iodol which forms is precipitated upon the addition of water.

Official Description.—A light, grayish-brown, crystalline powder.
Odor and Taste.—Odorless; tasteless.
Solubility.—*Water.* In about 4900 parts at 25° C. (77° F.).
Alcohol. In 9 parts of alcohol at 25° C. (77° F.).
Other solvents. In 1.5 parts of ether and 105 parts of chloroform at 25° C. (77° F.); soluble in fixed oils. Soluble in concentrated sulphuric acid, producing a green solution gradually changing to brown.
Impurities and Tests for Impurities.—*Limit of inorganic impurities.* When heated to 100° C. (212° F.) it remains unchanged, but at a temperature of 140° to 150° C. (284° to 302° F.) it is decomposed with the liberation of violet iodine vapors. When ignited it should leave not more than 0.1 percent. of residue.
Hydriodic acid or soluble metallic iodides. If 0.5 Gm. of Iodol be shaken with 100 Cc. of water and filtered, the filtrate should not be made more than slightly opalescent by silver nitrate T.S.
Appreciable amount of free iodine. If 0.5 Gm. of Iodol be shaken with 100 Cc. of water and filtered, the filtrate should not communicate more than a light yellowish tinge to chloroform.

Uses.—Iodol is used as a substitute for iodoform as a dressing for wounds. It is preferred by some physicians because it is odorless and tasteless, but it does not seem to have met expectations, as it is not the equal of iodoform in efficiency. The dose is three to five grains (0.2 to 0.3 Gm.).

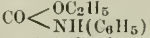
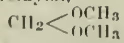
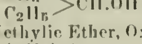
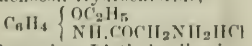
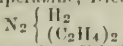
Unofficial Ethyl, Amyl, and Methyl Compounds, and Allied Products

Acetal (Diethylacetal, Diethylaldehyde, Ethylenediethyl Ether), $CH_3-CH(OC_2H_5)_2$	Obtained from reaction between acetaldehyde and alcohol in the presence of dehydrating agents. Soluble in 20 parts of water, and in all proportions of alcohol and ether. Used as an hypnotic in two fluidrachm doses (8 Cc.)
Aldehyde (Acetaldehyde), C_2H_4O	By gently warming a mixture of alcohol, manganese dioxide, sulphuric acid, and water, and collecting the vapor which is formed by means of a condenser. If exposed, it will gradually be converted into acetic acid. It is a colorless, thin, and very inflammable liquid, having an ethereal odor, and the sp. gr. 0.805
Amyl Acetate, $C_5H_{11}.C_2H_3O_2$	By distilling amyl alcohol with an acetate and sulphuric acid. It is when pure a colorless liquid having a very fragrant odor. Insoluble in water. Sp. gr. 0.876
Amyl Butyrate, $C_5H_{11}.C_4H_7O_2$	Sp. gr. 0.852. Fragrant odor
Amyl Chloride, $C_5H_{11}.Cl$	By the action of strong hydrochloric acid upon amylic alcohol. Sp. gr. 0.874
Amyl Iodide, $C_5H_{11}.I$	By acting upon amylic alcohol with iodine and phosphorus. It is a colorless, transparent liquid, of a faint odor and a pungent taste. Sp. gr. 1.509
Amyl Valerate, $C_5H_{11}.C_5H_9O_2$	Sp. gr. 0.864. Odor of apples
Amylene (Valerene, Pentene, Pental), $(CH_3)_2C.CH.CH_3$	A colorless liquid, having a peculiar, disagreeable odor; density, 0.655 at 10° C. (50° F.). Anæsthetic. Too dangerous for use
Amylene Hydroxide	Used as an hypnotic. Dose, one fluidrachm (4 Cc.)
Anesthesin	Ethyl ester of par-amido-benzoic acid; white, odorless, tasteless powder. Soluble in alcohol, ether, chloroform, but slowly in water. Used as a local anæsthetic. Dose, five to ten grains (0.32 to 0.6 Gm.) twice daily
Barium Sulphethylate, $Ba(C_2H_5SO_4)_2$	By neutralizing ethylsulphuric acid with barium carbonate, filtering off the insoluble barium sulphate, and evaporating the filtrate to crystallization
Bromal, C_2HBr_3O	Hypnotic. Dose, three grains (0.2 Gm.)

Unofficial Ethyl, Amyl, and Methyl Compounds, and Allied Products—*Continued*

Bromamide, $C_6H_2Br_3NH_2.HBr$	Antipyretic, analgesic, and antirheumatic. Dose, ten to fifteen grains (0.65 to 1 Gm.)
Bromopyrine (Monobromantipyrine), $C_{11}H_{11}BrN_2O$	In white, crystalline needles. Soluble in alcohol and chloroform. Slightly soluble in hot water
Butyl Chloral, $C_4H_5Cl_3O$, Butyl Chloral-Hydrate, (Croton Chloralhydrate), $C_4H_5Cl_3O.H_2O$	By passing chlorine gas into aldehyde when it is formed in addition to chloral. Butyl chloral is a dense, oily liquid, of peculiar odor. It dissolves when treated with an excess of warm water, and on cooling deposits *Butyl chloral hydrate.* Used as an hypnotic in ten grain (0.6 Gm.) doses
Calcium Sulphethylate, $Ca(C_2H_5SO_4)_2$	By neutralizing ethylsulphuric acid with calcium carbonate, filtering off the insoluble calcium sulphate, and evaporating the filtrate to crystallization
Carbonei Tetrachloridum, Carbon Tetrachloride, Tetrachlor-Methane, Chlorocarbon, Carbonei Chloratum, CCl_4	Anæsthetic. A colorless liquid. Sp. gr. 1.599
Chloral Ammonium, $CCl_3CH(NH_2)OH$	Used as an hypnotic and substitute for chloral and urethane. Dose, fifteen to thirty grains (1 to 2 Gm.). Called also tri-chlor-amido-ethylic alcohol
Chloral Carbamide	Similar to chloral in its action, but slow and uncertain
Chloral Carbol, Carbolated Chloral	Used locally as an anæsthetic and counterirritant
Chloral Cyanhydrate, $CCl_3.COH.HCN$	A substitute for hydrocyanic acid. 6½ parts, by weight, correspond with 1 part of anhydrous hydrocyanic acid
Chloralimide, $CCl_3CH–NH$	Antipyretic and analgesic. Dose, three to seven grains (0.2 to 0.45 Gm.)
Chloral Menthol, Mentholated Chloral	An oily, colorless liquid, with a mint-like odor. Sp. gr. 1.984. Counterirritant and local anæsthetic
Chloralose, $C_8H_{11}Cl_3O_6$	Hypnotic. Dose, twelve grains (0.775 Gm.)
Chloral Urethane (Uralium), $CCl_3CH\begin{cases}OH\\NHCO_2C_2H_5\end{cases}$	Hypnotic. Dose, fifteen grains (1 Gm.)
Copper Sulphethylate, $Cu(C_2H_5SO_4)_2$	By mixing alcoholic solutions of ethyl sulphydrate and copper acetate and collecting the gelatinous precipitate
Ethyl Benzoate, $C_2H_5.C_7H_5O$	By heating to 100° C. in a sealed glass tube a mixture of alcohol and benzoic acid. It is a colorless, oily liquid, with a pleasant aromatic smell and a pungent taste. Sp. gr. 1.051
Ethyl Bromide, C_2H_5Br	By mixing amorphous phosphorus with absolute alcohol, and adding bromine gradually, then distilling carefully, and washing with a small quantity of solution of sodium hydroxide to remove any free bromine. A transparent and colorless liquid. Sp. gr. 1.40. Very volatile. It has a strong ethereal odor and a pungent taste
Ethyl Butyrate, $C_2H_5.C_4H_7O_2$	By heating together a mixture of strong sulphuric acid, butyric acid, and strong alcohol. A transparent, colorless, very thin liquid. It has an odor resembling that of pineapple. Sp. gr. 0.902
Ethyl Cyanide, Hydrocyanic Ether, Propionitrile, C_3H_5N, or $C_2H_5.CN$	A colorless liquid. Sp. gr. 0.78. Very poisonous, but less so than hydrocyanic acid, with which it agrees in therapeutic action and dose
Ethyl Disulphide, C_2H_5S	By acting upon potassium disulphide in concentrated solution with potassium sulphethylate. A colorless, oily liquid, having a very strong odor and a sharp, sweetish taste
Ethyl Iodide, C_2H_5I	By acting upon alcohol with iodine and phosphorus. A colorless, volatile liquid, but gradually turning brown in the light. Slightly soluble in water. Sp. gr. 1.946. Anæsthetic, antispasmodic, and stimulant. Dose, fifteen drops three or four times a day, inhaled from a handkerchief
Ethyl Pelargonate (Grape Oil), $C_2H_5.C_9H_{17}O_2$	By adding sulphuric acid and water to wine lees, and distilling in a current of steam. A colorless, mobile liquid, of a strong vinous odor. Almost insoluble in water, but soluble in alcohol. Sp. gr. 0.860
Ethyl Sulphydrate (Mercaptan), $C_2H_5.HS$	By distilling crystallized calcium sulphethylate with a solution of barium sulphydrate, collecting the product in a well-cooled receiver, then decanting the aqueous portion, and purifying the mercaptan by distilling with mercury, and dehydrating by calcium chloride. A colorless, very mobile liquid, having an alliaceous odor

Unofficial Ethyl, Amyl, and Methyl Compounds, and Allied Products—*Continued*

Ethylsulphuric Acid (Sulphovinic Acid), $C_2H_5.HSO_4$	By reacting upon sulphuric acid with alcohol. It is produced during the preparation of ether
Ethyl Valerate, $C_2H_5.C_5H_9O_2$	A colorless liquid, having a fruity odor, and also one like that of valerian. Sp. gr. 0.866. It is also called ethyl valerianate
Ethylene Bromide, $C_2H_4.Br_2$	Contains 90.9 percent. of bromine. Dose, six drops three times a day
Ethylidene Chloride, Aran's Ether, Wigger's Ether, Ethydene-Chloride, CH_3CHCl_2	A colorless liquid, somewhat resembling chloroform. Sp. gr. 1.175 at 17° C; boiling at 60° C. Anæsthetic
Euphorine, Phenyl Urethane,  $CO{<}\begin{matrix}OC_2H_5\\NH(C_6H_5)\end{matrix}$	Antipyretic, antiseptic, antirheumatic, and analgesic. Dose, eight grains (0.5 Gm.), equivalent to fifteen grains (1 Gm.) of antipyrine
Exalgine, Methylacetanilide, $C_6H_5N(CH_3)CH_3CO$, or $C_9H_{11}NO$	Antipyretic, analgesic, and antispasmodic. Dose, three to six grains (0.2 to 0.4 Gm.), not more than twelve grains being given in twenty-four hours
Formanilide, $C_6H_5NH.COH$	Colorless crystals, readily soluble in water, alcohol, glycerin, and oils. Used as an antipyretic and analgesic in two to five grain (0.13 to 0.3 Gm.) doses. A local anæsthetic, in 3 percent. solution, in subcutaneous injection
Helmitol (Hexamethylene-tetramine-anhydro-methylene-citrate)	Colorless crystals, soluble in 15 parts of water, slowly soluble in alcohol. Used as a urinary antiseptic in doses of fifteen grains (1 Gm.)
Iodal, $CI_3.COH$	Made by the action of iodine on alcohol and nitric acid. It resembles chloral in its therapeutic action
Menthiodol	Prepared by carefully heating 4 parts of menthol in a capsule, adding 1 part of finely powdered iodol, and triturating into a homogeneous mass. Used as a local application in neuralgia
Methacetin, Para-acetanisidine, Paraoxymethylacetanilide, $C_6H_4(OCH_3).NHC_2H_3O$	Antipyretic, analgesic, antirheumatic. Dose, eight grains (0.5 Gm.)
Methyl Acetate, $CH_3.C_2H_3O_2$	(Prepared by processes similar to those employed for obtaining ethyl acetate, *quod vide.*) It is present to some extent in crude wood naphtha. Sp. gr. 0.919. Readily soluble in water
Methyl Chloride, CH_3Cl	By distilling together a mixture of methyl alcohol, sodium chloride, and sulphuric acid. It is a gas at ordinary temperatures, but may be condensed by pressure to a colorless, very mobile liquid. It has an ethereal smell and a sweet taste. Used chiefly as a refrigerating agent
Methyl Iodide, CH_3I	By distilling 1 part phosphorus, 8 parts iodine, and 12 parts methyl alcohol, allowing the distillate to pass into a bottle containing water, then rectifying the product in a water-bath over calcium chloride and lead oxide. A colorless liquid. Sp. gr. 2.23. Vesicant. It is best applied on lint
Methylal,  $CH_2{<}\begin{matrix}OCH_3\\OCH_3\end{matrix}$	A colorless liquid, easily soluble in water, in alcohol, in fatty and in ethereal oils. Used as an hypnotic. Dose, seventy-five to one hundred grains (4.9 to 6.4 Gm.)
Methylene Dichloride, Dichloromethane, Bichloride of Methylene, CH_2Cl_2	A colorless liquid (sp. gr. 1.344), having an odor analogous to that of chloroform. Anæsthetic. Given internally in the dose of ten to thirty minims (0.6 to 2 Cc.)
Methylethylcarbinol,  $\begin{matrix}CH_3\\C_2H_5\end{matrix}{>}CH.OH$	Antipyretic. Isomeric with trimethylcarbinol
Methylic Ether, Oxide of Methyl, $(CH_3)_2O$	Anæsthetic
Pentane (Amylhydride), $CH_3.CH_2.CH_2.CH_2.CH_3$	A colorless, volatile liquid (sp. gr. 0.626), very inflammable. Proposed as an anæsthetic
Phenocoll Hydrochloride,  $C_6H_4\left\{\begin{matrix}OC_2H_5\\NH.COCH_2NH_2HCl\end{matrix}\right.$	Antipyretic, antirheumatic. Dose, eight to twelve grains (0.5 to 0.77 Gm.)
Piperazine, Diethylendiamine,  $N_2\left\{\begin{matrix}H_2\\(C_2H_4)_2\end{matrix}\right.$	Antirheumatic and solvent of uric acid. Dose, fifteen grains (1 Gm.) during the day
Potassium Ethylate, C_2H_5KO	By treating absolute alcohol with potassium. It crystallizes in colorless crystals
Potassium Sulphethylate, $KC_2H_5SO_4$	By acting upon mercaptan with potassium. It is a dull white, granular mass, very soluble in water
Silver Sulphethylate, $AgC_2H_5SO_4$	By adding silver nitrate to an aqueous solution of mercaptan and collecting the white precipitate

Unofficial Ethyl, Amyl, and Methyl Compounds, and Allied Products—*Continued*

Sodium Ethylate, C_2H_5NaO	By treating absolute alcohol with sodium. It crystallizes in broad laminæ
Somnal, $C_7H_{12}Cl_3O_3N$	A compound of chloral, alcohol, and urethane forming a clear, colorless liquid of a burning taste. Used as an hypnotic. Dose, from one-half to one drachm (2 to 4 Gm.)
Sozal, $(C_6H_4(OH)SO_3)_3Al$ Aluminum Paraphenol-sulphonate	Antiseptic. Used in a 1 percent. solution as a wash
Soziodol, Diiodparaphenol-sulphonic Acid, $C_6H_2I_2(SO_3H)OH$	Bactericide. Used as a dusting powder and as a wash in 3 percent. solution
Sulphaminol, $C_{12}H_9S_2NO$ Thioxydiphenylamine	Used as a substitute for iodoform. The dose is four grains (0.25 Gm.). Externally, it may be used in powder or in oily mixtures
Tetronal, $(C_2H_5)_2.C.(SO_2C_2H_5)_2$	Sedative hypnotic. Dose, fifteen to thirty grains (1 to 2 Gm.)
Thymacetin, $C_6H_2.CH_3.C_3H_7\left\{\begin{matrix}OC_2H_5\\NH(C_2H_3O)\end{matrix}\right.$	Antiseptic, analgesic, and hypnotic. Dose, three to fifteen grains (0.2 to 1 Gm.)
Trimethylamine, Propylamine, $N(CH_3)_3$	The chloride is usually preferred for internal use. Dose, seven to twenty grains (0.4 to 1.3 Gm.)

CHAPTER LIV

PRODUCTS OF THE ACTION OF FERMENTS UPON ACID SACCHARINE FRUITS

THE acid saccharine fruits form an important class in medicine and pharmacy. Their principal constituent is usually a vegetable acid (in some fruits several acids are found); sugar and albuminous principles are present in small amount, and on account of their presence vinous fermentation may be induced in their juices, resulting in the production of important alcoholic liquids. The fruits of this class which contribute the most useful products to pharmacy are grapes, lemons, limes, oranges, apples, tamarinds, raspberries, mulberries, pineapples, strawberries, currants, blackberries, etc. Most of the juices of these fruits readily undergo fermentation. The clear alcoholic liquid left after decomposition has received various names according to the fruit from which it is derived,—viz., wine from grapes, cider from apples, perry from pears, etc.

The products from the grape will be considered first.

VINUM ALBUM. U.S. White Wine

An alcoholic liquid, made by fermenting the juice of fresh grapes, the fruit of *Vitis vinifera* Linné (Fam. *Vitaceæ*), freed from seeds, stems, and skins, and subjected to the usual cellar-treatment for fining and aging.

When White Wine is prescribed without further specification, it is recommended that a dry White Wine of domestic production be employed.

White Wine should be preserved in well-closed casks, filled as full as possible, or in well-stoppered bottles, in a cool place.

VINUM RUBRUM. U.S. Red Wine

An alcoholic liquid, made by fermenting the juice of fresh red-colored grapes, the fruit of *Vitis vinifera* Linné (Fam. *Vitaceæ*), in presence of their skins, and subjected to the usual cellar-treatment for fining and aging.

When Red Wine is prescribed without further specification, it is recommended that a dry Red Wine of domestic production be employed.

Red Wine should be preserved in well-closed casks, filled as full as possible, or in well-stoppered bottles, in a cool place.

The grape is the fruit of *Vitis vinifera;* the juice contains grape sugar, tannin, acid potassium tartrate, calcium tartrate, potassium sulphate, sodium chloride, pectin, albuminous principles, and water. It will be seen that grape juice naturally contains all the substances essential to the production of vinous fermentation, a favorable temperature and the presence of the atmosphere alone being needed to convert it into wine.

Preparation.—The grape juice is run into vats, and constitutes the *must.* The temperature of the air being about 15.6° C. (60° F.), fermentation gradually takes place in the must, which becomes sensibly warmer and emits a large quantity of carbon dioxide. The liquor from being sweet becomes vinous, owing to the conversion of the grape sugar into alcohol. When the liquor has acquired a strong vinous taste and become perfectly clear, the wine is considered formed, and is racked off into casks. But even after this stage of the process the fermentation continues for several months. During the whole of this period a frothy matter is formed, which for the first few days collects around the bung, but afterwards precipitates along with coloring matter and tartar, forming a deposit which constitutes the wine lees. Wines are sweet, dry, light, sparkling, still, acid, or rough, according to the character of the grape juice and the method employed in making the wine. When the quantity of sugar in the juice is large, and the amount of ferment insufficient to convert all the sugar into alcohol, a *sweet* wine is produced; if, on the other hand, the quantity of ferment is sufficient to convert all the sugar into alcohol, a *strong* or *generous* wine is formed. If only a moderate amount of sugar is present in the juice, with enough ferment to convert all of it into alcohol, the wine is termed *dry*. A small portion of sugar results in the production of a *light* wine; if a large quantity of ferment is present, however, a *sour* wine is produced, because the fermentation has progressed until acetic acid is formed. Wines are *sparkling* or *still* according as they contain carbon dioxide or not, and, if fermented in contact with the seeds, which contain tannin, they are *rough* or astringent. Two kinds of wine are official,—Vinum Album, white wine, and Vinum Rubrum, red wine. Any of the commercial brands of wine which fulfil the requirements of the Pharmacopœia may therefore be used.

White Wine is officially described as follows:

Official Description.—A pale amber-colored or straw-colored liquid.

Odor and Taste.—Pleasant odor free from yeastiness; fruity, agreeable, slightly spirituous taste without excessive sweetness or acidity.

Specific Gravity.—Not less than 0.990 nor more than 1.010 at 15.6° C. (60° F.).

Test for Identity.—If a portion of White Wine be evaporated, the residue, when dried during twelve hours on a water-bath, should amount to not less than 1.5 nor more than 3 percent.; this residue ignited at a low temperature and burned gradually to whiteness, moistened with a small portion of ammonium carbonate T.S., and again carefully ignited, should weigh not less than 0.14 Gm. nor more than 0.26 Gm. for each 100 Cc. of White Wine tested.

Impurities and Tests for Impurities.—*Limit of free acid.* To neutralize 50 Cc. of White Wine should require not less than 3 nor more than 5.2 Cc. of normal potassium hydroxide V.S., litmus T.S. being used as indicator.

More than traces of tannic acid. If 10 Cc. of White Wine be diluted with an equal volume of water, and treated with 5 drops of ferric chloride T.S., only a faint, greenish-brown color should make its appearance.

Saccharin. If 75 Cc. of White Wine be acidified with 5 Cc. of diluted sulphuric acid (1 in 3), and thoroughly shaken in a separator with a mixture of equal parts of petroleum benzin and ether, and if the solvent, after separation, be transferred to a porcelain dish, allowed to evaporate spontaneously, and the residue dissolved in 3 Cc. of water, the solution should not have a sweet taste.

Salicylic acid. Nor should it give a violet color upon the addition of a diluted solution of ferric chloride (1 in 200).

Quantitative Test.—Tested by the following method, White Wine should be found to contain not less than 7 percent. nor more than 12 percent., by weight (equivalent to 8.5 percent. to 15 percent. by volume), of absolute alcohol:

Take the specific gravity (to four decimals) of a sufficient portion of the White Wine carefully measured at the temperature of 15.6° C. (60° F.), evaporate the wine in a tared dish to one-third of its original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60° F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities deducted from 1.0000 corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the Wine under examination, the corresponding percentage being ascertained by referring to the alcohol tables. (See page 765.)

Red Wine is officially described as follows:

Official Description.—A deep red liquid.

Odor and Taste.—Pleasant odor free from yeastiness; fruity, moderately astringent, pleasant, and slightly acidulous taste, without excessive sweetness or acidity.

Specific Gravity.—Not less than 0.989 nor more than 1.110 at 15.6 C. (60° F.).

Tests for Identity.—If a portion of Red Wine be evaporated, the residue, when dried during twelve hours on a water-bath, should amount to not less than 1.6 percent. nor more than 3.5 percent.; this residue, ignited at a low temperature and burned gradually to whiteness, moistened with a small portion of ammonium carbonate T.S., and again carefully ignited, should weigh not less than 0.22 Gm. nor more than 0.34 Gm. for each 100 Cc. of Red Wine tested.

If 10 Cc. of Red Wine be diluted with an equal volume of water, and treated with 5 drops of ferric chloride T.S., the liquid should acquire a brownish-green color (presence of *tannic acid*).

With lead acetate T.S. Red Wine forms a heavy precipitate which may vary in color from bluish-green to green.

Impurities and Tests for Impurities.—*Limit of free acid.* To neutralize 50 Cc. of Red Wine should require not less than 3 Cc. nor more than 5.2 Cc. of normal potassium hydroxide V.S., litmus T.S. being used as indicator.

Red aniline colors. If 50 Cc. of Red Wine be treated with a slight excess of ammonia water, the liquid should acquire a green or brownish-green color; if it be then well shaken with 25 Cc. of ether, the greater portion of the ethereal layer removed, and evaporated in a porcelain dish with an excess of acetic acid and a few fibres of uncolored silk, the latter should not acquire a crimson or violet color.

Acid fuchsine. If 25 Cc. of Red Wine, heated to about 45° C. (113° F.), be well agitated with 25 Gm. of manganese dioxide, the liquid filtered off and acidulated with hydrochloric acid, it should not acquire a red color.

Saccharin. If 75 Cc. of Red Wine be acidified with 5 Cc. of diluted sulphuric acid (1 in 3) and thoroughly shaken in a separator with a mixture of equal parts of petroleum benzin and ether, and if the solvent after separation be transferred to a porcelain dish, allowed to evaporate spontaneously, and the residue dissolved in 3 Cc. of water, the solution should not have a sweet taste.

Salicylic acid. Nor should it give a violet color upon the addition of a diluted solution (1 in 200) of ferric chloride.

Quantitative Test.—Tested by the following method, Red Wine should be found to contain not less than 7 percent. nor more than 12 percent., by weight (equivalent to 8.5 percent. to 15 percent. by volume), of absolute alcohol:

Take the specific gravity (to four decimals) of a sufficient portion of the Red Wine accurately measured at the temperature of 15.6° C. (60° F.), evaporate the Wine in a tared dish to one-third of its original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60° F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities deducted from 1.0000 corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the Wine under examination, the corresponding percentage being ascertained by referring to the alcohol tables. (See page 765.)

The explanation of the official quantitative test for the amount of alcohol in wine is based upon the assumption that when the alcohol from a measured weight of wine at a given temperature is entirely evaporated without boiling or wasting it, and when the original volume has been exactly restored by the addition of pure water at the same temperature, the difference between the two specific gravities deducted from 1.0000 expresses the specific gravity of an alcoholic liquid of the same strength as that in the wine. By referring to the alcohol table the percentage of alcohol by weight corresponding to this specific gravity is ascertained, and thus the percentage of alcohol in the wine is obtained.

An example will illustrate this. The original specific gravity of a sample of wine is 0.9875 at 15.6° C.; after the evaporation of the alcohol and the restoration of the original volume, the specific gravity is found to be 1.0080. This figure represents the solids and water in the wine. If the specific gravity of water (1.0000) now be subtracted from this, the resulting figure will be 0.0080, which represents the solids and may be used as a correction factor in the original specific gravity. Subtracting therefore 0.0080 from 0.9875, a figure is obtained (0.9795) which upon referring to the alcohol table, indicates about 13 percent. of alcohol by weight, or 17 percent. by volume.

The aroma of wines, termed their "bouquet," depends upon the formation of certain esters during the fermentation, and also during the aging or ripening process. These are said to be *œnanthic, caprylic, butyric, caproic, acetic*, and *pelargonic ethers.*

Argol.—During the fermentation of wines, especially those that are acid, a peculiar matter is deposited upon the sides and bottom of the casks, forming a crystalline crust, called *crude tartar*, or *argol.* That deposited from red wines is of a reddish color, and is called *red argol;* that derived from white wines is of a dingy white color, and is denominated *white argol.* Both kinds consist of acid potassium tartrate rendered impure by calcium tartrate, more or less coloring matter, and other substances which are deposited during the clarification of the wine. The deposition of the tartar is thus explained; the acid tartrate exists naturally in the juice of the grape, held in solution by the sweet aqueous liquid; when the juice is submitted to fermentation in the process for converting it into wine, the sugar disappears, and is replaced by alcohol, in which the salt is insoluble. It is from this substance that acid potassium tartrate is obtained by a process of purification (see Potassii Bitartras, page 517), and from the latter tartaric acid is produced.

Uses.—Wine is used, pharmaceutically, as a menstruum (see Vinum Album, page 368), the present requirements being that it shall contain, when fortified, from 20 to 25 percent., by weight, of absolute alcohol. This insures greater stability in the medicated wines. Medicinally, wine is used as a stimulant.

SPIRITUS VINI GALLICI. U. S. Brandy

An alcoholic liquid obtained by the distillation of the fermented, unmodified juice of fresh grapes.

Brandy varies in quality according to the source from which it is obtained. The best brandy is obtained from French wines, and the kind called Cognac is most esteemed. Very large quantities of brandy are now made in California, but the taste is peculiar and easily distinguished from that of Cognac. The Pharmacopœia recognizes all spirits when obtained from the juice of grapes, if sufficiently strong and pure to meet the tests given below.

Brandy owes its aroma to œnanthic and acetic ethers and other volatile products. (See Vinum Album.) Œnanthic ether is known chemically as ethyl pelargonate, $C_{11}H_{22}O_2$, but in commerce it is called *oil of cognac.* It is a fragrant, ethereal oil, of a greenish color, and is largely used in making factitious brandy.

Official Description.—A pale amber-colored liquid. Brandy should be at least four years old.
Odor, Taste, and Reaction.—Distinctive odor and taste; slightly acid reaction.
Specific Gravity.—Not more than 0.941 nor less than 0.925 at 15.6° C. (60° F.), corresponding, approximately, to an alcoholic strength of 39 to 47 percent. by weight, or 46 to 55 percent. by volume, of absolute alcohol (see Alcohol Tables, page 765.)
Impurities and Tests for Impurities.—*Fusel oil from grain or potato spirit.* If 100 Cc. of Brandy be slowly evaporated in a tared dish on a water-bath, the last portions volatilized should have an agreeable odor free from harshness.

Added sugar, glycerin, and aromatic substances. The residue, when dried at 100° C. (212° F.), should not weigh more than 0.5 Gm. This residue should have no sweet or distinctly spicy taste.

More than traces of oak tannin from casks. This residue should almost completely dissolve in 10 Cc. of cold water, forming a solution which is colored not deeper than light green by a few drops of ferric chloride T.S. diluted with 10 volumes of water.

Limit of free acid. To render 100 Cc. of Brandy distinctly alkaline to litmus, not more than 1 Cc. of normal potassium hydroxide V.S. should be required.

Uses.—Brandy is not used in any official preparation. It is employed as a stimulant, and often administered with milk, yolk of eggs, etc.; under the name of *Mistura Spiritus Vini Gallici* a preparation is official in the British Pharmacopœia which contains in addition, cinnamon water and sugar. (See page 305.)

ACIDUM TARTARICUM. U.S. Tartaric Acid

$H_2C_4H_4O_6 = 148.92$

A dibasic organic acid [$C_2H_2(OH)_2(COOH)_2$], usually prepared from argol. It should contain not less than 99.5 percent. of pure Tartaric Acid.

Preparation.—This important acid may be prepared by saturating the excess of acid in acid potassium tartrate or cream of tartar with calcium carbonate, and decomposing the resulting insoluble calcium tartrate by sulphuric acid, which precipitates in combination with the lime as calcium sulphate, and liberates the tartaric acid. The process, when thus conducted, furnishes only one-half of the tartaric acid. The other half may be procured by decomposing the neutral potassium tartrate remaining in the solution after the precipitation of the calcium tartrate by calcium chloride in excess. By double decomposition, potassium chloride will be formed in solution, and a second portion of calcium tartrate will precipitate, which may be decomposed by sulphuric acid together with the first portion.

$$\underset{\substack{\text{Acid Potassium}\\\text{Tartrate}}}{2KHC_4H_4O_6} + \underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3} = \underset{\substack{\text{Potassium}\\\text{Tartrate}}}{K_2C_4H_4O_6} + \underset{\substack{\text{Calcium}\\\text{Tartrate}}}{CaC_4H_4O_6} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide}}}{CO_2}$$

then

$$\underset{\substack{\text{Potassium}\\\text{Tartrate}}}{K_2C_4H_4O_6} + \underset{\substack{\text{Calcium}\\\text{Chloride}}}{CaCl_2} = \underset{\substack{\text{Calcium}\\\text{Tartrate}}}{CaC_4H_4O_6} + \underset{\substack{\text{Potassium}\\\text{Chloride}}}{2KCl}$$

and

$$\underset{\substack{\text{Calcium}\\\text{Tartrate}}}{2CaC_4H_4O_6} + \underset{\substack{\text{Sulphuric}\\\text{Acid}}}{2H_2SO_4} = \underset{\substack{\text{Calcium}\\\text{Sulphate}}}{2CaSO_4} + \underset{\text{Tartaric Acid}}{2H_2C_4H_4O_6}$$

Calcium sulphate is sometimes substituted for calcium chloride in the second stage of the decomposition. Tartaric acid is a dibasic acid; one or two of its hydrogen atoms are capable of being replaced by metals. With monad metals, acid, neutral, and double tartrates may be formed, thus:

$$\underset{\text{Tartaric Acid}}{\begin{matrix}C_4H_4O_6\\H_2\end{matrix}} \qquad \underset{\substack{\text{Acid Potassium}\\\text{Tartrate}}}{\begin{matrix}C_4H_4O_6\\HK\end{matrix}} \qquad \underset{\substack{\text{Neutral Potas-}\\\text{sium Tartrate}}}{\begin{matrix}C_4H_4O_6\\K_2\end{matrix}} \qquad \underset{\substack{\text{Potassio-Sodium}\\\text{Tartrate}}}{\begin{matrix}C_4H_4O_6\\KNa\end{matrix}}$$

Tartaric acid contains no water of crystallization. The tartrates are important salts. Five are official, four of them being double salts,—viz., antimony and potassium tartrate, iron and potassium tartrate, iron and ammonium tartrate, potassium and sodium tartrate; the other salt is potassium bitartrate. Tartrates may be recognized by becoming blackened on the addition of sulphuric acid, evolving at the same time an empyreumatic odor. Their solutions, if neutral, yield with calcium chloride white precipitates of calcium tartrate, which are soluble in solution of potassium hydroxide. Tartaric acid is recognized by a strong solution producing with a solution of potassium hydroxide a crystalline precipitate of acid potassium tartrate.

Official Description.—Colorless, translucent, monoclinic prisms, or crystalline crusts, or a white powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless, having a purely acid taste; acid reaction.

Solubility.—*Water.* In 0.71 part at 25° C. (77° F.); in about 0.5 part of boiling water.

Alcohol. In 1.67 parts of alcohol at 25° C. (77° F.); in about 0.2 part of boiling alcohol.

Other solvents. In 250 parts of ether; nearly insoluble in chloroform, benzene, or petroleum benzin.

Tests for Identity.—When heated for some time at 100° C. (212° F.), the powdered crystals do not suffer a sensible loss of weight. From 168° to 170° C. (334.4° to 338° F.) the Acid melts. At a higher temperature it is gradually decomposed, emitting an odor resembling burning sugar, and is finally consumed, leaving not more than 0.05 percent. of ash.

An aqueous solution (1 in 2) of the Acid mixed with a strong solution (1 in 3) of potassium acetate yields a white crystalline precipitate, which is soluble in solutions of alkalies and in mineral acids, but insoluble in acetic acid.

Impurities and Tests for Impurities.—*Limit of sulphuric acid.* The aqueous solution (1 in 10) of the Acid, acidulated with a few drops of hydrochloric acid, should show but a faint turbidity by barium chloride T.S.

Absence of, and difference from, oxalic acid. An aqueous solution (1 in 10) in which the free Acid has been nearly but not entirely neutralized by ammonia water, should not be affected by calcium sulphate T.S.

More than a trace of calcium. On supersaturating 10 Cc. of the aqueous solution (1 in 10) with ammonia water, no more than a faint turbidity should be produced in the liquid by ammonium oxalate T.S.

Heavy metals. Nor should the above aqueous solution (1 in 20) mixed with a few drops of hydrochloric acid show any color in the acid solution when submitted to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII), omitting the subsequent addition of ammonia water.

Quantitative Test.—To neutralize 3.73 Gm. (3.723) of Tartaric Acid should require not less than 49.8 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 2 percent. of pure Tartaric Acid), phenolphthalein T.S. being used as indicator.

Uses.—Tartaric acid is used in making diluted hydriodic acid, and enters into the preparation of the following granular effervescent salts: effervescent citrated caffeine, lithium citrate, magnesium sulphate, potassium citrate, and sodium phosphate; it is also an ingredient in compound effervescent powder.

Official Preparation containing Tartaric Acid

Pulvis Effervescens Compositus Compound Effervescent Powder (Seidlitz Powder)	Prepared by wrapping 35 grains (2.25 Gm.) of powdered tartaric acid in white paper, and 160 grains (10.3 Gm.) of Seidlitz mixture (composed of 40 grains (2.59 Gm.) of sodium bicarbonate and 120 grains (7.75 Gm.) of Rochelle salt) in blue paper. (See Pulveres)

LIMONIS SUCCUS. U. S. Lemon Juice

The freshly expressed juice of the ripe fruit of *Citrus Limonum* Risso (Fam. *Rutaceæ*).

Lemon juice owes its acidity to citric acid (see Acidum Citricum), and it can only be preserved with difficulty. It is generally heated so as to coagulate albuminous matter, and then a small quantity of alcohol is added as an antiseptic.

Official Description.—A slightly turbid, yellowish liquid.

Odor, Taste, and Reaction.—Odor of lemon; taste acid and often slightly bitter. It reddens blue litmus paper and should contain from 7 to 9 percent. of citric acid.

Specific Gravity.—1.030 to 1.040 at 25° C. (77° F.).

Impurities and Tests for Impurities.—*Sulphuric acid or sulphates.* If a few drops of barium chloride T.S. be added to filtered Lemon Juice, no turbidity or white precipitate should be produced.

Acetic acid. If an equal volume of sulphuric acid containing a few drops of alcohol be added to Lemon Juice, and the liquid heated, no odor of acetic ether should be developed.

Tartaric acid.—Upon the addition of solution of potassium acetate (1 in 3) and alcohol in excess, no white crystalline precipitate should form after allowing the liquid to stand fifteen minutes.

Quantitative Test.—At least 10 Cc. of normal potassium hydroxide V.S. should be required to neutralize 10 Cc. of Lemon Juice, phenolphthalein T.S. being used as indicator.

Uses.—Lemon juice is used as an antiscorbutic and as an ingredient in true neutral mixture and real syrup of lemon.

ACIDUM CITRICUM. U. S. Citric Acid

$$H_3C_6H_5O_7 + H_2O = 208.50$$

A tribasic organic acid [$C_3H_4(OH)(COOH)_3 + H_2O$], usually prepared from the juice of limes or lemons. It should contain not less than 99.5 percent. of pure Citric Acid.

Preparation.—Although this acid is found in many plants, it is obtained upon a commercial scale only from the juice of limes[1] and lemons. It is extracted from *lime juice* by a very simple process, but one requiring some careful manipulation. The boiling juice is first completely saturated with calcium carbonate (chalk or whiting) in fine powder, and the calcium citrate formed is allowed to subside. This is then washed repeatedly with water, and decomposed by diluted sulphuric acid. An insoluble calcium sulphate is precipitated, and the disengaged citric acid remains in solution. This is carefully concentrated in leaden boilers until a pellicle begins to form, when it is transferred to other vessels to cool and crystallize.

$$\underset{\substack{\text{Citric Acid in}\\ \text{Lime Juice}}}{2H_3C_6H_5O_7} + \underset{\substack{\text{Calcium}\\ \text{Carbonate}}}{3CaCO_3} = \underset{\text{Calcium Citrate}}{Ca_32C_6H_5O_7} + \underset{\text{Water}}{3H_2O} + \underset{\substack{\text{Carbon}\\ \text{Dioxide}}}{3CO_2}$$

$$\underset{\text{Calcium Citrate}}{Ca_32C_6H_5O_7} + \underset{\text{Sulphuric Acid}}{3H_2SO_4} = \underset{\text{Citric Acid}}{2H_3C_6H_5O_7} + \underset{\text{Calcium Sulphate}}{3CaSO_4}$$

Citric acid contains one molecule of water of crystallization. It differs in this respect from tartaric acid, which contains none. It is a tribasic acid; in other words, three atoms of hydrogen are replaceable by metals, three classes of citrates being formed according as one, two, or three hydrogen atoms are replaced.

The citrates are a valuable class of medicinal salts, twelve being official,—five of which are simple salts, two are granular effervescent, and five are double,—as follows: bismuth, iron, lithium, potassium and sodium citrates, effervescent lithium citrate, effervescent potassium citrate, bismuth and ammonium citrate, iron and ammonium citrate, iron and quinine citrate, soluble iron and quinine citrate, iron and strychnine citrate. It is used in two solutions,—solution of magnesium citrate and solution of potassium citrate. It is an ingredient in compound solution of sodium phosphate, syrup of citric acid, syrup of orange, syrup of lactucarium, and all of the effervescent granular salts.

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[1] Limes—the fruit of *Citrus acris*—are usually smaller than lemons, and abound in a very acid juice.

Official Description.—Colorless, translucent, right-rhombic prisms; efflorescent in warm air, and deliquescent when exposed to moist air.

Odor, Taste, and Reaction.—Odorless; having an agreeable, purely acid taste; acid reaction.

Solubility.—*Water.* In 0.54 part of water at 25° C. (77° F.); in about 0.4 part of boiling water.

Alcohol. In 1.55 parts of alcohol at 25° C. (77° F.); in 1.43 parts of boiling alcohol.

Other solvents. In 18 parts of ether.

Tests for Identity.—When heated to about 75° C. (167° F.), the Acid begins to lose its water of crystallization; at about 135° C. (275° F.) it becomes anhydrous, and melts between 152° and 153° C. (305.6° and 307.4° F.).

When slowly ignited, it is gradually decomposed without emitting an odor resembling burning sugar (difference from *tartaric acid*), and is finally consumed without leaving more than 0.05 percent. of residue.

On adding 1 Cc. of an aqueous solution of the Acid (1 in 10) to 50 Cc. of calcium hydroxide T.S. (or sufficient of the latter to render the mixture alkaline) the liquid remains clear. Upon boiling this for about one minute, it becomes opaque through the precipitation of calcium citrate, which redissolves on cooling.

Impurities and Tests for Impurities.—*Calcium.* On mixing 5 Cc. of an aqueous solution of the Acid (1 in 10) with a quantity of ammonia water insufficient to neutralize it completely, and adding to this liquid 1 Cc. of ammonium oxalate T.S., it should remain clear:

Heavy metals. The aqueous solution (1 in 20), mixed with a few drops of hydrochloric acid should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII) omitting the subsequent addition of ammonia water.

Limit of sulphuric acid. If to 10 Cc. of the aqueous solution of the Acid (1 in 100) a few drops of hydrochloric acid be added, followed by 1 Cc. of barium chloride T.S., no turbidity should result within five minutes.

Quantitative Test.—If 5 Gm. of Citric Acid be dissolved in sufficient water to measure 100 Cc., then 34.75 Cc. of this solution should require not less than 24.87 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 4 percent. of pure Citric Acid), phenolphthalein T.S. being used as indicator.

Uses.—Citric acid in solution is used as a substitute for lemon juice. The dose is from five to thirty grains (0.3 to 2 Gm.). It is rarely given in its free state, but is largely used in combination and in many solutions and syrups, and in making effervescent salts.

TAMARINDUS. U.S. Tamarind

The preserved pulp of the fruit of *Tamarindus indica* Linné (Fam. *Leguminosæ*).

A pulpy mass of a light reddish-brown color, darkening with age so as to become dark brown, containing some branching fibers and numerous reddish-brown, smooth, oblong or quadrangular, compressed seeds, each enclosed in a tough membrane; odor distinct; taste sweet and agreeably acid.

Among the constituents of the pulp of tamarinds are citric and tartaric acids; malic acid is present in small quantity.

It frequently contains traces of copper on account of its being evaporated in copper kettles.

Uses.—This pulp is one of the ingredients in confection of senna. It is purgative, and is often used to make laxative confections. The dose is four drachms (16 Gm.).

RHUS GLABRA. U.S. Rhus Glabra

The dried fruit of *Rhus glabra* Linné (Fam. *Anacardiaceæ*).

Flattened-ovoid, 3 to 4 Mm. in diameter, externally deep crimson, glandular-tomentose; endocarp light yellow, smooth, shiny, enclosing a single seed; inodorous; taste acidulous and astringent.

This fruit owes its acidity to malic acid, which exists in it as calcium and potassium malate. This acid is found in unripe apples and in a great number of fruits, roots, leaves, stems, etc. Rhus glabra also contains tannin, gallic acid, and red coloring matter.

Malic acid may be obtained from rhus glabra by exhausting the berries with water, evaporating, filtering, and crystallizing the acid calcium malate, which is then dissolved in boiling water, and treated with lead acetate, when lead malate is precipitated ; this is then suspended in water, hydrogen sulphide is passed through it, lead sulphide is precipitated, and the solution of malic acid is evaporated to permit crystallization. Malic acid is found in colorless shining needles having a sour taste and an acid reaction. It is soluble in alcohol and deliquescent in the air. It is dibasic.

Uses.—Rhus glabra is a useful refrigerant and astringent. The dose is fifteen grains to one drachm (1 to 4 Gm.).

Official Preparation

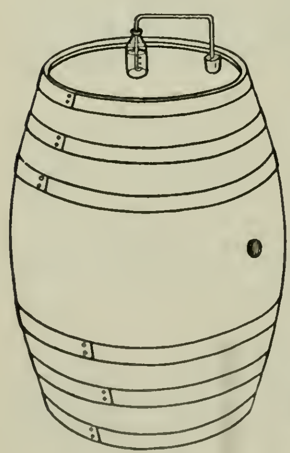
Fluidextractum Rhois Glabræ Fluidextract of Rhus Glabra	Made with 10 percent. of glycerin and a menstruum of diluted alcohol (see page 413).

Acid Saccharine Fruits containing Pectinous Bodies.

The pulpy constituents of fruits and fleshy roots undergo naturally certain changes when subjected to the influences of a ferment known as *pectase*. These changes can be closely imitated artificially when the pulp is treated with acids or alkalies in aqueous solution, by the aid of heat. According to Fremy, pectase exists in fruits in either a soluble or an insoluble condition. Green unripe fruits contain *pectose*, a substance which is supposed to be isomeric with cellulin, and which gives to such fruits their hardness. Pectose is insoluble in water, alcohol, or ether.

In the process of ripening fruits, the pectase slowly acts on the pectose, the hardness disappears, *pectin* is formed, and the fruit is soft and ripe. When it is overripe, *parapectin* and *metapectic acid* are produced. The moderate action of heat and water upon fruits is thus explained. The citric, tartaric, or malic acid in the fruit acts on the pectose, softening it, and converting it into pectin, and the pectin is then acted upon by the ferment pectase, which causes it to gelatinize, on cooling, through the production of pectosic acid. This is the cause of the formation of fruit jellies. The *rapid* application of strong heat to the pulp of fruits results in the coagulation and destruction of the ferment pectase, and the production of jelly is thus prevented.

Fig. 448



Preparation of fruit juice by fermentation

Alkalies form soluble compounds with pectosic acid and pectin, and hence, when gelatinous precipitates are found in fluidextracts and tinctures, due to the formation of either of these substances, they may be dissolved by the application of an alkaline solution. The use of solution of potassium hydroxide in fluidextract of senega is an illustration of this.

Fruit Juices.—These are largely used for flavoring syrups, and for use in dispensing soda water. They are made by expressing the juice from fresh fruits, and bottling as directed in the chapter on syrups (see page 284). They are often made by separating the pectinous substances by fermentation (see Fig. 448). A stout cask is selected and arranged as shown in the illustration; it is tightly closed, but provided with a suitable means of escape for the carbon dioxide. The fermentation is known to have stopped when gas bubbles no longer escape through the water contained in the bottle. The addition of 2 percent. of sugar to the weight of the fruit facilitates fermentation, aids in the filtration, and in preserving the color of the juice.

There are no official fruits belonging to this class, the raspberry, official in the U. S. P. 1890, having been dismissed in the present revision, but it includes many well known fruits as given below:

Unofficial Fruits

Apple	The fruit of *Pyrus malus*. The constituents are 7 to 10 percent. sugar, ½ to 1 percent. free acid, and 5 percent. each albuminous and pectinous substances. The fermented juice of the apple is termed *cider* or *vinegar*
Apricot	The fruit of *Prunus Armeniaca*. The average constituents are 1 to 2 percent. sugar, ½ to 1 percent. free acid, ½ to 1 percent. albuminous substances, and 5 to 10 percent. pectinous substances
Blackberry	The fruit of *Rubus villosus*, *R. canadensis*, and *R. trivialis*. The average constituents are 4 percent. sugar, 1 percent. free acid, ½ percent. albuminous substances, and 1 to 1½ percent. pectinous substances
Bilberry	The fruit of *Vaccinium resinosum*. The average constituents are 5 percent. sugar, 1 percent. free acid, 1 percent. albuminous substances, and ½ percent. pectinous substances
Cherry	The fruit of a species of *Prunus*. The average constituents are 8 to 13 percent. sugar, 1 percent. free acid, and ½ to 3 percent. each albuminous and pectinous substances
Currant	The fruit of *Ribes rubrum*. The average constituents are 4 to 7 percent. sugar, 1 to 2 percent. free acid, ¼ to ½ percent. albuminous substances, and ⅙ percent. pectinous substances
Gooseberry	The fruit of *Ribes Grossularia*. The average constituents are 6 to 8 percent. sugar, 1 to 1½ percent. free acid (chiefly citric), ½ percent. albuminous substances, and ½ to 2 percent. pectinous substances
Peach	The fruit of *Amygdalus Persica*. The average constituents are 1½ percent. sugar, ½ percent. free acid, ½ percent. albuminous substances, and 6 percent. pectinous substances
Pear	The fruit of *Pyrus communis*. The average constitutents are 7 percent. sugar, 7 percent. free acid, ¼ percent. albuminous substances, and 3 percent. pectinous substances
Pineapple	The fruit of *Ananassa sativa*. The juice contains 2 percent. sugar, 1 percent. free acid, and 3 percent. albuminous and pectinous substances
Plum	The fruit-trees belonging to the genus *Prunus*. The average constituents are about 1 to 2 percent. sugar, ½ to 1 percent. free acid, ½ percent. albuminous substances, and 2 to 11 percent. pectinous substances
Raspberry	The fruit of *Rubus idæus* (Fam. Rosaceæ) U. S. P. 1890. The average constituents are 3 to 5 percent. sugar, 1 percent. free acid, 1 percent. albuminous substances, and 2 to 5 percent. pectinous bodies
Strawberry	The fruit of different species of *Fragaria*. The average constituents are 3 to 7 percent. sugar, 1 percent. free acid, ½ percent. albuminous substances, and 2 percent. pectinous substances

CHAPTER LV

VOLATILE OILS

VOLATILE OILS, or *essential oils*, are found in the various parts of plants. They usually constitute the odorous principles, and they either pre-exist in the plant, or are produced by the reaction of certain constituents when brought in contact with water. Volatile oils are sometimes formed through destructive distillation, as the oil of amber, and may also be obtained from the animal kingdom, as the oil from ambergris. They may be conveniently divided into four classes: 1. Terpenes. 2. Oxygenated oils. 3. Sulphurated oils. 4. Nitrogenated oils.

1. **Terpenes,** or hydrocarbons, consisting of carbon and hydrogen, and mostly having the formula $C_{10}H_{16}$, oil of turpentine being the type.

2. **Oxygenated Oils.**—Hydrocarbons containing oxygen, like the oil of cinnamon.

3. **Sulphurated Oils.**—Containing sulphur, like the volatile oil from mustard.

4. **Nitrogenated Oils.**—A very small class containing hydrocyanic acid, like true oil of bitter almond; otherwise, nitrogen is never one of the constituents of volatile oils.

While the above classification may be deemed sufficient for the needs of the pharmacist, it is not adequate in view of the elaborate researches of Wallach and other chemists who have worked with zeal upon the problems of the constituents of volatile oils (see Gildemeister and Hoffman's work on The Volatile Oils, translated from the German by Professor E. Kremers). A comprehensive and satisfactory classification, including the latest researches, cannot well be made at this time, as the subject is in a transition stage. The hydrocarbons are widely distributed. The oxygenated substances are of great interest because they are mainly the bearers of the characteristic odors of the oil in which they exist. In addition to the terpenes there have been found alcohols, aldehydes, acids, esters, ketones, phenols, phenolethers, lactones, oxides, sulphides, nitriles, and isothiocyanates.

Many synthetic products are now to be found in commerce like methyl salicylate, benzaldehyde, etc., which are identical chemically with the volatile oils obtained from plants. Some of these products have been admitted to the U. S. P. (8th Rev.).

Proximately, volatile oils consist mainly of two principles, which differ in their point of volatilization or congelation, or in their composition. They are termed *stearoptene* and *eleoptene*. It is, however, impossible to separate these by distillation alone so as to obtain them entirely pure. When, as often happens, they congeal at different temperatures, they may be separated by compressing the frozen oil between folds of bibulous paper. The solid matter, stearoptene, remains within the folds, and the fluid, eleoptene, is absorbed by the paper, from which it may be separated by distillation with water. The solid crystalline substances deposited by volatile oils upon standing are also called stearoptenes. Some of them are denominated *camphors*, from their resemblance to true camphor. Some are isomeric with the oils in which they are formed; others are oxides or hydroxides, alcohol-like in character. Certain oils, under the influence of water, deposit crystalline hydroxides of the respective oils.

Color of Volatile Oils.—Most oils are colorless when pure and fresh, or can be made colorless by redistillation. Upon exposure to the air they acquire various colors, becoming green, as in oil of wormwood; yellow, as in oil of peppermint; red, as in oil of origanum; brown, as in oil of cinnamon; or blue, as in oil of chamomile.

Odor.—The odor of volatile oils is very variable. It is their most characteristic feature. It is sensibly modified by the exposure of the oils to the air. Oil of turpentine may be rectified by distillation in an atmosphere of carbon dioxide, or *in vacuo*, so that it will be odorless, or have an agreeable, fragrant odor. A very slight exposure to the air is sufficient, however, to restore the well known unpleasant odor.

Taste.—Their taste is almost as variable as their odor. Some are sweet, others have a mild, pungent, hot, acrid, caustic, or burning taste.

Density.—The specific gravity of official volatile oils also varies (from 0.842 to 1.172). They are mostly lighter than water (see table, page 90).

Boiling Point.—This is also variable. The oils volatilize to some extent at ordinary temperatures and diffuse their peculiar odors. Upon heating, however, they may be completely vaporized. When sufficiently heated, they take fire, and burn with a bright flame.

Solubilities.—Water is a poor solvent for volatile oils, although it acquires a decided odor and flavor when brought in contact with the oil in a finely divided state, as has been shown in the medicated waters. Alcohol, ether, chloroform, naphtha, glacial acetic acid, petroleum benzin, and benzene are solvents for volatile oils. Alcohol is a better solvent for the oxygenated oils than for the terpenes. Volatile oils freely dissolve fixed oils, fats, resins, camphors, sulphur, phosphorus, and similar bodies.

Exposure to Light and Air injures the quality and destroys the fragrance of volatile oils. Ozone is developed, and they thicken and become resinified, or deposit crystalline compounds upon exposure. The whitening of corks which have been inserted in bottles containing volatile oils and kept a long time is due to the bleaching action of the ozone which is gradually produced during their decomposition. Volatile oils should be kept in tightly stoppered, amber-colored vials.

Action of Acids, Alkalies, etc.—Nitric acid, if strong, decomposes volatile oils with great rapidity. Iodine reacts with some oils with explosive violence. Alkalies have generally little effect on volatile oils, with the exception of a few with which it forms chemical compounds, like the oils from cloves, gaultheria, cinnamon, etc.

Adulterations.—The volatile oils are costly enough to tempt the cupidity of some manufacturers of these products. A fixed oil is sometimes used to mix with the volatile oil. This mixture may be detected by dropping the suspected oil on a piece of filtering paper. The stain of a pure volatile oil is not permanent. By slightly heating it the oil is vaporized; if fixed oil is present, the stain remains. Alcohol may be detected by shaking the mixed oil in a graduated tube with glycerin or water. The volume of the oil will be diminished, and that of the water or glycerin correspondingly increased, in proportion to the amount used. This test is not susceptible of fine determination, because of the slight solubility of volatile oils in water and in mixtures of alcohol and water. Metallic sodium, calcium chloride, aniline red, have all been used to show the presence of alcohol and traces of water in volatile oils. The adulteration of volatile oils by the addition of cheaper grades of the same oil, or by using a cheaper oil having a similar odor, is largely practised. The only reliable test here is the use of the olfactories. By practice the sense of smell can be highly educated by the analyst. The specific rotary power, the index of refraction, the amount of iodine absorbed, and the saponification number, or the amount of potassium hydroxide absorbed by the ester to form a potassium salt, have all been used with more or less success in detecting adulterations. The detection of adulterations in volatile oils is very difficult, and as a rule those who practise this nefarious art are very skilful. The U. S. P. (8th Rev.) has included a number of assays to indicate the required percentage of the valuable constituents.

Preparation of Volatile Oils

Volatile oils are generally obtained from plants by the following methods: 1. Distillation with steam. 2. Distillation *per se*. 3. Expression. 4. Solution.

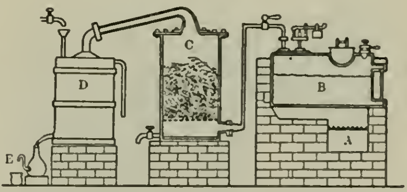
1. **Distillation with Steam.**—This is the method most frequently employed. The general formula is as follows: Put the substance from which the oil is to be extracted into a still (see Distillation, page 140), and add enough water to cover it; then distil by a regulated heat into a large condenser. Separate the distilled oil from the water which comes over with it.

The substances from which the volatile oils are extracted may be employed in either the recent or the dried state. Certain flowers, however, such as orange flowers and roses, must be used fresh, or preserved with salt or by means of glycerin, as they afford little or no oil after desiccation. Dried substances, before being submitted to distillation, require to be macerated in water till they are thoroughly penetrated by this fluid; and, to facilitate the action of the water, it is necessary that, when of a hard or tough consistence, they should be properly comminuted.

The water which is added to the substance to be distilled answers the double purpose of preventing the decomposition of the vegetable matter by regulating the temperature, and of facilitating the volatilization of the oil, which, though in most instances it readily rises with the vapor of boiling water, requires, when distilled alone, a considerably higher temperature, and is at the same time liable to be partly decomposed. Some oils, however, will not ascend readily with steam at 100° C. (212° F.), and in the distillation of these it is customary to use water saturated with common salt, which does not boil under 108.4° C. (227.1° F.) (see page 123). Other oils, again, may be volatilized with water at a temperature below the boiling point; and, as heat exercises an injurious influence over the oils, it is desirable that the distillation should be effected at as low a temperature as possible. To prevent injury from heat, it has been recommended to suspend the substance containing the oil in a basket, or to place it upon a perforated shelf, in the upper part of the still, so that it may be penetrated by the steam without being in direct contact with the water. Another mode of effecting the same object is to distil it *in vacuo*. Steam can be very conveniently applied to this purpose by causing it to pass through a coil of tube, of an inch or three-quarters of an inch bore, placed in the bottom of a common still (see page 128). The end of the tube or steam pipe enters the still at the upper part, and the other end, at which the steam and condensed water escape, passes out laterally below, being furnished with a stopcock, by which the pressure of the steam may be regulated, and the water drawn off when necessary. In some instances it is desirable to conduct the steam immediately into the still near the bottom, by which the contents are kept in a state of brisk ebullition (see Fig. 112).

The quantity of water added is not a matter of indifference. An amount above that which is necessary acts injuriously by holding the oil in solution when the mixed vapors are condensed; and if the proportion be very large, it is possible that no oil whatever may be separated. On the contrary, if the quantity be too small, the whole of the oil will not be distilled, and there will be danger of the substance in the still adhering to the sides of the vessel and thus becoming burnt. The cage shown on page 212 will be found useful in this connection. Sometimes the quantity of oil is so small that it entirely dissolves in the water, and then the process of *cohobation* is applicable; this consists in repeatedly returning the distillate to a fresh portion of the plant, the water in this way becoming supersaturated, and then the oil can be separated. Fig. 448*a* illustrates the ordinary method of distilling volatile oils from plants. A shows the fire box, B the steam boiler, C the tank containing the plant on the slat or perforated bottom, and D the condenser.

FIG. 448*a*



Distillation of volatile oils

2. **Distillation** *per se*.—By this is meant the distillation of certain bodies without the use of water (*per se*, "by itself"). This is done in the cases of certain oleoresins, oils, copaiba, etc., water not being required in the process, and always being difficult to separate from the distillate.

3. **Expression** (see page 244).—This method generally produces the most fragrant products, because there are very few volatile oils whose aroma is not injuriously affected by the action of heat. The

volatile oils of the Rutaceæ are mostly made by expressing the rind of the fresh fruit (see page 805).

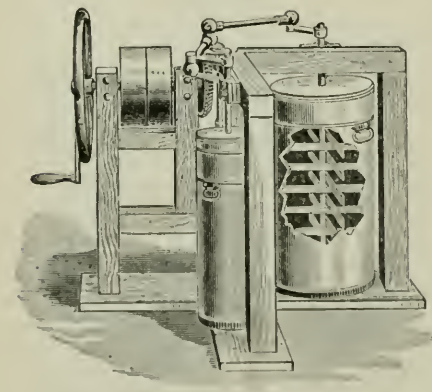
4. **Solution or Absorption.**—Some volatile oils are so susceptible to decomposition that they are dissociated by distillation, while they do not exist in sufficient quantity in the plant to pay for their extraction by expression. In such cases the odorous principle may be extracted by some form of solution or absorption. This may be effected by maceration, digestion, percolation with carbon disulphide or similar solvent, enfleurage, or the pneumatic process.

Maceration.—In obtaining volatile oils by maceration, the odorous portions of the plant (generally fragrant flowers) are allowed to stand in contact with a bland, inodorous fixed oil, like fine olive oil, oil of benne, or purified cotton seed oil; the oil absorbs the odor, and after a certain length of time the oil is strained. The odorous fixed oil is generally used in perfumery.

Digestion.—This process is similar to maceration, except that a moderate heat is employed, by the use of a salt bath, to aid in the extraction.

Enfleurage is largely used for extracting the odors of very delicate flowers. It is a cold process, and consists in spreading a thin layer of purified inodorous fat upon glass frames (*châssis*). These resemble an ordinary window sash, with one pane of glass in each. The flowers are sprinkled on the fat, and the frames piled in a stack. The whole is left undisturbed for a time varying from twelve hours to four days. The fat absorbs the odor completely. When strong pomades are desired, fresh flowers are continually added as long as the absorption continues, and the pomades are known commercially as Nos. 6, 12, 18, and 24, the numbers indicating the strength. The volatile products may be obtained from the pomade by chopping the latter into small pieces and macerating them in pure alcohol. A small portion of the fat is apt to be dissolved by this treatment and give a disagreeable odor to the solution, but this may be separated by subjecting it to a cold atmosphere in a refrigerator, when the congealed fat can be filtered out.

Fig. 449



Day's pomade washer

The process of extracting odors from pomades by agitating them in contact with alcohol has been largely used in the United States. The pomades are mostly imported from Grasse, France, and Fig. 449 illustrates Day's pomade washer, a machine constructed for agitating the mixture of pomade and alcohol in order to hasten the process of extraction.

Pneumatic Process.—This method is used only with very delicate volatile oils. It consists in forcing a current of air into a vessel filled with fresh flowers, and then conveying the perfumed air into another vessel containing purified fat which is kept melted. Circular plates, half immersed, revolve in the fat, and these, when coated, absorb the odor from the perfumed air.

Percolation.—This process consists in percolating odorous flowers with purified carbon disulphide; the latter is distilled, and the volatile oils are found in the residue.

Official Products from the Rutaceæ

The Family Rutaceæ furnishes valuable products to medicine and pharmacy, which are conveniently grouped together.

AURANTII AMARI CORTEX. U.S. Bitter Orange Peel

The dried rind of the unripe fruit of *Citrus vulgaris* Risso (Fam. *Rutaceæ*).

In narrow, thin bands or in quarters; epidermis of a brownish-green color; outer layer with numerous oil reservoirs; inner layer spongy, light yellowish-brown; odor fragrant; taste aromatic and bitter.

The peel from the bitter orange contains *hesperidin* and a small quantity of volatile oil. It is not used to communicate flavor, but as a bitter tonic. In addition to the official preparations given below it is used in the compound tincture of cinchona and the compound tincture of gentian. The dose is ten to forty grains (0.6 to 2.6 Gm.).

Official Preparations

Fluidextractum Aurantii Amari Fluidextract of Bitter Orange Peel	Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 383). Dose, fifteen minims (1 Cc.)
Tinctura Aurantii Amari Tincture of Bitter Orange Peel	Made by exhausting 200 Gm. of bitter orange peel with sufficient menstruum, made by mixing 3 parts of alcohol and 2 parts of water, to make 1000 Cc. (see page 344). Dose, one to two fluidrachms (4 to 8 Cc.)

AURANTII DULCIS CORTEX. U.S. Sweet Orange Peel

The recently separated outer rind of the ripe fruit of *Citrus Aurantium* Linné (Fam. *Rutaceæ*).

Outer surface orange-yellow, with numerous oil reservoirs; odor highly fragrant; taste pungently aromatic.

Sweet orange peel owes its virtues to the volatile oil found in the epidermis. It also communicates a yellowish color to the preparations made with it. It is used as a flavoring substance. Dose, fifteen grains (1 Gm.).

Official Preparations

Syrupus Aurantii Syrup of Orange	Made by triturating 50 Cc. of tincture of sweet orange peel with 10 Gm. of magnesium carbonate, adding, gradually, 400 Cc. of water, filtering, washing filter with enough water to make 450 Cc. of filtrate, dissolving in this filtrate 5 Gm. of citric acid and 820 Gm. of sugar, and adding enough water to measure 1000 Cc. (See page 290)
Tinctura Aurantii Dulcis Tincture of Sweet Orange Peel	Made by macerating 500 Gm. of sweet orange peel with 1000 Cc. of alcohol for 48 hours, filtering through purified cotton, passing enough menstruum through the residue to make 1000 Cc. of tincture, and finally filtering through paper. Tincture of sweet orange peel is used as a flavoring in wine of iron and bitter wine of iron. (See page 344.) Dose, one fluidrachm (4 Cc.)

OLEUM AURANTII CORTICIS. U.S. Oil of Orange Peel

A volatile oil obtained by expression from the fresh peel of the Sweet Orange. It should be kept in small, well-stoppered, amber-colored bottles, in a cool place, so as to avoid, as far as possible, the development of a terebinthinate odor. Oils that have developed such an odor should not be dispensed.

This oil has the composition of the terpenes, $C_{10}H_{16}$. It is soluble in alcohol, and may be preserved by shaking it with one-fourth of its volume of water, separating, and mixing with five times its measure of alcohol. It is very prone to decomposition, and rapidly acquires a terebinthinate odor.

Official Description.—A pale yellow liquid.
Odor and Taste.—Characteristic, aromatic odor of orange, and an aromatic taste.
Specific Gravity.—0.842 to 0.846 at 25° C. (77° F.).
Impurity and Tests.—*Oil of turpentine, etc.* Its optical rotation should be dextrogyrate, not less than 95° in a 100 Mm. tube, at a temperature of about 25° C. (77° F.)

When subjected to careful fractional distillation, any Oil coming over below 170° C. (338° F.) should not yield pinene nitrosochloride and nitrosopinene (derived from added oil of turpentine) when tested in the following manner:

Dissolve 5 Cc. of the fraction to be tested in one-half its volume of glacial acetic acid, add 5 Cc. of amyl nitrite, cool thoroughly in a freezing mixture, and add, very gradually, 5 Cc. of a mixture of equal volumes of hydrochloric acid and glacial acetic acid. Collect any crystals which separate from the blue or greenish liquid upon standing, on a force filter, and wash them with a little alcohol. Transfer the crystals to a flask, add 5 Cc. of alcoholic potassium hydroxide T.S., and heat on a water-bath fifteen minutes. Pour the solution into cold water, collect the precipitate, and wash it with cold water. Recrystallize the dried precipitate from alcohol, and determine the melting point of the crystals. Nitrosopinene melts at 132° C. (269.6° F.), whereas nitrosolimonene or carvoxime (from limonene, one of the normal constituents of Oil of Orange Peel) melts at 72° C. (161.6° F.).

Uses.—It is used as a flavoring agent in elixirs and other preparations.

Official Preparation

Spiritus Aurantii Compositus Compound Spirit of Orange	Made by dissolving 200 Cc. oil of orange peel, 50 Cc. oil of lemon, 20 Cc. oil of coriander, and 5 Cc. oil of anise, in enough alcohol to make 1000 Cc. (Used in making Aromatic Elixir, U. S. P.)

LIMONIS CORTEX. U.S. Lemon Peel

The recently separated outer rind of the ripe fruit of *Citrus Limonum* Risso (Fam. *Rutaceæ*).

Outer surface lemon-yellow, the tissue beneath containing numerous large oil reservoirs; odor highly fragrant; taste pungently aromatic.

Lemon peel is principally used to communicate flavor and color to spirit and syrup of lemon. It contains volatile oil and *hesperidin*.

OLEUM LIMONIS. U.S. Oil of Lemon

A volatile oil obtained by expression from fresh Lemon Peel, yielding, when assayed by the process given below, not less than 4 percent. of aldehyde, calculated as citral. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

FIG. 450

Ecuelle

This important volatile oil is a terpene, $C_{10}H_{16}$; when fresh it has the fragrant odor of lemons. It is soluble in about 3 parts of alcohol, in glacial acetic acid, and in all proportions in absolute alcohol. It may be preserved from the effects of oxidation by the addition of 5 percent. of alcohol and separation from the sediment. This oil is often prepared by expression, although the sponge process is at present largely used. The *ecuelle* (Fig. 450) is a convenient instrument for rapidly rupturing the oil vesicles. It is held in one hand by the operator, while with the other hand the bergamot, lemon, or orange fruit is skilfully rotated on the sharp points. The oil flows into the gutter in the cup, and then through the hollow handle into a suitable vessel. Oil of bergamot is used solely for its perfume.

Official Description.—A pale yellow, limpid liquid.
Odor and Taste.—Fragrant odor of lemon and an aromatic, somewhat bitter taste.
Specific Gravity.—0.851 to 0.855 at 25° C. (77° F.).
Test for Identity.—It is dextrogyrate; its optical rotation should not be less than +58° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). The angle of rotation of the first 10 percent. of Oil obtained by fractional distillation should not differ more than 2° from that of the original Oil.
Assay for Citral.—Introduce into a counterpoised 150 Cc. flask, by means of a pipette, about 15 Cc. of Oil of Lemon, and note the exact weight; add 5 Cc. of distilled water and a few drops of rosolic acid T.S., and then neutralize the liquid exactly by the cautious addition of tenth-normal sodium hydroxide V.S. Add 25 Cc. of a neutral solution of sodium sulphite (1 in 5), and immerse the flask in a water-bath containing boiling water. From a burette add, as needed, just sufficient half-normal hydrochloric acid V.S. to maintain the neutrality of the mixture, keeping the flask continuously heated and frequently agitated, and adding a drop or two of rosolic acid T.S. When a permanent condition of neutrality is reached, note the number of cubic centimeters of the half-normal hydrochloric acid V.S. consumed. Carry out a blank test, identical with the foregoing, except that the Oil of Lemon is omitted, and note the amount of half-normal hydrochloric acid V.S. consumed. Subtract the number of cubic centimeters required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.03802 Gm. of citral. To find the percentage, multiply the above difference by 0.03802, and this product by 100, and divide by the weight of the Oil of Lemon taken.

Uses.—Oil of lemon is used as a flavoring agent in aromatic spirit of ammonia and compound spirit of orange.

Unofficial Volatile Oils from the Rutaceæ

Oleum Aurantii Florum Oil of Orange Flowers. U. S. P. 1890 (Oil of Neroli)	A volátile oil distilled from the fresh flowers of the Bitter Orange, *Citrus vulgaris* Risso. Brownish-yellow, fragrant oil. Specific gravity 0.875 to 0.890 at 15° C. (59° F.). This volatile oil is now largely made synthetically. It is used almost exclusively in perfumery
Oleum Bergamottæ Oil of Bergamot. U. S. P. 1890	A volatile oil obtained by expression from the rind of the fresh fruit of *Citrus Bergamia* Risso et Poiteau Greenish-yellow, thin, fragrant oil. Specific gravity 0.880 to 0.885 at 15° C. (59° F.). Used solely for its perfume

Official Products from the Labiatæ

The family of the mints is a strongly marked group, the members of it being remarkable for their botanical analogy with one another and for the similarity of their chemical constituents.

MENTHA PIPERITA. U.S. Peppermint

The dried leaves and flowering tops of *Mentha piperita* Linné (Fam. *Labiatæ*). Branches quadrangular, with scattered, deflexed hairs; leaves petiolate, ovate-lanceolate, 3 to 8 Cm. long, acute, sharply serrate, light or dark green; flower-whorls in oblong or oval spikes which are usually compact, or somewhat interrupted at the base, 1 to 1.5 Cm. broad, rounded at the summit, when in fruit becoming 3 to 7 Cm. long; calyx tubular, 5-toothed and often purplish; corolla small, purplish, and 4-lobed; stamens four, short, and equal; odor strong and characteristic; taste pungent and cooling.

Its properties are due to the presence of about 2 percent. of volatile oil. It is largely cultivated, and is a grateful aromatic stimulant. It is used in making spirit of peppermint. The dose is one drachm (4 Gm.).

OLEUM MENTHÆ PIPERITÆ. U.S. Oil of Peppermint

A volatile oil distilled from the fresh or partly dried leaves and flowering tops of Peppermint, rectified by steam distillation, and yielding, when assayed by the process given below, not less than 6 percent. of ester, calculated as menthyl acetate, and not less than 50 percent. of total menthol (free and as ester). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This is one of the most important of the group of volatile oils. It has been shown to contain seventeen chemical constituents, but it is principally composed of menthone, $C_{10}H_{18}O$; menthol, $C_{10}H_{20}O$; and terpenes, $C_{10}H_{16}$. It is distilled in large quantities in Michigan, Ohio, Indiana, and New York from cultivated plants. *Menthol* is official, and the proportion which should be present forms the basis of the official assay (see below). Dementholated oil is often found in the market.

Official Description.—A colorless liquid.

Odor, Taste, and Reaction.—Strong odor of peppermint, and a strongly aromatic, pungent taste, followed by a sensation of cold when air is drawn into the mouth. Neutral reaction in alcoholic solution.

Specific Gravity.—0.894 to 0.914 at 25° C. (77° F.).

Solubility.—*Alcohol.* Clear solution with equal volume of alcohol; also soluble in 4 volumes of 70 percent. alcohol, the solution showing not more than a slight opalescence.

Test for Identity.—It is laevogyrate, the angle of rotation varying from —20° to —33° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Impurity and Test for Impurity.—*Dimethyl sulphide found in non-rectified oils.* If from 25 Cc. of Oil about 1 Cc. be distilled and the distillate poured on an aqueous solution of mercuric chloride, a white film should not form at the zone of contact after a short time.

Assay.—Introduce into a tared flask 10 Cc. of Oil of Peppermint, and note the exact weight; add 25 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 25 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 9.834, and divide the product by the weight of the Oil of Peppermint taken to find the percentage of menthyl acetate. Wash the residual oil repeatedly with water, transfer it to a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 1 Gm. of anhydrous sodium acetate, and boil gently during one hour. Allow it to cool, wash the acetylized oil with distilled water, and afterwards with sodium hydroxide T.S., until the mixture is slightly alkaline to phenolphthalein T.S., and then dry it with the aid of fused calcium chloride, and filter.

Transfer to a tared 100 Cc. flask 5 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 50 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 7.749, and divide the product by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of menthol in the Oil of Peppermint.

Note.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide V.S. consumed by the acetylized oil.

Uses.—Oil of peppermint is used as a stimulant and carminative in the dose of three minims (0.2 Cc.) and as an ingredient in cataplasm of kaolin, antiseptic solution, vegetable cathartic pills, and compound pills of rhubarb, and from it are made the following official preparations:

Official Preparations

Aqua Menthæ Piperitæ Peppermint Water	Made by adding 2 Cc. of oil of peppermint to 15 Gm. of purified talc and filtering with distilled water until 1000 Cc. have been obtained (see page 278)
Spiritus Menthæ Piperitæ Spirit of Peppermint	Made by dissolving 100 Cc. of oil of peppermint in 900 Cc. of alcohol, adding 10 Gm. of peppermint, macerating for twenty-four hours, and filtering (see page 316). Dose thirty minims (2 Cc.)

MENTHOL. U.S. Menthol

$C_{10}H_{19}OH = 154.98$

A secondary alcohol [$C_6H_9(CH_3)(OH)(C_3H_7)$ 1 : 3 : 4], obtained from the oil from *Mentha piperita* Linné, or other peppermint oils. Menthol should be kept in well-stoppered bottles, in a cool place.

The oil of peppermint owes its odor to *menthol* ($C_{10}H_{20}O$) a stearoptene obtained from it through fractional distillation, cooling, and crystallization.

Official Description.—Colorless, acicular or prismatic crystals.
Odor, Taste, and Reaction.—Strong and pure odor of peppermint, warm, aromatic taste, followed by a sensation of cold when air is drawn into the mouth; neutral in alcoholic solution.
Solubility.—*Water.* Only slightly soluble in water, but imparts to the latter its odor and taste.
Alcohol. Freely.
Other solvents. Freely in ether and chloroform.
Tests for Identity.—It melts at 43° C. (109.4° F.) to a colorless liquid, boils at 212° C. (413.6° F.), and volatilizes slowly at the ordinary temperature.
When it is triturated with about an equal weight of camphor, thymol, or hydrated chloral, the mixture becomes liquid.
Its alcoholic solution is lævogyrate.
Impurities and Tests for Impurities.—*Wax, paraffin, or inorganic substances.* If a little Menthol be heated in an open dish, on a water-bath, it should gradually volatilize without leaving any residue.
Thymol. If a few crystals of Menthol be dissolved in 1 Cc. of glacial acetic acid, and then 3 drops of sulphuric acid and 1 drop of nitric acid added, no green color should be produced.

Uses.—Menthol is largely used, compressed into cones, as a local remedy in neuralgia and headache.

MENTHA VIRIDIS. U.S. Spearmint

The dried leaves and flowering tops of *Mentha spicata* Linné (*Mentha viridis* Linné) (Fam. *Labiatæ*).

Closely resembling Peppermint (see *Mentha Piperita*), but the leaves usually sessile and lanceolate, the flower-spikes usually slender, interrupted, cylindrical, or crowded, conical at the apex, 5 to 8 Mm. thick, becoming when in fruit 5 to 10 Cm. long; the stamens rather long; odor and taste resembling, but distinguishable from those of Peppermint.

The volatile oil is the only constituent of importance in this plant; the yield is from ½ to 1 percent. It is used in the preparation of spirit of spearmint. The dose is one drachm (4 Gm.).

OLEUM MENTHÆ VIRIDIS. U.S. Oil of Spearmint

A volatile oil distilled from the fresh or partly dried leaves and flowering tops of Spearmint, rectified by steam distillation. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Oil of spearmint contains an oxygenated oil, $C_{10}H_{14}O$, which is the odorous portion, and a terpene, $C_{10}H_{16}$.

Official Description.—A colorless, yellow or greenish-yellow liquid.
Odor and Taste.—Characteristic, strong odor of spearmint, and a hot, aromatic taste.
Specific Gravity.—0.914 to 0.934 at 25° C. (77° F.).
Solubility.—*Alcohol.* With an equal volume of 80 percent. alcohol it forms a clear solution, which upon further dilution becomes turbid.
Test for Identity.—It is lævogyrate, the angle of rotation varying from —35° to —48° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—It is used as a stimulant and carminative in doses of three minims (0.2 Cc.).

Official Preparations

Aqua Menthæ Viridis Spearmint Water.	Made by adding 2 Cc. of oil of spearmint to 15 Gm. of purified talc and filtering with distilled water until 1000 Cc. have been obtained (see page 278)
Spiritus Menthæ Viridis Spirit of Spearmint.	Made by dissolving 100 Cc. of oil of spearmint in 900 Cc. of alcohol, adding 10 Gm. of spearmint, macerating for twenty-four hours and filtering (see page 316). Dose, thirty minims (2 Cc.)

OLEUM LAVANDULÆ FLORUM. U.S. Oil of Lavender Flowers

A volatile oil distilled from the fresh flowering tops of *Lavandula officinalis* Chaix (Fam. *Labiatæ*). It should be kept in amber-colored, well-stoppered bottles, in a cool place, protected from light.

Oil of lavender flowers is most largely used in perfumery. The best quality is distilled at Mitcham, England. It has the same composition and properties as oil of lavender. It is, however, more fragrant and more expensive.

Official Description.—A colorless or yellow liquid.
Odor and Taste.—Fragrant odor of lavender flowers; pungent and slightly bitter taste.
Specific Gravity.—0.875 to 0.910 at 25° C. (77° F.).
Solubility.—*Alcohol.* In 3 parts of 70 percent. alcohol.
Impurity and Test.—*Alcohol.* When the oil is shaken with water in a narrow graduated cylinder, its volume should not be diminished.

Uses.—It is used in the liniment of soft soap, diachylon ointment, and aromatic spirit of ammonia, and is the most important ingredient in the following preparations. Dose, three minims (0.2 Cc.).

Official Preparations

Spiritus Lavandulæ Spirit of Lavender	Made by dissolving 50 Cc. of oil of lavender flowers in 950 Cc. of alcohol (see page 316). Dose, thirty minims (2 Cc.)
Tinctura Lavandulæ Composita Compound Tincture of Lavender	Made by dissolving 8 Cc. of oil of lavender flowers and 2 Cc. of oil of rosemary in 750 Cc. of alcohol and 250 Cc. of water, macerating 5 Gm. of cloves, 20 Gm. of Saigon cinnamon, 10 Gm. of nutmeg, and 10 Gm. of red saunders with the liquid during 3 days, filtering, and adding sufficient menstruum to obtain 1000 Cc. (see page 356). Dose, thirty minims (2 Cc.)

OLEUM ROSMARINI. U.S. Oil of Rosemary

A volatile oil distilled from the fresh flowering tops of *Rosmarinus officinalis* Linné (Fam. *Labiatæ*), yielding, when assayed by the process given below, not less than 2.5 percent. of ester, calculated as bornyl acetate, and not less than 10 percent. of total borneol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil principally consists of a terpene, $C_{10}H_{16}$, and *borneol*, the presence of which is recognized in the official assay (see below).

Official Description.—A colorless or pale yellow, limpid liquid.
Odor and Taste.—Characteristic, pungent odor of rosemary; warm, somewhat camphoraceous taste.
Specific Gravity.—0.894 to 0.912 at 25° C. (77° F.).
Solubility.—*Alcohol.* In about one-half volume or more of 90 percent. alcohol; in 2 to 10 volumes of 80 percent. alcohol.
Tests for Identity.—The Oil should be dextrogyrate, the angle of rotation being not more than +15° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). The first 10 percent. obtained by fractional distillation should also be dextrogyrate.
Assay.—Introduce into a tared flask 10 Cc. of Oil of Rosemary, and note the exact weight; add 25 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 25 Cc. of half-normal alcoholic potassium hydroxide V.S., taken, multiply the difference by 9.734, and divide the product by the weight of the Oil of Rosemary taken to find the percentage of bornyl acetate. Wash the residual oil repeatedly with water, transfer it to a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 1 Gm. of anhydrous sodium acetate, and boil gently during one hour. Allow it to cool, wash the acetylized oil with distilled water, and afterwards with sodium hydroxide T.S., until the mixture is slightly alkaline to phenolphthalein T.S., and then dry it with the aid of fused calcium chloride, and filter.

Transfer to a tared 100 Cc. flask 5 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 50 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 7.649, and divide the product by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of borneol in the Oil of Rosemary.

Note—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide V.S. consumed by the acetylized oil.

Uses.—It is used as an ingredient in soap liniment and compound tincture of lavender. It may be given in doses of three minims (2 Cc.).

HEDEOMA. U. S. Hedeoma

[American Pennyroyal]

The dried leaves and flowering tops of *Hedeoma pulegioides* (Linné) Persoon (Fam. *Labiatæ*).

Branchlets quadrangular, with numerous spreading hairs; leaves opposite, short-petioled, oblong-ovate, 15 to 35 Mm. long, thin, obtuse, obscurely serrate, glandular-hairy beneath; flowers in axillary fascicles, with a tubular-ovoid, bilabiate and 5-toothed calyx, and a pale blue, spotted, bilabiate corolla, containing two sterile and two fertile, exserted stamens; odor strong, somewhat mint-like; taste aromatic and pungent.

This indigenous plant is frequently confounded with *Mentha pulegium*, or European pennyroyal, which yields an oil having a similar odor and properties. It is stimulant and aromatic. Dose two drachms (8 Gm.).

OLEUM HEDEOMÆ. U. S. Oil of Hedeoma

[Oil of Pennyroyal]

A volatile oil distilled from the leaves and flowering tops of Hedeoma. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Official Description.—A pale yellow, limpid liquid.
Odor and Taste.—Characteristic, pungent, mint-like odor and taste.
Specific Gravity.—0.920 to 0.935 at 25° C. (77° F.).
Solubility.—*Alcohol.* Should form a clear solution with 2 volumes or more of 70 percent. alcohol.
Test for Identity.—It is dextrogyrate, the angle of rotation varying from about +18° to +22° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—This is an oxygenated oil, and is used principally to protect the exposed parts of the body from the bites of flies, mosquitoes, fleas, etc. It is employed sometimes in amenorrhœa, in doses of one to three minims (0.05 to 0.2 Cc.).

MARRUBIUM. U. S. Marrubium

[Hoarhound Horehound]

The dried leaves and flowering tops of *Marrubium vulgare* Linné (Fam. *Labiatæ*).

Branches quadrangular, grayish-green, densely white-hairy; leaves opposite, petiolate, roundish-ovate, 1.5 to 5 Cm. long, obtuse, coarsely crenate, strongly rugose-veined, more or less white-hairy, especially underneath; flowers in dense axillary whorls, with a 10-toothed calyx, the divisions of which are slightly unequal, erect-spreading and pungent; corolla small, whitish, bilabiate; stamens four, included; fruit of four ovoid, obtuse, nearly smooth nutlets, about 1.5 Mm. long; odor distinct, rather agreeable; taste somewhat aromatic and bitter.

This plant contains a volatile oil associated with resin and a bitter principle, *marrubiin*. It is stimulant, tonic, and expectorant. Dose, thirty grains (2 Gm.).

OLEUM THYMI. U.S. Oil of Thyme

A volatile oil distilled from the leaves and flowering tops of *Thymus vulgaris* Linné (Fam. *Labiatæ*), and containing, when assayed by the process given below, not less than 20 percent., by volume, of phenols. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

The oil, as prepared in the south of France, is known commercially as *oil of origanum*. It is, after one distillation, of a reddish-brown color, and is called the *red oil*, but when again distilled is colorless, and in this condition is distinguished as the *white oil*. The specific gravity of the red or common oil is stated at 0.905, but probably varies, as the oil is a complex body. The more volatile portion, that coming over below 180° C. (356° F.) in distillation, is a mixture of *cymene*, $C_{10}H_{14}$, boiling at 175° C. (347° F.), and *thymene*, $C_{10}H_{16}$, boiling at 165° C. (329° F.). The less volatile portion is chiefly *thymol*, $C_{10}H_{14}O$, a white, crystalline solid, melting at 50° C. (122° F.), and possessing a pungent taste. This substance is also found in oil of monarda (horsemint). (See Thymol, page 732.)

Official Description.—A colorless or reddish liquid.
Odor and Taste.—Strong odor of thyme; aromatic, pungent, afterwards cooling taste.
Specific Gravity.—0.900 to 0.930 at 25° C. (77° F.).
Solubility.—*Alcohol.* In half its volume, also in 1 to 2 volumes of 80 percent. alcohol.
Tests for Identity.—It is slightly lævogyrate; not more than —3° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

With a drop of ferric chloride T.S. it yields a greenish-brown color, which changes to reddish.

Impurity and Test.—*Official phenol.* If 1 Cc. of Oil of Thyme be shaken with 10 Cc. of hot water, and, after cooling, the liquid be passed through a wet filter, the filtrate should not assume, with a drop of ferric chloride T.S., a bluish or violet color.
Assay.—Introduce 40 Cc. of solution of sodium hydroxide (1 in 20) into a burette of 50 Cc. capacity (graduated in tenths). Add 10 Cc. of the Oil to be assayed, stopper the burette with a well-fitting cork, shake the mixture thoroughly, and set aside for twelve to twenty-four hours. Drops of Oil adhering to the side of the burette should be loosened by tapping and rotating the burette. After the alkaline solution has become clear, the volume of non-phenol oil remaining (which should measure not more than 8 Cc.) is noted and subtracted from the 10 Cc. of the Oil originally taken. The difference, multiplied by 10, indicates the percentage of phenols in the Oil.

Uses.—Oil of thyme or *oil of origanum*, as it is usually called, is largely used in liniments as a stimulant. It is an ingredient in the official antiseptic solution.

SALVIA. U.S. Salvia

[SAGE]

The dried leaves of *Salvia officinalis* Linné (Fam. *Labiatæ*).

Long and stoutly petiolate, the blade elliptical or ovate-oblong, 3 to 7 Cm. long, obtuse or subacute at the summit, rounded or subcordate at the base, finely crenulate, thick, grayish-green, very pubescent, especially on the under surface, conspicuously reticulate-veined; odor aromatic; taste aromatic, bitter and somewhat astringent.

This useful plant contains a volatile oil, which consists of a terpene, $C_{10}H_{16}$, and an oxygenated portion, *salviol*, $C_{10}H_{18}O$. It also contains tannin and extractive. It is used largely as a condiment. Infusion of sage is a popular remedy in sore throat. Dose, thirty grains (2 Gm.).

SCUTELLARIA. U.S. Scutellaria

[Skullcap]

The dried plant of *Scutellaria lateriflora* Linné (Fam. *Labiatæ*).

About 50 Cm. long, smooth; stem quadrangular, branched; leaves opposite, petiolate, about 5 Cm. long, ovate-lanceolate or ovate-oblong, serrate; flowers about 6 Mm. long, in axillary one-sided racemes, with a pale blue corolla and bilabiate calyx, closed in fruit, the upper lip helmet-shaped; odor slight; taste bitterish.

This plant contains volatile oil, tannin, and a bitter principle. It is used as a tonic and antispasmodic. Dose, fifteen grains (1 Gm.).

Official Preparation

Fluidextractum Scutellariæ Fluidextract of Scutellaria	Made with a menstruum of diluted alcohol by percolation (see page 417). Dose, fifteen minims to one fluidrachm (1 to 4 Cc.)

Unofficial Plants of the Labiatæ

Brunella	The herb of *B.* (*Prunella*) *vulgaris*. Found in North America, Asia, and Europe
Calamintha Wild Basil	The herb of *C. clinopodium*
Cataria Catnep	Antispasmodic and emmenagogue. Dose, two drachms (8 Gm.) in infusion
Collinsonia Horsebalm	The herb of *Collinsonia canadensis*, grown in North America
Glechoma Ground Ivy	From *G. hederacea* and others, grown in Europe. It contains volatile oil, resin, etc.
Hyssopus Hyssop	From *H. officinalis*, indigenous to Southern Europe. It contains about ½ percent. of volatile oil, etc.
Lavender	The flowers of *Lavandula vera*. It was formerly official, and contains a volatile oil
Leonurus Motherwort	The herb of *L. cardiaca*, grown in Europe. It contains volatile oil and a bitter principle
Lycopus Bugleweed	The herb of *L. virginicus*, found in the United States. It contains a volatile oil, resin, etc.
Melissa Balm. U. S. P. 1890	The leaves and tops of *Melissa officinalis* Linné
Monarda Horsemint	The leaves and tops of *M. punctata*, indigenous to the United States. It contains a volatile oil, etc.
Rosemary	The leaves of *Rosmarinus officinalis*. It was formerly official, and contains a volatile oil

Official Products of the Aromatic Umbelliferæ

The aromatic plants belonging to the family Umbelliferæ are all characterized by the very distinctive properties of the volatile oils obtained by distilling their fruits (sometimes called seeds) with water. These oils are oxygenated, and are soluble in alcohol. Cumin and dill belong to this class. They are not official.

CARUM. U. S. Caraway

The dried fruit of *Carum Carvi* Linné (Fam. *Umbelliferæ*).

About 4 or 5 Mm. long, oblong, laterally compressed, usually separated into the two mericarps, which are curved, tapering toward each end, dark brown, with five yellowish, filiform ribs, and with six oil-tubes; seed plane upon the face, nearly equilaterally pentagonal in transverse section; odor and taste agreeably aromatic; ash not more than 8 percent.

This fruit, commonly called caraway seed, contains about 5 percent. of volatile oil, with a little fixed oil and other constituents.

Uses.—It is carminative and stimulant, and is used in the compound tincture of cardamom. Dose, fifteen grains (1 Gm.).

OLEUM CARI. U.S. Oil of Caraway

A volatile oil distilled from Caraway and rectified by steam distillation. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

It consists of a terpene, *carvene*, $C_{10}H_{16}$, and *carvol*, $C_{10}H_{14}$.

Official Description.—A colorless or pale yellow, thin liquid.
Odor and Taste.—Characteristic, aromatic odor of caraway and a spicy taste.
Specific Gravity.—0.900 to 0.910 at 25° C. (77° F.).
Solubility.—*Acohol.* Soluble in an equal volume; also in from 3 to 10 volumes of 80 percent. alcohol.
Tests for Identity.—Oil of Caraway is dextrogyrate, the angle of rotation varying from +70° to +80° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—It is a valuable aromatic oil, used in making caraway water and officially in compound spirit of juniper. Dose, three minims (0.2 Cc.).

FŒNICULUM. U.S. Fennel

The dried, nearly ripe fruit of *Fœniculum vulgare* Miller (Fam. *Umbelliferæ*). Mericarps usually separated, each 4 to 10 Mm. long, and 2 to 3 Mm. broad, more or less curved, with five prominent, light-colored primary ribs, otherwise smooth, yellowish- or brownish-green; pericarp containing an oil-tube between each two ribs, and two upon the flat side; odor and taste aromatic, anise-like.

This fruit contains about 5 percent. of an oygenated volatile oil, with 10 percent. of fixed oil. It is used in compound infusion of senna. Dose, fifteen grains (1 Gm.).

OLEUM FŒNICULI. U.S. Oil of Fennel

A volatile oil distilled from Fennel. It should be kept in well-stoppered, amber-colored bottles, in a cool place, and, if it has partly or wholly solidified, it should be completly liquefied by warming and then well shaken before being dispensed.

The property of this oil of solidifying at a low temperature is used in the official test to indicate its purity. Oil of fennel consists of a terpene, $C_{10}H_{16}$, and the constituent which solidifies, *anethol*, $C_{10}H_{12}O$.

Official Description.—A colorless or pale yellow liquid.
Odor, Taste, and Reaction.—Characteristic, aromatic odor of fennel; sweetish, mild, and spicy taste. An alcoholic solution is neutral to litmus paper.
Specific Gravity.—0.953 to 0.973 at 25° C. (77° F.).
Solubility.—*Alcohol.* In an equal volume, the solution being neutral to litmus paper; also soluble in 10 volumes or less of 80 percent. alcohol.
Tests for Identity.—When tested according to the following method, the congealing point of Oil of Fennel should not be below —3° C. (26.6° F.).

Transfer about 10 Cc. of the Oil to a test-tube placed in a freezing mixture; insert a thermometer at once into the Oil, and allow it to remain undisturbed until its temperature has fallen to about —5° C. (23° F.). Induce crystallization either by rubbing the inner wall of the test-tube with the thermometer or by the addition of a particle of solid anethol, and stir continuously during the solidification of the Oil. The highest temperature reached during the crystallization is regarded as the congealing point.

Impurities and Tests for Impurities.—*Some volatile oils containing phenols.* An alcoholic solution of Oil of Fennel is neutral to litmus paper, and is not colored by the addition of a drop of ferric chloride T.S.

Uses.—It is used in the compound powder of glycyrrhiza and the compound spirit of juniper. Dose, three minims (0.2 Cc.).

Official Preparation

Aqua Fœniculi Fennel Water	Made by adding 2 Cc. of oil of fennel to 15 Gm. of purified talc and filtering it with 1000 Cc. of distilled water (see page 277)

CORIANDRUM. U.S. **Coriander**

[CORIANDER SEED]

The dried ripe fruit of *Coriandrum sativum* Linné (Fam. *Umbelliferæ*).

Nearly globular, brownish-yellow, smooth, 4 to 5 Mm. in diameter, crowned with the calyx teeth and a short stylopodium; mericarps usually united, each with five prominent, straight primary ribs and four indistinct secondary ribs, the inner surface deeply concave and with two oil-tubes; odor and taste agreeably aromatic.

This fruit furnishes an agreeable aromatic oil. The yield is about 1 percent. It also contains about 10 percent. of fixed oil. Dose, eight grains (0.5 Gm.).

OLEUM CORIANDRI. U.S. **Oil of Coriander**

A volatile oil distilled from Coriander. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil is composed principally of $C_{10}H_{18}O$.

Official Description.—A colorless or slightly yellow liquid.
Odor and Taste.—Characteristic, aromatic odor of coriander, and a warm, spicy taste.
Specific Gravity.—0.863 to 0.878 at 25° C. (77° F.).
Solubility.—*Alcohol.* It should be soluble in 3 volumes of 70 percent. alcohol; also soluble in all proportions in 80 percent. and 90 percent. alcohol.
Test for Identity.—It is dextrogyrate, the angle of rotation varying from +7° to +14° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—It is officially used in confection of senna, compound spirit of orange, and syrup of senna. Dose, three minins (2 Cc.).

SUMBUL. U.S. **Sumbul**

[MUSK-ROOT]

The dried rhizome and root of an undetermined plant, probably of the family *Umbelliferæ*.

In transverse segments, of variable length and rarely exceeding 10 Cm. in diameter; externally dusky brown, annulate, longitudinally wrinkled, or with a smooth, silver-gray periderm; fracture short-fibrous, light yellow or brownish-yellow, spongy, porous, with numerous brownish-yellow resin reservoirs, and irregular, easily separable fibres; bark about 0.5 Mm. thick; odor strong, musk-like; taste bitter.

This Asiatic root contains about $\frac{1}{2}$ percent. of volatile oil and about 10 percent. of a resinous compound having a musky odor. It is used as a stimulant and nervine. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Sumbul Fluidextract of Sumbul	Made with a menstruum of 750 Cc. of alcohol and 250 Cc. of water (see page 241). Dose, one-half to one fluidrachm (2 to 4 Cc.)

ANISUM. U.S. **Anise**

The ripe fruit of *Pimpinella Anisum* Linné (Fam. *Umbelliferæ*), obtained from cultivated plants.

Ovoid, laterally compressed, 4 to 5 Mm. long; carpels usually cohering and attached to a slender pedicel; grayish or greenish-gray to grayish-brown; each with a flat face and five light brown filiform ridges and about 16 oil-tubes; odor and taste agreeable and aromatic.

No mouse-like odor should be developed when solution of potassium hydroxide is poured upon Anise (absence of *conium*).

The powder contains one-celled, straight or curved, non-secreting hairs, which vary from 0.025 to 0.100 Mm. in length.

This fruit contains about 2 percent. of volatile oil and 3 percent. of fixed oil. It is a useful carminative and stimulant. Dose, eight grains (0.5 Gm.).

OLEUM ANISI. U.S. Oil of Anise

A volatile oil distilled from Anise or from the fruit of Star Anise, *Illicium verum* Hooker filius (Fam. *Magnoliaceæ*). It should be kept in well-stoppered, amber-colored bottles, protected from light, and, if it has separated into a liquid and a solid portion, it should be completely liquefied by warming, and then well shaken, before being dispensed.

Official Description.—A colorless or pale yellow, thin, and strongly refractive liquid.

Odor, Taste, and Reaction.—Characteristic odor of anise; sweetish, mildly aromatic taste; neutral reaction.

Specific Gravity.—0.975 to 0.988 at 25° C. (77° F.).

Solubility.—*Alcohol.* Soluble in an equal volume, forming a clear solution, also in 5 volumes of 90 percent. alcohol.

Tests for Identity.—When tested according to the following method, the congealing point of Oil of Anise should not be below 15° C. (59° F.).

Transfer about 10 Cc. of the Oil to a test-tube, placed in water cooled with ice; insert a thermometer at once into the Oil, and allow it to remain undisturbed until its temperature has fallen to about 6° C. (42.8° F.). Induce crystallization either by rubbing the inner wall of the test-tube with the thermometer, or by the addition of a particle of solid anethol, remove the test-tube from the bath, and stir continuously during the solidification of the Oil.

The highest temperature reached during the crystallization is regarded as the congealing point.

Impurities and Tests for Impurities.—*Oil of fennel, etc.* The oil should be lævogyrate, the angle of rotation being up to—2° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Petroleum, of most fixed oils, and of oil of turpentine. Soluble in an equal volume of alcohol forming a clear solution, also in 5 volumes of 90 percent. alcohol.

Some volatile oils containing phenols. An alcoholic solution of Oil of Anise is neutral to litmus paper, and should not assume a blue or brownish color on the addition of a drop of ferric chloride T.S.

Alcohol. When the Oil is shaken with water in a narrow graduated cylinder, its volume should not be diminished.

Oil of Illicium (*Star Anise*) has the same properties as the oil from *Pimpinella Anisum.* It consists of a small quantity of a hydrocarbon, $C_{10}H_{16}$, but mainly of anethol, $C_{10}H_{12}O$, which is present in two modifications, one solid at ordinary temperatures and heavier than water (*anise camphor, solid anethol*), the other liquid and more volatile (*liquid anethol*). *Anethol* is the chief constituent of the oils of *anise, star aniseed*, and *fennel.* Oil of anise is given in the dose of three minims (0.2 Cc.), and is an ingredient in compound spirit of orange, compound syrup of sarsaparilla, camphorated tincture of opium, troches of glycyrrhiza and opium, and the following.

Official Preparations

Aqua Anisi Anise Water	Made by adding 2 Cc. of oil of anise to 15 Gm. of purified talc and filtering with distilled water until 1000 Cc. are obtained (see page 275)
Spiritus Anisi Spirit of Anise	Made by mixing 100 Cc. of oil of anise with 900 Cc. of alcohol (see page 314). Dose, thirty minims to one fluidrachm (2 to 4 Cc.)

Unofficial Volatile Oils and Plants of the Umbelliferæ

Anethum Graveolens Dill	An umbelliferous fruit, indigenous to Southern Europe
Oleum Anethi Oil of Dill	An oxygenated oil. The yield is about 4 percent.
Angelica Angelica Root	The root of several species of *Angelica*, grown in Europe and America
Oleum Angelicæ Oil of Angelica	A yellowish, volatile oil. The yield is about ½ percent.
Carota Carrot Fruit	The fruit of *Daucus Carota*, indigenous to Northern Asia
Oil of Carrot	An oxygenated oil

Unofficial Volatile Oils and Plants of the Umbelliferæ—*Continued*

Cicuta Water Hemlock	The herb of *Cicuta virosa*, found in Northern Canada
Cuminum Cumin	The fruit of *Cuminum Cyminum*, indigenous to Egypt
Oil of Cumin	Consists of several hydrocarbons. The yield is about ¼ percent.
Heracleum Cow Parsnip (Masterwort)	From *Heracleum lanatum*, grown in the United States. It contains a volatile oil, resin, etc.
Illicium Star Anise. U. S. P. 1890	The fruit of *Illicium verum* Hooker filius (Fam. *Magnoliaceæ*). (Containing about 5 percent. of a volatile oil nearly identical with the oil of anise)
Levisticum Lovage	The root of *Levisticum officinale*, indigenous to Southern Europe. It contains soft and pungent resins
Petroselinum Parsley	The root of *P. sativum*, indigenous to Europe. It contains a volatile oil and apiin, $C_{24}H_{28}O_{13}$
Oil of Parsley	A colorless or yellowish, volatile oil, sp. gr. 1.01 to 1.14. The yield is about 1½ percent.
Phellandrium Water Fennel	The fruit of *Œnanthe Phellandrium*, grown in Europe. It contains about 1½ percent. of volatile oil and resins

Official Aromatic Products, with their Volatile Oils

CINNAMOMUM SAIGONICUM. U.S. Saigon Cinnamon

The bark of an undetermined species of *Cinnamomum* (Fam. *Lauraceæ*).

In quills about 15 Cm. long, and 10 to 15 Mm. in diameter, the bark 2 or 3 Mm. thick; outer surface gray or light grayish-brown with whitish patches, more or less rough from numerous warts and some transverse ridges and fine longitudinal wrinkles; the inner surface cinnamon-brown or dark brown, granular, and slightly striate; fracture short, granular, in the outer layer cinnamon-colored, having near the cork numerous whitish striæ forming an almost uninterrupted line; odor agreeably aromatic; taste sweet, warmly aromatic, somewhat astringent.

CINNAMOMUM ZEYLANICUM. U.S. Ceylon Cinnamon

The inner bark of the shoots of *Cinnamomum zeylanicum* Breyne (Fam. *Lauraceæ*).

Long, closely rolled quills, composed of eight or more thin layers of bark; pale yellowish-brown; outer surface smooth, marked with wavy lines of bast-bundles; inner surface striate; fracture short-splintery; odor agreeably aromatic; taste sweet and warmly aromatic. The yield of ash, when incinerated, should not be over 4 percent.

Ceylon and Saigon cinnamon owe their virtues to a volatile oil. There are also present tannin, mannite, mucilage, sugar, etc. The tannin present often causes a fluidextract of cinnamon to gelatinize through its alteration. Six official preparations contain Saigon cinnamon: aromatic powder, compound tincture of cardamom, compound tincture of gambir, compound tincture of lavender, aromatic tincture of rhubarb, and wine of opium, and in one it is the sole active ingredient.

Official Preparation

Tinctura Cinnamomi Tincture of Cinnamon	Made by percolating 200 Gm. of powdered Saigon cinnamon with sufficient menstruum, composed of 675 Cc. of alcohol, 250 Cc. of water, and 75 Cc. of glycerin, to obtain 1000 Cc. (see page 350). Dose, thirty minims to two fluidrachms (2 to 4 Cc.)

OLEUM CINNAMOMI. U.S. Oil of Cinnamon Oil of Cassia

A volatile oil distilled from Cassia Cinnamon (Fam. *Lauraceæ*), yielding, when assayed by the process given below, not less than 75 percent., by volume, of cinnamic aldehyde. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

There are two oils of cinnamon in commerce; one procured from the Ceylon cinnamon, the other from the Chinese cinnamon. The latter (*oil of cassia*) is now the only official one. There is no essential difference in the two oils, and that of the Chinese cinnamon, as much the cheaper and more abundant of the two, will probably continue to be generally employed, notwithstanding the fact that the Ceylon product has the finer flavor. The quality of oil of cinnamon has been greatly improved through the publication by Schimmel & Co. of good tests for detecting adulterations.

Official Description.—A yellowish or brownish liquid, becoming darker and thicker by age and exposure to the air.

Odor and Taste.—Characteristic odor of cinnamon, and a sweetish, spicy, and burning taste.

Specific Gravity.—1.045 to 1.055 at 25° C. (77° F.).

Solubility.—*Alcohol.* In 2 volumes of 70 percent. alcohol.

Tests for Identity.—When shaken with a saturated solution of sodium bisulphite, it solidifies to a crystalline mass.

If 4 drops of the Oil, contained in a test-tube, be cooled to 0° C. (32° F.), and then shaken with 4 drops of fuming nitric acid, crystalline needles or plates will be formed.

The Oil (or if it be dark, its distillate) should be optically almost inactive; it should not be more than 1° dextrogyrate or lævogyrate when viewed through a 100 Mm. tube.

Impurities and Tests for Impurities.—*Lead and copper.* If a portion of the Oil be shaken with hydrogen sulphide T.S., it should not assume a dark color.

Petroleum and rosin. If 1 Cc. of the Oil be mixed with 3 Cc. of a mixture of 3 volumes of alcohol and 1 volume of water, a clear solution should result; and if to this solution there be gradually added 2 Cc. of a saturated solution of lead acetate in a mixture of 3 volumes of alcohol and 1 volume of water, no precipitate should be produced.

Assay for Cinnamic Aldehyde.—Introduce into a flask with a long graduated neck (cassia-flask), by means of a measuring-pipette, 10 Cc. of the Oil of Cinnamon, add 10 Cc. of a 30 percent. solution of sodium bisulphite, shake the flask, and heat it in a water-bath containing boiling water until the contents are liquefied; add successive portions (10 Cc. each) of the bisulphite solution, shaking and heating as before, after each addition, until the flask is three-fourths filled. Continue to heat it in the water-bath until the odor of cinnamic aldehyde is no longer perceptible, cool the flask to about 25° C. (77° F.), and add enough of the bisulphite solution to raise the lower limit of the oily layer to the zero mark of the scale. The residual liquid should not measure more than 2.5 Cc., corresponding to at least 75 percent., by volume, of cinnamic aldehyde.

Oil of Ceylon cinnamon has a slightly acid reaction. Specific gravity between 1.024 and 1.040. It is readily soluble in alcohol, and contains between 65 and 75 percent. of cinnamic aldehyde and from 4 to 8 percent. of eugenol. When cooled to —10° C. (14° F.) it remains clear, but at a lower temperature a solid portion separates from it. *Oil of Chinese cinnamon* (oil of cassia) has similar properties, the marked difference being that its specific gravity is between 1.045 and 1.055, the aldehyde content being 75 percent. or above, and that it contains no eugenol. The odor and taste are not quite so agreeable as that of the Ceylon variety.

With the exception of quite small quantities of hydrocarbons, oil of cinnamon consists of *cinnamic aldehyde*, C_9H_8O, which by moderate oxidation yields the corresponding cinnamic acid, $C_9H_8O_2$, but by more energetic oxidation yields benzoic acid, $C_7H_6O_2$.

Oil of Ceylon cinnamon when not very fresh contains cinnamic acid in sufficient quantity to give a permanent cloudiness to cinnamon water made from it. Dose, one minim (0.05 Cc.) Oil of cinnamon is an ingredient in aromatic sulphuric acid, and is used in the following:

Official Preparations

Aqua Cinnamomi Cinnamon Water	Made by adding 2 Cc. of oil of cinnamon to 15 Gm. of purified talc and filtering with distilled water until 1000 Cc. are obtained (see page 275)
Spiritus Cinnamomi Spirit of Cinnamon	Made by mixing 10 Cc. of oil of cinnamon with 90 Cc. of alcohol (see page 315). Dose, ten to thirty minims (0.6 to 2 Cc.)

CINNALDEHYDUM U:S. **Cinnamic Aldehyde**

$C_9H_8O = 131.07$

[SYNTHETIC OIL OF CASSIA]

An aldehyde obtained from Oil of Cinnamon or prepared synthetically, containing not less than 95 percent. of pure Cinnamic Aldehyde [$C_6H_5.CH:CH.COH$]. It is nearly identical with the oil distilled from Cassia Cinnamon, and should be kept in small, amber-colored, well-stoppered bottles.

Preparation.—This liquid is found in both oil of cassia and oil of Ceylon cinnamon, and can be separated by treatment with solution of sodium sulphite. It may also be made synthetically by saturating a mixture of acetaldehyde and benzaldehyde with hydrochloric acid gas. It was introduced into the U. S. P. (8th Rev.).

Official Description.—A colorless liquid. Optically inactive.
Odor and Taste.—Cinnamon-like odor; burning, aromatic taste.
Specific Gravity.—About 1.047 at 25° C. (77° F.).
Solubility.—*Water.* Sparingly.
Alcohol. In all proportions.
Other solvents. In all proportions in ether and fixed and volatile oils.
Tests for Identity.—It boils at about 250° C. (482° F.), with partial decomposition.

Cinnamic Aldehyde should partially solidify when the temperature is reduced by a freezing mixture of ice and salt, and should melt again at —7.5° C. (18.5° F.).

Impurities and Tests for Impurities.—*Chlorinated products.* If the looped end of a piece of clean copper wire be held in a non-luminous flame until it glows, then cooled, and the loop dipped into Cinnamic Aldehyde, ignited, and held so that the liquid burns outside of the flame, then if the loop be slowly brought in contact with the lower outer edge of the flame, no green tinge should be discernible.

Assay.—Introduce into a counterpoised 150 Cc. flask, by means of a pipette, 12 drops of Cinnamic Aldehyde, and note the exact weight; add 5 Cc. of distilled water and a few drops of rosolic acid T.S., and then neutralize the solution exactly by the cautious addition of tenth-normal sodium hydroxide V.S. Add 50 Cc. of a solution of sodium sulphite (1 in 5), and immerse the flask in a water-bath containing boiling water. From a burette add just sufficient half-normal hydrochloric acid V.S. to maintain the neutrality of the mixture, keeping the flask continuously heated and frequently agitated, and adding a drop or two of rosolic acid T.S. When a permanent condition of neutrality is reached, note the number of cubic centimeters of the half-normal hydrochloric acid V.S. consumed. Carry out a blank test identical with the foregoing, except that the Cinnamic Aldehyde is omitted, and note the amount of half-normal hydrochloric acid V.S. consumed

Subtract the number of cubic centimeters required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.033 Gm. of Cinnamic Aldehyde. To find the percentage, multiply the above difference by 0.033 and the product by 100, and divide by the weight of the Cinnamic Aldehyde taken.

Uses.—Cinnamic aldehyde is used to replace oil of cinnamon in making cinnamon water and spirit of cinnamon, and as a flavoring agent. Its odor is not equal to that of the finest oil of cinnamon made from cassia, but as the latter is often grossly adulterated, and cinnamic aldehyde can be easily obtained of good quality, it has come into use. The dose is one minim (0.05 Cc.).

CARYOPHYLLUS. U.S. **Cloves**

The dried flower buds of *Eugenia aromatica* (Linné) O. Kuntze (Fam. *Myrtaceæ*).

About 15 Mm. long, brownish-black, consisting of a stem-like, solid calyx-tube, obscurely four-angled and granular roughened, terminated by four teeth, and surmounted by a globular head, consisting of four petals, which cover numerous curved stamens and one style; odor strongly aromatic; taste pungent and aromatic, followed by slight numbness.

Cloves should not float in a horizontal position on water.

The powder contains few or no starch grains or stone cells. Ash not more than 8 percent.

Cloves contain about 16 percent. of volatile oil, 10 percent. of tannin, *caryophyllin*, $C_{10}H_{16}O$, a crystalline principle, and *eugenin*, $C_{10}H_{12}O_2$, also crystalline. It is used as an aromatic in three official preparations: compound tincture of lavender, aromatic tincture of rhubarb, and wine of opium. Dose, four grains (0.25 Gm.).

OLEUM CARYOPHYLLI. U.S. Oil of Cloves

A volatile oil distilled from Cloves, yielding, when assayed by the process given below, not less than 80 percent., by volume, of eugenol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Oil of cloves, when recently distilled, is very fluid, clear, and colorless, but becomes yellowish by exposure, and ultimately reddish-brown. The oil of cloves consists of two distinct oils, one lighter (a terpene) and the other heavier than water. They may be separated by distilling the oil from a solution of potassium hydroxide. The lighter comes over, the heavier remains combined with the potassium hydroxide, from which it may be separated by adding sulphuric acid and again distilling. *Light oil of cloves* is colorless, is of the sp. gr. 0.918, and has the formula $C_{10}H_{16}$. It is said not to possess active properties. *Heavy oil of cloves* is colorless at first, but darkens with age, has the odor and taste of cloves, is of the sp. gr. 1.079, boils at 243.3° C. (470° F.), and forms soluble and crystallizable salts with the alkalies. It consists of a phenol-like compound, *eugenol* (eugenic acid), $C_{10}H_{12}O_2$, which has been made official and is capable of conversion into *vanillin*. The proportion of eugenol in oil of cloves is regarded as an index of the quality of the oil (see official assay below).

Official Description.—A colorless or pale yellow, thin liquid, becoming darker and thicker by age and exposure to the air.

Odor and Taste.—Strongly aromatic odor of cloves, and a pungent, spicy taste.

Specific Gravity.—1.040 to 1.060 at 25° C. (77° F.).

Solubility.—*Alcohol.* In an equal volume, this solution being slightly acid to litmus paper; also soluble in about 2 volumes of 70 percent. alcohol.

Tests for Identity.—When shaken with an equal volume of a concentrated solution of potassium hydroxide, or of stronger ammonia water, it forms a semi-solid, yellowish mass.

If 2 drops of the Oil be dissolved in 4 Cc. of alcohol, and a drop of ferric chloride T.S. added, a bright green color will be produced; and if the same test be made with a drop of diluted ferric chloride T.S., prepared by diluting the test solution with four times its volume of water, a blue color will be produced, which soon changes to yellow.

Impurity and Test.—*Phenol.* If 1 Cc. of the Oil be shaken with 20 Cc. of hot water, the water should show a scarcely perceptible acid reaction to litmus paper. If, after cooling, the aqueous layer be passed through a wet filter, the clear filtrate should yield, with a drop of ferric chloride T.S., only a transient, grayish-green, but not a blue or violet color.

Assay for Eugenol.—Introduce into a flask with a long neck (graduated in tenths) 10 Cc. of the Oil of Cloves and 100 Cc. of potassium hydroxide T.S., and shake the mixture for five minutes. When the liquids have separated completely, add sufficient potassium hydroxide T.S. to raise the lower limit of the oily layer to the zero mark of the scale, and note the volume of the residual liquid, which should not measure more than 2 Cc., indicating the presence of at least 80 percent. of eugenol.

Oil of cloves is largely used as a remedy for toothache. It produces relief if the pain is caused by an exposed nerve, and may be used by applying a little upon cotton to the affected nerve. Dose, three minims (0.2 Cc.).

EUGENOL. U.S. Eugenol

$C_{10}H_{12}O_2 = 162.86$

An unsaturated, aromatic phenol [$C_6H_3(OH)(OCH_3).C_3H_5$ 4 : 3 : 1], obtained from Oil of Cloves and other sources. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Preparation.—Eugenol is found in the volatile oils from cloves, pimenta, bay leaves, Ceylon cinnamon, camphor, sassafras, massoy bark, canella, culilawan and others. It is principally obtained, however, from oil of cloves. It was introduced into the U. S. P. (8th Rev.). It may be made by treating oil of cloves with an excess of solution of sodium hydroxide and shaking the mixture with ether to remove terpenes. The aqueous solution of sodium eugenol is decomposed by hydrochloric acid, and the eugenol purified by repeated washing.

Official Description.—A colorless, or pale yellow, thin liquid; exposure to the air causes it to become darker and thicker.

Odor and Taste.—Strongly aromatic odor of cloves, and a pungent and spicy taste.

Specific Gravity.—From 1.066 to 1.068 at 25° C. (77° F.).

Solubility.—*Alcohol.* Miscible in all proportions, and should be soluble in 2 parts of 70 percent. alcohol.

Tests for Identity.—Boiling point: 251° to 253° C. (483.8° to 487.4° F.).

It is optically inactive.

When 1 part of Eugenol is dissolved in 12 parts of sodium hydroxide T.S. and 18 parts of water added, a clear solution should result, which becomes turbid when exposed to the air.

Impurity and Test.—*Phenol.* A mixture of 1 part of Eugenol and 20 parts of hot water should redden litmus paper very slightly. Five Cc. of the cold, clear filtrate from this mixture, upon the addition of 1 drop of ferric chloride T.S., should show a transient grayish-green color, but not a blue or violet color.

Uses.—Eugenol is coming into extensive use for replacing oil of cloves. It is used for similar purposes (see page 820). The dose is three minims (0.2 Cc.).

PIMENTA. U. S. Pimenta

[ALLSPICE PIMENTO]

The dried, nearly ripe fruit of *Pimenta officinalis* Lindley (Fam. *Myrtaceæ*).

Subglobular, 5 to 7 Mm. in diameter, crowned with a short, 4-parted calyx and a short style, or their remnants; externally dark brown; pericarp brittle, about 1 Mm. thick, glandular-punctate; 2-celled, each cell containing one reddish-brown, plano-convex, slightly reniform seed; odor and taste peculiarly and agreeably aromatic.

This aromatic fruit contains about 3 percent. of volatile oil, with tannin, fat, resin, gum, sugar, etc. Dose, fifteen grains (1 Gm.).

OLEUM PIMENTÆ. U. S. Oil of Pimenta

[OIL OF ALLSPICE]

A volatile oil distilled from Pimenta, yielding, when assayed by the process given below, not less than 65 percent., by volume, of eugenol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

It contains a terpene, $C_{10}H_{16}$, and *eugenol*, $C_{10}H_{12}O_2$, the proportion of which is used as the basis of the official assay process (see below).

Official Description.—A colorless, yellow, or reddish liquid.

Odor and Taste.—Strong, aromatic odor of allspice; pungent, spicy taste.

Specific Gravity.—1.028 to 1.048 at 25° C. (77° F.).

Solubility.—*Alcohol.* Miscible in all proportions with 90 percent. alcohol; soluble in 2 volumes of 70 percent. alcohol.

Tests for Identity.—When mixed with an equal volume of a concentrated solution of sodium hydroxide, it forms a semi-solid mass.

Assay for Eugenol.—Introduce into a flask with a long neck (graduated in tenths) 10 Cc. of the Oil of Pimenta and 100 Cc. of potassium hydroxide T.S., and shake the mixture for five minutes. When the liquids have separated completely, add sufficient potassium hydroxide T.S. to raise the lower limit of the oily layer to the zero mark of the scale, and note the volume of residual liquid, which should not measure more than 3.5 Cc., indicating the presence of at least 65 percent. of eugenol.

Uses.—It is used as an ingredient in spirit of myrcia or artificial bay rum, which was formerly official. Dose, three minims (0.2 Cc.).

VANILLA. U.S. Vanilla

The cured, full grown, but immature fruit of *Vanilla planifolia* Andrews (Fam. *Orchidaceæ*).

Linear, narrowed, and bent or hooked at the rather oblique base, about 15 to 25 Cm. long and about 7 Mm. thick; externally blackish-brown, longitudinally wrinkled, glossy, frequently covered with an efflorescence of vanillin in acicular crystals, flexible and tough, 1-celled, containing a blackish-brown pulp and numerous minute, blackish, ovoid and flattened seeds; odor and taste characteristic and very agreeable.

This valuable drug contains a trace of a volatile oil, 10 percent. of fixed oil, resin, sugar, etc., and *vanillin*, $C_8H_8O_3$, which is the aldehyde of methylprotocatechuic acid, and is now official. (See Vanillinum.) The agreeable odor and taste of "vanilla bean" is due to a fermentation occurring during the curing process; the fruit when first plucked from the plant has little odor or taste.

Official Preparation

Tinctura Vanillæ Tincture of Vanilla	Made by macerating 100 Gm. of vanilla with 500 Cc. of a mixture of 650 Cc. of alcohol and 350 Cc. of water, draining and reserving the macerate, beating the residue with 200 Gm. of sugar, and percolating with the reserved liquid and sufficient menstruum to make 1000 Cc. (see page 366)

VANILLINUM. U.S. Vanillin

$C_8H_8O_3 = 150.92$

Methylprotocatechuic aldehyde [$C_6H_3.OH.OCH_3.COH$ 4 : 3 : 1], occurring naturally in vanilla, or made artificially from several orthodihydroxybenzene derivatives.

Preparation.—Vanillin may be obtained from vanilla, which contains from 2 to 3 percent. It is also found in many substances, and in the tissues of certain plants, in crude beet sugar, asparagus, and even in asafetida. The vanillin of commerce is made artificially, and, while chemically identical with the product obtained from the "vanilla bean," owing to the fact that vanilla contains other odorous products, "extract of vanilla," made from vanillin, never equals in flavor the preparation in which vanilla alone is used. Vanillin is made synthetically by oxidizing either coniferin or eugenol, by treating guaiacol with chloroform in the presence of an alkali, and by other methods. It is frequently adulterated. Some of the substances which have been detected are acetanilide, boric acid, benzoic acid, sugar, acetisoeugenol, and coumarin.

Official Description.—Fine, white, crystalline needles.

Odor, Taste, and Reaction.—Odor and taste of vanilla; acid reaction.

Solubility.—*Water.* In about 100 parts of water at 25° C. (77° F.), and in 15 parts at 80° C. (176° F.).

Alcohol. Easily soluble.

Other solvents. Easily soluble in ether, glycerin, or chloroform.

Tests for Identity.—When heated to between 80° and 81° C. (176° and 177.8° F.), it melts, and at 285° C. (545° F.) it can be distilled without decomposition in a current of carbon dioxide, leaving no residue.

It is easily soluble in aqueous solutions of alkali hydroxides, and from the combinations thus formed it is precipitated at once by the addition of acids.

An aqueous solution of Vanillin gives, with ferric chloride T.S., a blue color; if the mixture be boiled, the blue color changes to brown, and on cooling a white precipitate of dihydro-divanillin separates.

Vanillin is extracted completely from its solution in ether by shaking with a saturated aqueous solution of sodium bisulphite, from which solution it is precipitated by the addition of sulphuric acid.

An aqueous solution of Vanillin will give, on the addition of lead acetate T.S., a white precipitate of a lead compound of vanillin, soluble in hot water, and crystallizing, on cooling, in scales.

Impurity and Test.—*Acetanilide.* On warming 0.1 Gm. of Vanillin with concentrated alcoholic solution of sodium hydroxide, adding chloroform and again warming, it should not give an odor of phenyl-isocyanide.

Uses.—Vanillin is used as a flavoring agent. It is sometimes given internally for dyspepsia in the dose of one-half to one grain (0.03 to 0.65 Gm.).

OLEUM CAJUPUTI. U.S. Oil of Cajuput

A volatile oil distilled from the fresh leaves and twigs of *Melaleuca Leucadendron* Linné (Fam. *Myrtaceæ*), yielding, when assayed by the process given below, not less than 55 percent., by volume, of cineol. It should be kept in well-stoppered, amber-colored bottles, in a cool place.

This aromatic oil has a penetrating odor, analogous to that of cardamom, and a warm, pungent taste. Its composition is $C_{10}H_{16}.H_2O$. It is termed chemically *cajuputene hydroxide*, or *cajuputol.* It boils at 175° C. (347° F.), and is freely soluble in alcohol. It contains *cineol* (eucalyptol), and the official assay recognizes this as a valuable constituent. When oil of cajuput is distilled, a light, colorless liquid first comes over, and afterwards a green and denser one. The green color has been ascribed to a salt of copper derived from the vessels in which the distillation is performed, and various investigators have found traces of copper present in it. Others, again, have carefully tested the green oil and proved its absence. A fair inference is that the oil of cajuput is naturally green, but that as found in commerce it sometimes contains copper, either accidentally present, or added with a view of imitating or maintaining the fine color of the oil.

Official Description.—A thin, colorless or greenish liquid.

Odor, Taste, and Reaction.—Peculiar, agreeable, distinctly camphoraceous odor, and an aromatic, slightly bitter taste. The alcoholic solution should be neutral.

Specific Gravity.—0.915 to 0.925 at 25° C. (77° F.).

Solubility.—*Alcohol.* Miscible in all proportions, also soluble in 1 part of 80 percent. alcohol.

Test for Identity.—Oil of Cajuput is lævogyrate; the angle of rotation should not exceed —2° in a 100 Mm. tube, at a temperature of 25° C. (77° F).

Impurity and Test.—*Copper.* On shaking 5 Cc. of the Oil with 5 Cc. of water containing 1 drop of diluted hydrochloric acid, a reddish-brown color should not be produced in the acid liquid when separated from the Oil, if a drop of potassium ferrocyanide T.S. be added.

Assay for Cineol.—Introduce into a beaker a solution prepared by dissolving 10 Cc. of Oil of Cajuput in 50 Cc. of purified petroleum benzin; immerse the beaker in a freezing mixture and add phosphoric acid, drop by drop, with constant stirring, until the white magma of cineol phosphate formed, begins to assume a yellowish or pinkish tint; then transfer the magma to a force filter, wash it with cold purified petroleum benzin, and then dry it by pressure between two porous plates. Transfer the precipitate (cineol phosphate) to a narrow graduated cylinder, and add warm water, which will cause separation of the cineol. The volume, in cubic centimeters, of the separated oily liquid, multiplied by 10, represents the volume percent. of cineol.

Uses.—Oil of cajuput is a stimulant, and is given in doses of eight minims (0.5 Cc.).

EUCALYPTUS. U.S. Eucalyptus

The dried leaves of *Eucalyptus Globulus* Labillardière (Fam. *Myrtaceæ*), collected from the older parts of the tree.

Petiole twisted, 2 to 3 Cm. long; blade lanceolately scythe-shaped, from 15 to 30 Cm. long, 2 to 4 Cm. broad, tapering above, rounded or very abruptly contracted at the oblique base, coriaceous, pale green, pellucid-punctate ; venation inconspicuous, anastomosing near the entire margin ; odor aromatic and somewhat camphoraceous ; taste aromatic, bitter, and cooling.

The virtues of eucalyptus leaves depend upon a volatile oil which should contain about 50 percent. of eucalyptol. There are also present resin, tannin, chlorophyll, fatty acid, etc. The leaves are used as a stimulant, febrifuge, or astringent. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Eucalypti Fluidextract of Eucalyptus	Made by percolating Eucalyptus with 3 parts of alcohol and 1 part of water (see page 395). Dose, ten to forty minims (0.6 to 2.4 Cc.)

OLEUM EUCALYPTI. U.S. Oil of Eucalyptus

A volatile oil distilled from the fresh leaves of Eucalyptus, rectified by steam distillation, and yielding, when assayed by the process given below, not less than 50 percent., by volume, of cineol (eucalyptol). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

The valuable portion of this oil consists of *eucalyptol*, $C_{10}H_{18}O$, which is very soluble in alcohol ; there are also present two terpenes, $C_{10}H_{14}$, $C_{10}H_{16}$. The proportion of eucalyptol (cineol) is recognized as a useful test for the quality of the oil (see official assay below).

Official Description.—A colorless or pale yellow liquid.

Odor, Taste, and Reaction.—Characteristic, aromatic, somewhat camphoraceous odor, and a pungent, spicy, and cooling taste. Its alcoholic solution should be neutral to litmus paper.

Specific Gravity.—0.905 to 0.925 at 25° C. (77° F.).

Solubility.—*Alcohol.* In all proportions ; also soluble in 3 volumes of 70 percent. alcohol.

Test for Identity.—It is dextrogyrate, the angle of rotation being not more than +10° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Impurities and Tests for Impurities.—*Eucalyptus oils containing much phellandrene.* If 2 Cc. of the Oil be mixed with 4 Cc. of glacial acetic acid, and 3 Cc. of a saturated, aqueous solution of sodium nitrite be gradually added, the mixture, when gently stirred, should not form crystals of phellandrene nitrite.

Assay for Cineol.—Introduce into a beaker a solution prepared by dissolving 10 Cc. of Oil of Eucalyptus in 50 Cc. of purified petroleum benzin ; immerse the beaker in a freezing mixture and add phosphoric acid, drop by drop, with constant stirring, until the white magma of cineol phosphate formed, begins to assume a yellowish or pinkish tint ; then transfer the magma to a force filter, wash it with cold purified petroleum benzin, and then dry it by pressure between two porous plates. Transfer the precipitate (cineol phosphate) to a narrow graduated cylinder, and add warm water, which will cause separation of the cineol. The volume, in cubic centimeters, of the separated oil, multiplied by 10, represents the volume percent. of cineol (eucalyptol). This should correspond to the properties and tests given under *Eucalyptol.*

Uses.—Oil of eucalyptus is used as a stimulant in doses of eight minims (0.5 Cc.). Eucalyptol is frequently preferred to it (see page 824).

EUCALYPTOL. U.S. Eucalyptol

$C_{10}H_{18}O = 152.98$

[Cineol]

An organic oxide (cineol), obtained from the volatile oil of *Eucalyptus Globulus* Labillardière (Fam. *Myrtaceæ*), and from other sources. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Preparation.—Eucalyptol may be obtained from many volatile oils, and chemists prefer to call it cineol. It may be separated from the purified volatile oils by taking advantage of its property of forming crystals when subjected to a low temperature (—1° C. ; 30.2° F.).

Official Description.—A colorless liquid.
Odor and Taste.—Characteristic, aromatic, and distinctly camphoraceous odor, and a pungent, spicy, and cooling taste.
Specific Gravity.—From 0.921 to 0.923 at 25° C. (77° F.).
Solubility.—*Alcohol.* Soluble in all proportions in alcohol.
Tests for Identity.—Boiling point: 176° to 177° C. (348.8° to 350.6° F.).

Eucalyptol is optically inactive (distinction from the *oil of eucalyptus* and *many other volatile oils*).

When exposed to a temperature somewhat below 0° C. (32° F.) it solidifies to a mass of colorless, needle-shaped crystals, which liquefy at —1° C. (30.2° F.).

If 1 Cc. of Eucalyptol be placed in a freezing mixture, and an equal volume of phosphoric acid be gradually added, a solid white crystalline mass of cineol-phosphoric acid should result, and if warm water be then added the cineol will separate.

If 5 Cc. of Eucalyptol be shaken with 5 Cc. of sodium hydroxide T.S., it should not diminish in volume.

Impurity and Test.—*Phenols.* Its alcoholic solution should be neutral to litmus paper, and if to 5 Cc. of this solution a drop of ferric chloride T.S. be added, there should not be produced a brownish or violet color.

Uses.—Eucalyptol is used in the official antiseptic solution, and is a stimulant and antiseptic. Dose, five minims (0.3 Cc.).

MYRISTICA. U.S. Myristica

[NUTMEG]

The kernel of the ripe seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceæ*). Ovoid or ellipsoidal, about 25 Mm. long; externally light brown, reticulately furrowed, with a circular scar at the broad end; internally more or less mottled from the infolding of the light brown perisperm and tegmen with the yellowish-brown endosperm; easily cut, the cut surface having a waxy lustre; odor strongly aromatic; taste agreeably aromatic, warm, and slightly bitter.

This valuable spice owes its activity to the presence of an oxygenated volatile oil. Nutmeg contains about 25 percent. of fixed oil, together with proteids, starch, etc. It forms one of the ingredients in the following official preparations: vinegar of opium, aromatic powder, compound tincture of lavender, aromatic tincture of rhubarb, and troches of sodium bicarbonate. Dose, eight grains (0.5 Gm.).

OLEUM MYRISTICÆ. U.S. Oil of Myristica

[OIL OF NUTMEG]

A volatile oil distilled from Myristica. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil consists of a terpene called *myristicene*, $C_{10}H_{16}$, and an oxygenated portion, $C_{10}H_{14}O$, *myristicol.*

Expressed oil of nutmeg, or *oil of mace*, is made by expressing nutmegs between hot plates, or macerating them in carbon disulphide, and distilling the macerate. It is a fat, having the composition $C_3H_5(C_{14}H_{27}O_2)_3$, *myristicin.*

Official Description.—A thin, colorless or pale yellow liquid.
Odor and Taste.—Characteristic odor of nutmeg, and a warm, spicy taste.
Specific Gravity.—0.884 to 0.924 at 25° C. (77° F.).
Solubility.—*Alcohol.* In equal volume; also soluble in 3 volumes of 90 percent. alcohol.
Tests for Identity.—Oil of Myristica is dextrogyrate.

When 2 or 3 Cc. of Oil are evaporated on a water-bath, no residue which crystallizes on cooling should be left.

Uses.—It is used in aromatic spirit of ammonia. This oil is very difficult to keep and even if slightly terebinthinate is unfit for flavoring purposes. Dose, three minims (0.2 Cc.).

SASSAFRAS. U.S. Sassafras

The dried bark of the root of *Sassafras variifolium* (Salisbury) O. Kuntze (Syn. *Sassafras Sassafras* (Linné) Karsten) (Fam. *Lauraceæ*), collected in early spring or autumn, and deprived of the periderm.

In irregular transversely curved, reddish-brown pieces, of variable length and 0.5 to 5 Mm. thick; outer surface nearly smooth; inner surface obscurely short-striate; soft, fragile, with a short, corky fracture; strongly fragrant; taste mucilaginous, aromatic, and astringent.

This well known bark contains volatile oil (safrol), sassafrid, tannin, starch, resin, etc. It is principally used on account of its aromatic oil. It is an ingredient in the compound fluidextract of sarsaparilla, and is largely used in domestic practice, and as an addition to proprietary medicines for the purpose of covering the taste of disagreeable substances. Dose, two drachms (8 Gm.).

OLEUM SASSAFRAS. U.S. Oil of Sassafras

A volatile oil distilled from the root, especially the root bark, of *Sassafras variifolium* (Fam. *Lauraceæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil was formerly largely produced in New Jersey and Maryland from the wood and bark of the sassafras; the yield is about 2 percent. It consists of a terpene, $C_{10}H_{16}$ (*safrene*), and an oxygenated portion, $C_{10}H_{10}O_2$ (*safrol*), now obtained on an immense scale from oil of camphor. When treated with cold nitric acid, it becomes dark red, and is finally converted into a red resin. If to a few drops of the oil a drop of sulphuric acid be added, a deep red color will be produced at first, which soon becomes blackish.

Official Description.—A yellow or reddish-yellow liquid.
Odor, Taste, and Reaction.—Characteristic odor of sassafras; warm, aromatic taste.
Specific Gravity.—1.065 to 1.075 at 25° C. (77° F.).
Tests for Identity.—The Oil is dextrogyrate, but should not deviate the ray of polarized light more than +4° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—Oil of sassafras is largely used as a flavoring agent by confectioners. It is used officially in compound syrup of sarsaparilla and troches of cubeb. It may be given in the dose of three minims (0.2 Cc.).

SAFROLUM. U.S. Safrol

$C_{10}H_{10}O_2 = 160.86$

The methylene ether of allyl pyrocatechol [$C_6H_3.C_3H_5.(OOCH_2)$ 1 : 3 : 4], found in oil of sassafras, camphor oil, and other volatile oils, purified, if necessary, by repeated chilling and crystallization.

Preparation.—Safrol is made on a large scale by chilling at a low temperature the oils of camphor and sassafras, and also some other oils; the crystals are separated, and allowed to melt, forming liquid safrol. It has also been made synthetically.

Official Description.—A colorless or faintly yellow liquid.
Odor.—Sassafras-like odor.
Specific Gravity.—1.098 to 1.100 at 25° C. (77° F.).
Solubility.—*Alcohol.* In about an equal volume of strong alcohol, and in about 30 parts of 70 percent. alcohol.
Other solvents. Miscible in all proportions with ether and chloroform.
Tests for Identity.—Boiling point: about 233° C. (451.4° F.).
It is optically inactive. On cooling to —20° C. (—4° F.) or below, it solidifies to a mass of crystals, which do not melt below 11° C. (51.8° F.).

Uses.—Safrol is used very extensively for scenting soaps, and frequently as a substitute for oil of sassafras, over which it has the advantage of being a definite product. It may be given in the dose of five minims. (0.3 Cc.).

OLEUM GAULTHERIÆ. U.S. Oil of Gaultheria

[Oil of Wintergreen]

A volatile oil distilled from the leaves of *Gaultheria procumbens* Linné (Fam. *Ericaceæ*), rectified, if necessary, by steam distillation. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil consists of a terpene, $C_{10}H_{16}$, termed *gaultherilene*, and methyl salicylate, $CH_3.C_7H_5O_3$. It is the heaviest of all the volatile oils, having the sp. gr. 1.172 to 1.180. When mixed with concentrated solution of sodium or potassium hydroxide it becomes a solid crystalline mass, and the odor of the oil is lost. The reddish color is due to a trace of iron.

The adulteration with chloroform or alcohol is shown by heating it to about 80° C. (176° F.), when the oil should not yield a colorless distillate having the characteristics of chloroform or of alcohol; and that of oil of sassafras by mixing 5 drops of the oil with 5 drops of nitric acid, when the mixture should not acquire a deep red color and should not solidify to a dark red, resinous mass.

Official Description.—A colorless or almost colorless liquid.
Odor and Taste.—Characteristic, strongly aromatic odor; sweetish, warm, and aromatic taste.
Specific Gravity.—1.172 to 1.180 at 25° C. (77° F.).
Tests for Identity.—Boiling point: 218° to 221° C. (424.4° to 429.8° F.).
It is slightly lævogyrate, up to —1° in a 100 Mm. tube, at 25° C. (77° F.).
In other respects it has the same properties as, and conforms to the reactions and tests given under, *Methylis Salicylas*.

Uses.—Oil of gaultheria is used as a flavor in emulsion of cod liver oil, emulsion of cod liver oil with hypophosphites, antiseptic solution, and compound syrup of sarsaparilla, and in place of salicylic acid in rheumatism, neuralgia, and kindred diseases, in doses of ten to twenty minims (0.6 to 1.2 Cc.).

Official Preparation

Spiritus Gaultheriæ Spirit of Gaultheria	Made by mixing 50 Cc. of oil of gaultheria with 950 Cc. of alcohol (see page 315). Dose, ten to thirty minims (0.6 to 2 Cc.).

OLEUM BETULÆ. U.S. Oil of Betula

[Oleum Betulæ Volatile, Pharm. 1890 Oil of Sweet Birch]

A volatile oil obtained by maceration and distillation from the bark of the Sweet Birch, *Betula lenta* Linné (Fam. *Betulaceæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

It is optically inactive, but otherwise has essentially the same properties as, and conforms to the reactions and tests given under, *Oleum Gaultheriæ*.

Uses.—Its medicinal properties are identical with those of oil of gaultheria (see page 827). Dose, fifteen minims (1 Cc.).

METHYLIS SALICYLAS. U.S. Methyl Salicylate

$CH_3C_7H_5O_3 = 150.92$

[METHYL SALICYLAS, PHARM. 1890 SYNTHETIC OIL OF WINTERGREEN SYNTHETIC OIL OF GAULTHERIA]

An ester [$C_6H_4(OH)COOCH_3$ 1:2], produced synthetically; it is the principal constituent of Oil of Gaultheria and Oil of Betula. For flavoring purposes, Oil of Gaultheria, Oil of Betula, and Methyl Salicylate may be regarded as identical products. It should be kept in well-stoppered bottles, protected from light.

Preparation.—Methyl Salicylate is found naturally in the oils of gaultheria and betula and in many other plants, but the product found in commerce is usually made by distilling salicylic acid or a salicylate with methyl alcohol and strong sulphuric acid.

Official Description.—A colorless liquid.

Odor, Taste, and Reaction.—Characteristic, strongly aromatic, wintergreen odor; sweetish, warm, and aromatic taste. The alcoholic solution is neutral or slightly acid to litmus paper.

Specific Gravity.—1.180 to 1.185 at 25° C. (77° F.), according to the amount of moisture present.

Solubility.—*Water.* Sparingly.

Alcohol and other solvents. Soluble, in all proportions, in alcohol, glacial acetic acid, and carbon disulphide.

Tests for Identity.—Boiling point: 219° to 221° C. (426.2° to 429.8° F.).

It is optically inactive.

If a drop of Methyl Salicylate be shaken with a little water, and a drop of ferric chloride T.S. subsequently added, a deep violet color will be produced.

Alcohol or chloroform. When heated on a water-bath, in a flask provided with a suitable condenser, it should yield no distillate having the characteristics of *alcohol* or *chloroform.*

Impurities and Tests for Impurities.—*Volatile oils or petroleum.* If to 1 Cc. of Methyl Salicylate, contained in a capacious test-tube, 10 Cc. of potassium hydroxide T.S. be added and the mixture agitated, a clear, colorless or faintly yellowish solution, should result without the separation of any oily drops, either on the surface or at the bottom of the liquid.

Methyl benzoate, etc. If the alkaline liquid thus obtained be subsequently diluted with about three times its volume of water, and a slight excess of hydrochloric acid added, a white, crystalline precipitate will be produced which, when collected on a filter, washed with a little water, and recrystallized from hot water, should respond to the tests of identity and purity given under *Acidum Salicylicum.*

Uses.—Methyl salicylate is identical in medical properties with oil of wintergreen and oil of betula, and it has largely replaced these oils in commerce, as it is cheaper and if pure answers the purpose as a flavoring agent. Dose, fifteen minims (1 Cc.).

CALAMUS. U.S. Calamus

[SWEET FLAG]

The unpeeled, dried rhizome of *Acorus Calamus* Linné (Fam. *Araceæ*).

Rhizome 1 to 2 Cm. thick, usually in longitudinally split pieces of various lengths; when entire, cylindraceous and somewhat vertically flattened, externally reddish-brown, somewhat annulate from remnants of leaf-sheaths; upper surface with triangular leaf-scars, the lower surface with circular pitted scars of roots; fracture short, showing numerous oil-cells and scattered fibrovascular bundles, the latter crowded within the endodermis; odor aromatic; taste pungent and bitter.

Calamus contains a volatile oil having the composition of a terpene, $C_{10}H_{16}$, soft resin, a bitter principle, acorin, starch, and mucilage. It is esteemed solely on account of its aromatic properties, which are due to the volatile oil. Dose, fifteen grains (1 Gm.).

Official Preparation

Fluidextractum Calami Fluidextract of Calamus	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 386). Dose, fifteen minims to one fluidrachm (1 to 4 Cc.)

CARDAMOMUM. U.S. Cardamom

The dried nearly ripe fruit of *Elettaria repens* (Sonnerat) Baillon (Fam. *Zingiberaceæ*).

Oblong-ovoid, obtusely triangular in transverse section, from 10 to 20 Mm. long, slightly beaked at the apex, rounded to truncate at the base; three-celled and with central placentæ; pericarp thin, leathery, nearly tasteless, and of a pale yellow color; seeds 15 to 18 in number, about 4 Mm. long, oblong-ovoid and irregularly angular, reddish-brown, enclosed in a thin, membranous aril; odor and taste strongly and agreeably aromatic. Ash not more than 4 percent.

The seeds alone contain active and valuable constituents.

This valuable aromatic is imported from India. The seeds contain 5 percent. of an oxygenated volatile oil, of the sp. gr. 0.943, 10 percent. of fixed oil, starch, mucilage, etc. Owing to the presence of the fixed oil, they are very difficult to powder alone. Hence the practice in preparing compound powders containing cardamom of mixing the other ingredients with it, so that they may absorb the oil. The oil of cardamom is usually made by percolation with ether, and is a mixture of both volatile and fixed oils. Cardamom enters into a number of official preparations, as an aromatic in tincture and compound tincture of cardamom, compound extract of colocynth, aromatic powder, compound tincture of gentian, and tincture of rhubarb. Dose, fifteen grains (1 Gm.).

Official Preparations

Tinctura Cardamomi Tincture of Cardamom	Made by percolating 200 Gm. of cardamom with sufficient diluted alcohol to make 1000 Cc. (see page 348). Dose, one fluidrachm (4 Cc.)
Tinctura Cardamomi Composita Compound Tincture of Cardamom	Made by macerating 25 Gm. each of cardamom and Saigon cinnamon, 12 Gm. of caraway, and 5 Gm. of cochineal with 750 Cc. of a mixture of 950 Cc. of diluted alcohol and 50 Cc. of glycerin for seven days with occasional agitation, filtering, then pouring on the residue, first the remainder of the menstruum and then sufficient diluted alcohol to make 1000 Cc. (see page 348). Dose, one fluidrachm (4 Cc.)

ZINGIBER. U.S. Ginger

The dried rhizome of *Zingiber officinale* Roscoe (Fam. *Zingiberaceæ*).

Laterally compressed, irregularly branched pieces; externally whitish or pale buff, longitudinally striate; fracture short-fibrous, mealy, showing numerous small oil and resin cells and circular groups of fibrovascular bundles; odor agreeably aromatic; taste aromatic and pungent.

This well known and largely used rhizome owes its virtues to about 4 percent. of volatile oil, having the composition $C_{10}H_{16}$, and therefore a terpene, and a soft, pungent, aromatic resin, which is soluble in alcohol and ether. It is used in aromatic powder and compound powder of rhubarb, and in the following preparations, in which it is the sole medicinal ingredient. Dose, fifteen grains (1 Gm.).

Official Preparations

Fluidextractum Zingiberis Fluidextract of Ginger	Made with a menstruum of alcohol (see page 425). Dose, ten to thirty minims (0.6 to 1.8 Cc.)
Oleoresina Zingiberis Oleoresin of Ginger	Made by percolating powdered ginger with acetone (see page 428). Dose, one minim (0.05 Cc.)
Syrupus Zingiberis Syrup of Ginger	Made from 30 Cc. fluidextract of ginger, 10 Cc. alcohol, 820 Gm. sugar, magnesium carbonate, and sufficient water to make 1000 Cc. (see page 298)
Tinctura Zingiberis Tincture of Ginger	Made by percolating 200 Gm. powdered ginger with sufficient alcohol to make 1000 Cc. (see page 366). Dose, one fluidrachm (4 Cc.)

Unofficial Terpenes

Oil of Burgundy Pitch	From *Abies excelsa.* Fam. Coniferæ. Habitat, Europe
Calamus	From the rhizome of *Acorus Calamus.* Fam. Araceæ. Habitat, North America. The yield is about 1½ to 2 percent.
Canada Turpentine	From the oleoresin of *Abies balsamea.* Fam. Coniferæ
Cedrat	From *Citrus medica.* Fam. Rutaceæ. Used in perfumery
Elemi	From *Canarium Commune.* Fam. Burseraceæ. Habitat, Philippine Islands. The yield is about 10 percent.
Gurjun Balsam	From *Dipterocarpus turbinatus.* Fam. Dipterocarpaceæ. Habitat, India. The yield is from 40 to 70 percent.
Hemlock Spruce	From *Abies canadensis.* Fam. Coniferæ. Habitat, Canada
Hungarian Turpentine	From *Pinus Pumilio.* Fam. Coniferæ
Jaborandi	From the leaflets of *Pilocarpus pennatifolius.* Fam. Rutaceæ. Habitat, Brazil
Myrcia (Oil of Bay). U. S. P. 1890	From *Myrcia acris* De Candolle. Fam. Myrtaceæ
Myrtle	From *Myrtus communis.* Fam. Myrtaceæ
Sage	From the leaves of *Salvia officinalis.* Fam. Labiatæ. The yield is about ¼ percent.
Strassburg Turpentine	From *Abies pectinata.* Fam. Coniferæ
Templin	From the shoots of *Pinus Pumilio.* It is a colorless or yellowish-green oil, of an agreeable, somewhat terebinthinate odor
Venice Turpentine	From *Larix europæa.* Fam. Coniferæ

Unofficial Oxygenated Oils

Oil of Absinthium	From *Artemisia Absinthium.* Fam. Compositæ
Angustura	From the bark of *Galipea Cusparia.* Fam. Rutaceæ. Habitat, South America. Yield about ⅙ percent. Composition, $C_{13}H_{24}O$
Anthemis	From the flower heads of *Anthemis nobilis.* Fam. Compositæ. Habitat, Europe
Arnica	From the root and flowers of *Arnica montana.* Fam. Compositæ. Habitat, Europe. Yield about ½ to 1 percent.
Asarum	From the rhizome of *Asarum canadense.* It is used to give permanence to the odors of some cologne waters
Buchu	From the leaves of *Barosma betulina*, *B. crenulata*, and *B. serratifolia.* Fam. Rutaceæ. Habitat, Southern Africa. The yield is from ½ to 1½ percent.
Camphor	From the preparation of crude camphor. Fam. Laurineæ. Habitat, Asia
Canella	From the bark of *Canella alba.* Fam. Canellaceæ. Habitat, Southern United States. The yield is from ½ to 1 percent.
Capsicum	From the fruit of *Capsicum fastigiatum.* Fam. Solanaceæ. Habitat, Southern and Central America. The yield is very small
Cardamom	From the fruit of *Elettaria repens.* Fam. Zingiberaceæ. Habitat, Hindostan. The yield is about 4 percent.
Carrot	From the fruit of *Daucus Carota.* Fam. Umbelliferæ. Indigenous to Northern Asia. The yield is very small
Cascarilla	From the bark of *Croton Eluteria.* Fam. Euphorbiaceæ. Indigenous to the Bahama Islands. The yield of oil is about 1½ percent.
Catnep	From the leaves and tops of *Nepeta Cataria.* Fam. Labiatæ. Habitat, Europe. The yield is small
Celery	From the fruit of *Apium graveolens.* Fam. Umbelliferæ. Habitat, Europe
Citronella	From the leaves of *Andropogon Nardus.* Habitat, Ceylon. Contains a terpene, citronellol, and a heptoic aldehyde. Used in perfumery
Clove Cinnamon	From *Persea caryophyllata*
Curcuma	From the rhizome of *Curcuma longa.* Fam. Zingiberaceæ. Habitat, India. The yield is about 1 percent.
Cyna	From the flowers of *Artemisia maritima.* Fam. Compositæ. Habitat, Asia. A pale yellow oil. The yield is about 2 percent.
Dahlia	From the tubers of *Dahlia pinnata*
Elder (European)	From the flowers of *Sambucus nigra.* Fam. Caprifoliaceæ. Habitat, Europe. The yield is from ⅓ to ½ percent.
Feverfew	From *Pyrethrum Parthenium.* Fam. Compositæ. Habitat, Europe
Galangal	From the rhizome of *Alpinia officinarum.* Fam. Zingiberaceæ. Habitat, China. The yield of oil is about ½ percent.
Ginger	From the rhizome of *Zingiber officinale.* Fam. Zingiberaceæ. Habitat, Jamaica. The yield is from 1 to 2 percent.
Ginger Grass	From the flowers of *Andropogon Schœnanthus*
Golden Rod	From the leaves of *Solidago odora*
Heliotrope	From the flowers of *Heliotropium peruvianum* and *H. grandiflorum*

Unofficial Oxygenated Oils—*Continued*

Oil of Hop	From the strobiles of *Humulus Lupulus*. Fam. Urticaceæ. Habitat, North America. The yield is about 0.8 percent.
Horsemint	From the leaves and flowers of *Monarda punctata*. Fam. Labiatæ. Habitat, United States
Hyssop	From the herb of *Hyssopus officinalis*. Fam. Labiatæ. Habitat, Southern Europe. The yield is from $\frac{1}{4}$ to $\frac{1}{2}$ percent.
Ihlang-Ihlang	From *Unona odoratissima*
Indian Cannabis	From *Cannabis sativa*. Fam. Moraceæ. Habitat, Asia
Inula	From the root of *Inula Helenium*. Fam. Compositæ. Habitat, Europe. The yield is very small
Jessamine	From the flowers of *Jasminum grandiflorum* and *J. fragrans*. Fam. Jasmineæ. The yield is very small. Used in perfumery
Laurel	From *Laurus nobilis*. Fam. Lauraceæ. Habitat, Southern Europe. The yield of oil is about 20 percent
Lilac	From the flowers of *Syringa vulgaris*. Fam. Oleaceæ. Used in perfumery
Lily of the Valley	From the flowers of *Convallaria majalis*. Fam. Liliaceæ. The yield is very small. Used in perfumery
Oil of Linden	From the inflorescence of different species of *Tilia*. Fam. Tiliaceæ. Habitat, Europe and America. The yield is from $\frac{1}{20}$ to $\frac{1}{10}$ percent.
Lovage	From the root of *Levisticum officinale*. Fam. Umbelliferæ. Habitat, Europe
Mace	The arillode of *Myristica fragrans*. Fam. Myristicaceæ. Habitat, Molucca Islands. The yield is about 8 percent.
Marrubium	From *Marrubium vulgare*. Fam. Labiatæ. Habitat, Europe and Asia. The yield is small
Marsh Tea	From the leaves of *Ledum palustre*. Fam. Ericaceæ. Habitat, Europe and Asia. The yield is variable, but from $\frac{3}{4}$ to $1\frac{1}{2}$ percent.
Masterwort	From *Heracleum lanatum*. Fam. Umbelliferæ. Habitat, United States. The yield is small
Matico	From the leaves of *Piper angustifolium*. Fam. Piperaceæ. Habitat, tropical America. The yield is about $1\frac{1}{2}$ per cent.
Matricaria	From the flowers of *Matricaria Chamomilla*. Fam. Compositæ. Habitat, Europe and United States. The yield is about $\frac{1}{4}$ percent.
Melissa	From the leaves and tops of *Melissa officinalis*. Fam. Labiatæ. Habitat, Europe and United States. The yield is from $\frac{1}{8}$ to $\frac{1}{4}$ percent.
Mignonette	From the flowers of *Reseda odorata*. Fam. Resedaceæ. Habitat, Southern France. The yield is very small. Used in perfumery
Mountain Balm	From the leaves of *Eriodictyon californicum*. Fam. Hydrophyllaceæ. Habitat, California
Myrrh	From the gum-resin of *Commiphora Myrrha*. Fam. Burseraceæ. Habitat, Arabia. The yield is from 2 to $2\frac{1}{2}$ percent.
Olibanum	From *Boswellia Carterii*. Fam. Burseraceæ. Habitat, Arabia. The yield is from 4 to 8 percent.
Parsley	From the fruit of *Petroselinum sativum*. Fam. Umbelliferæ. Habitat, Southern Europe. The yield is about $1\frac{1}{2}$ percent.
Patchouly	From *Pogostemon Patchouly*. Fam. Labiatæ. Habitat, East India
Phellandrium	From the fruit of *Œnanthe Phellandrium*. Fam. Umbelliferæ. The yield is about $1\frac{1}{2}$ percent.
Red Cedar	From *Juniperus virginiana*. Fam. Coniferæ. Habitat, Canada and United States
Rhodium	From the root of *Convolvulus Scoparius*. Habitat, Canary Islands. The *oil of rhodium* sold in pharmacy is usually a factitious article, made by mixing 1 part of oil of rose with 20 parts of oil of copaiba. It is used as a lure for rats
Saffron	From *Crocus sativus*. Fam. Irideæ. Habitat, Europe. The yield is about 1 percent.
Serpentaria	From the rhizome and roots of *Aristolochia Serpentaria* and *A. reticulata*. Fam. Aristolochiaceæ. Habitat, Virginia. The yield is about $\frac{1}{2}$ percent.
Summer Savory	From the herb of *Satureja hortensis*. Fam. Labiatæ
Sweet Basil	From *Ocymum Basilicum*. Fam. Labiatæ. Habitat, Asia and Africa
Sweet Cicely	From *Osmorhiza longistylis*. Fam. Umbelliferæ
Sweet Marjoram	From *Origanum marjorana*. Fam. Labiatæ
Sweet Violet	From the flowers of *Viola odorata*. Fam. Violaceæ
Tansy	From the leaves of *Tanacetum vulgare*. Fam. Compositæ. Habitat, Europe and North America. The yield is variable, from $\frac{1}{4}$ to $\frac{1}{2}$ percent.

Unofficial Oxygenated Oils—*Continued*

Oil of Tea	From the leaves of *Thea sinensis*. Fam. Ternstrœmiaceæ. Habitat, China. The yield is from ½ to 1 percent.
Thuja	From the branches of *Thuja occidentalis*. Fam. Coniferæ. Habitat, Canada and United States. The yield is variable, but about 1 percent.
Tuberose	From the flowers of *Polianthes tuberosa*. Fam. Amaryllidaceæ
Verbena (Lemongrass)	From *Andropogon Citratis*. A grass cultivated in Ceylon and Singapore
Wormwood	From the herb of *Artemisia Absinthium*. Fam. Compositæ. Habitat, Europe. The yield is about ½ percent.
Zedoary	From the rhizome of *Curcuma Zedoaria*. Fam. Zingiberaceæ. Habitat, East India Islands

Stearoptenes from Volatile Oils

CAMPHORA. U.S. Camphor

$C_{10}H_{16}O = 150.98$

The dextrogyrate modification of the saturated ketone [$C_9H_{16}CO$], obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*), and purified by sublimation. Camphor should be kept in well-closed vessels, in a cool place.

Preparation.—Refined camphor is usually made by subliming in circular cakes the crude granular camphor imported from China and Japan. The vessels in which the camphor is sublimed are of cast iron, circular, from twelve to fifteen inches or more in diameter, and four inches deep, with perpendicular sides, and a ledge at top, on which the cover rests. This consists of sheet iron, with a hole through the centre about an inch in diameter, over which a small hollow cone of sheet iron is placed loosely. The crude camphor, mixed with lime,—the object of which is said to be to combine with the moisture present, which would interfere with the due solidification of the camphor vapor,—is placed in the iron vessels described, of which from twenty to fifty are arranged in a long sand bath. Heat is then applied until the camphor melts, after which the heat is kept as nearly uniform as possible, so that the vaporization may take place regularly, without violent ebullition. The camphor sublimes on the lower surface of the lid in a solid circular cake, care being taken, by the occasional removal of the iron cone and clearing of the opening by means of a knife, to allow the escape of any excess of the vapor; the round hole in the cakes is thus accounted for. Camphor is sometimes sublimed in powder by conducting the vapor into a large chamber (see Sublimation, page 161). This powder is often compressed into oblong cakes, forming *compressed camphor*. Japanese camphor, refined in Formosa, and put up in ounce cakes and pound packages is now supplied. Camphor has been made synthetically under the Thurlow patent by the interaction of oil of turpentine and anhydrous oxalic acid, the resulting mixture being treated with lime, and then distilled.

Official Description.—White, translucent masses, of a tough consistence and a crystalline structure, readily pulverizable in the presence of a little alcohol, ether, or chloroform.
Odor and Taste.—Penetrating, characteristic odor; pungent, aromatic taste.
Specific Gravity.—0.990 at 25° C. (77° F.).
Solubility.—*Water.* Very sparingly.
Alcohol. Readily.
Other solvents. Readily in ether, chloroform, carbon disulphide, petroleum benzin, and in fixed and volatile oils.

Tests for Identity.—It is optically active, being dextrogyrate.

On exposure to the air, it evaporates more or less rapidly at ordinary temperatures, and, when moderately heated, it sublimes without leaving a residue.

When camphor is triturated, in about molecular proportions, with menthol, thymol, phenol, or hydrated chloral, liquefaction ensues. It melts at 175° C. (347° F.), boils at 204° C. (399.2° F.), and is inflammable, burning with a luminous, smoky flame.

Impurity and Test.—*Chlorinated products.* If a small piece of camphor be dropped into a small porcelain dish, the latter placed in a larger dish, and a clean beaker moistened on the inner surface with distilled water be inverted over the smaller dish immediately after igniting the camphor, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water, and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S.

Uses.—Camphor is a stimulant. It is given in doses of two to ten grains (0.125 to 0.6 Gm.). There are four official preparations in which camphor is the chief medicinal ingredient; it is also an important substance in the following preparations: cerate of lead subacetate, belladonna liniment, soap liniment, compound powder of morphine, and camphorated tincture of opium.

Official Preparations

Aqua Camphoræ Camphor Water	Made by dissolving 8 Gm. of camphor in 8 Cc. of alcohol, triturating with 15 Gm. of purified talc, and filtering this with distilled water until 1000 Cc. have been obtained (see page 276)
Ceratum Camphoræ Camphor Cerate	Made by mixing 100 Gm. of camphor liniment, 350 Gm. of white wax, 150 Gm. of white petrolatum, and 400 Gm. of benzoinated lard (see page 1257)
Linimentum Camphoræ Camphor Liniment	Made by dissolving 200 Gm. of camphor in 800 Gm. of cotton seed oil (see page 322)
Spiritus Camphoræ Spirit of Camphor	Made by dissolving 100 Gm. of camphor in alcohol sufficient to make 1000 Cc. (see page 314). Dose, five to forty minims (0.3 to 2.4 Cc.)

ACIDUM CAMPHORICUM. U.S. Camphoric Acid

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

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

Preparation.—Camphoric acid is made by treating camphor with hot nitric acid.

Official Description.—Colorless, monoclinic prismatic crystals or plates.

Odor and Reaction.—Odorless; acid reaction.

Solubility.—*Water.* In 125 parts at 25° C. (77° F.); in 10 parts of boiling water.

Alcohol. Readily.

Other solvents. Less soluble in ether and chloroform; soluble in fatty oils.

Tests for Identity.—Melts at 187° C. (368.6° F.), at a higher temperature yields an anhydride, and ultimately decomposes without leaving any weighable residue.

Camphoric Acid is dextro-rotatory, showing, in 10 percent. alcoholic solution, the value $[\alpha]_D = +47.8°$.

Impurity and Test.—*Nitric acid.* If 2 Cc. of a saturated aqueous solution of Camphoric Acid be mixed with 2 Cc. of sulphuric acid in a test-tube, and 1 Cc. of a solution made by dissolving 1 Gm. of ferrous sulphate in 2 Cc. of diluted sulphuric acid be poured carefully upon it, no dark-colored zone should develop at the line of contact.

Uses.—Camphoric acid is used in the treatment of bronchitis and phthisis. Dose, fifteen grains (1 Gm.).

CAMPHORA MONOBROMATA. U.S. Monobromated Camphor

$C_{10}H_{15}BrO = 229.34$

A substitution product of camphor $[C_9H_{15}Br.CO]$.

Preparation.—This compound of camphor may be made by Prof. Maisch's process as follows: Four ounces of bromine are introduced gradually into a retort in which thirteen ounces of camphor have been previously placed. In fifteen or twenty minutes a brisk reaction will commence. When this subsides, eight or nine ounces more of bromine are to be poured in, in four portions, waiting after each addition until the reaction ceases. The liquid in the retort is now to be heated to about 132° C. (270° F.), then cooled, and sufficient petroleum benzin added to dissolve the crystalline mass. The crystals which are formed on cooling may be purified by recrystallization from petroleum benzin or hot alcohol.

Official Description.—Colorless, prismatic needles or scales; permanent in the air, and unaffected by light.

Odor, Taste, and Reaction.—Mild but characteristic camphoraceous odor and taste; neutral reaction.

Solubility.—*Water.* Almost insoluble.

Alcohol. Freely.

Other solvents. Freely in ether, chloroform, hot petroleum benzin, and fixed and volatile oils; slightly soluble in glycerin; it is also soluble, without decomposition, in cold, concentrated sulphuric acid, from which it separates again unaltered, when the solution is poured into water.

Tests for Identity.—It melts at 76° C. (168.8° F.), and sublimes at a slightly higher temperture. At 274° C. (525.2° F.) it boils without decomposition, and is finally volatilized without leaving a residue.

If a few crystals of Monobromated Camphor be fused in a dry test-tube with metallic sodium, the residue dissolved in water and the solution acidulated with nitric acid, a copious, faintly yellowish precipitate should be produced upon the addition of silver nitrate T.S.

Uses.—Monobromated camphor is given as a nervous sedative, in doses of two to five grains (0.125 to 0.3 Gm.).

Official Substances containing Nitrogenated and Sulphurated Oils with Allied Products

AMYGDALA AMARA. U.S. Bitter Almond

The ripe seed of *Prunus Amygdalus* Stokes, var. *amara* De Candolle (Fam. *Rosaceæ*).

Ovate or oblong-lanceolate, 20 to 30 Mm. long; seed-coat thin, brown, finely downy; embryo straight, white, and with two plano-convex cotyledons; taste bitter and oily; when triturated with water Bitter Almond yields a milk-white emulsion which emits an odor of hydrocyanic acid.

Bitter almond contains *amygdalin*, $C_{20}H_{27}NO_{11}$, a glucoside which splits into benzaldehyde, or oil of bitter almond, hydrocyanic acid, and glucose, under the influence of emulsin, or synaptase, a ferment which becomes active in the presence of water.

$$\underset{\text{Crystallized Amygdalin}}{C_{20}H_{27}NO_{11}} + \underset{\text{Water}}{3H_2O} = \underset{\text{Dextroglucose}}{2(C_6H_{12}O_6)} + \underset{\text{Hydrocyanic Acid}}{HCN} + \underset{\text{Oil of Bitter Almond}}{C_7H_6O} + \underset{\text{Water}}{H_2O}$$

It also contains about 35 percent. of fixed oil, mucilage, sugar, etc., with a trace of tannin in the testa. Bitter almond is used in making the volatile oil, and for flavoring purposes.

OLEUM AMYGDALÆ AMARÆ. U. S. Oil of Bitter Almond

A volatile oil obtained from Bitter Almond and other seeds containing amygdalin, yielding, when assayed as directed below, not less than 85 percent. of benzaldehyde, and not less than 2 percent nor more than 4 percent. of hydrocyanic acid. It should be kept in small, well-stoppered, completely filled, amber-colored bottles, protected from light and air.

Preparation.—As stated above, oil of bitter almond, or benzaldehyde, is produced as the result of the reaction of emulsin on amygdalin in aqueous mixture; it therefore does not pre-exist in the almond, and cannot be obtained from sweet almond, because amygdalin is not present in the latter.

$$\underset{\text{Amygdalin}}{C_{20}H_{27}NO_{11}} + \underset{\text{Water}}{2H_2O} = \underset{\text{Benzaldehyde}}{C_7H_6O} + \underset{\text{Glucose}}{2C_6H_{12}O_6} + \underset{\text{Hydrocyanic acid}}{HCN}$$

The process is simply to make a mixture of the bitter almond cake (obtained after the fixed oil has been extracted) with water, and distil it by passing a current of steam through it. The proportions of benzaldehyde and hydrocyanic acid in the oil are recognized as valuable tests (see official assay below, also Benzaldehydum, page 836).

Official Description.—A clear, colorless or yellow, thin, and strongly refractive liquid.

Odor, Taste, and Reaction.—Peculiar, aromatic odor, and a bitter and burning taste. In the fresh state neutral to litmus paper, but when kept for some time acquires an acid reaction, due to the formation of benzoic acid, which, when isolated and purified, should correspond to the tests given under *Acidum Benzoicum.* Oil of Bitter Almond containing crystals of benzoic acid should not be dispensed.

Specific Gravity.—1.045 to 1.060 at 25° C. (77° F.).

Solubility.—*Water.* In 300 parts at 25° C. (77° F.).

Alcohol. In all proportions, and in an equal volume of 70 percent. alcohol.

Other solvents. In ether in all proportions, and in nitric acid at ordinary temperatures without the evolution of nitrous vapors.

Tests for Identity.—Boiling point: about 180° C. (356° F.). Optically inactive.

If 10 drops of the Oil, dissolved in a little alcohol, be shaken with a few drops of sodium hydroxide T.S., also with 2 drops of ferrous sulphate T.S. and 2 drops of ferric chloride T.S., then warmed, and finally mixed with a slight excess of hydrochloric acid, a blue precipitate will be produced (presence of *hydrocyanic acid*).

Impurities and Tests for Impurities.—*Chlorinated products.* If the looped end of a piece of clean copper wire be held in a non-luminous flame until it ceases to give a green color, then cooled, and the loop dipped into Oil of Bitter Almond, ignited and held so that the liquid burns outside of the flame, then if the loop be slowly brought into contact with the lower outer edge of the flame, no green tinge should be discernible.

Artificial oils containing chlorinated products. If a small strip of filter paper, folded in the form of a taper and saturated with Oil of Bitter Almond, be placed in a small porcelain dish, and a clean beaker, moistened on the inner surface with distilled water, be inverted over the small dish immediately after igniting the taper, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S., or if a slight turbidity appears, it should entirely disappear upon boiling the liquid.

Assay.—*For benzaldehyde.* The method to be employed is identical with that given for Benzaldehyde, on page 836, using *twelve drops* of Oil of Bitter Almond.

For hydrocyanic acid. Mix, in a 100 Cc. flask, 1 Gm. of the Oil of Bitter Almond to be tested, with sufficient water and freshly precipitated magnesium hydroxide (free from chlorides) to make an opaque mixture of about 50 Cc. Add to this 2 or 3 drops of potassium chromate T.S., and then from a burette add tenth-normal silver nitrate V.S. until a red tint is produced which does not again disappear by shaking; not less than 7.5 Cc. nor more than 14.9 Cc. of tenth-normal silver nitrate V.S. should be required, each Cc. corresponding to 0.002684 Gm. of hydrocyanic acid.

Uses.—Oil of bitter almond is sedative and poisonous if it contains hydrocyanic acid. The dose is from one-half to one minim (0.03 to 0.05 Cc.). It is used for flavoring, although benzaldehyde is to be preferred, since its use does not involve the danger from hydrocyanic acid poisoning if it is taken by mistake.

Official Preparations

Aqua Amygdalæ Amaræ Bitter Almond Water	Made by dissolving 1 Cc. of oil of bitter almond in 999 Cc. of distilled water (see page 275). Dose one to two fluidrachms (4 to 8 Cc.).
Spiritus Amygdalæ Amaræ Spirit of Bitter Almond	Made by dissolving 10 Cc. of oil of bitter almond in 800 Cc. of alcohol and adding enough distilled water to make 1000 Cc. (see page 314). Dose, eight minims (0.5 Cc.).
Syrupus Amygdalæ Syrup of Almond	Made by mixing 10 Cc. of spirit of bitter almond, 100 Cc. of orange flower water, and sufficient syrup to make 1000 Cc. Dose, one to two fluidounces (30 to 60 Cc.).

BENZALDEHYDUM. U.S. **Benzaldehyde**

$C_7H_6O = 105.25$

[SYNTHETIC OIL OF BITTER ALMOND]

An aldehyde, produced artificially, or obtained from natural oil of bitter almond or other oils, and containing not less than 85 percent. of pure Benzaldehyde [$C_6H_5.COH$]. It should be kept in small amber-colored, well-stoppered bottles.

Preparation.—Artificial benzaldehyde, which is identical with the product obtained from the almond, is now made from toluene, C_7H_8. By the action of chlorine upon the hot toluene, there is produced benzyl chloride, $C_6H_5CH_2Cl$, and benzal chloride, $C_6H_5CHCl_2$, and these yield benzaldehyde upon treatment with manganese dioxide or other oxidizing agents. Artificial benzaldehyde is free from hydrocyanic acid, but is liable to retain traces of chlorine compounds. This product must not be confounded with nitrobenzene (nitrobenzol), or *oil of myrbane*, which is made by reacting on benzene with nitric acid. Nitrobenzene is made in large quantities for perfuming soap. Its odor is similar to, but by no means identical with, that of oil of bitter almond.

Official Description.—A colorless, strongly refractive liquid.
Odor and Taste.—Bitter-almond-like odor; burning, aromatic taste.
Specific Gravity.—About 1.045 at 25° C. (77° F.).
Solubility.—*Water.* Sparingly (1 in 300).
Alcohol. In all proportions.
Other solvents. In all proportions in ether, and fixed and volatile oils.
Test for Identity.—Boiling point: 179° to 180° C. (354.2° to 356° F.); optically inactive.

Impurities and Tests for Impurities.—*Hydrocyanic acid.* If 10 drops of Benzaldehyde, dissolved in a little alcohol, be shaken with a few drops of a strong solution of sodium hydroxide, then with a little ferrous sulphate T.S., and finally mixed with a slight excess of hydrochloric acid, a blue precipitate should not be produced.

Chlorinated products. If the looped end of a piece of clean copper wire be held in a non-luminous flame until it glows, then cooled, and the loop dipped into Benzaldehyde, ignited, and held so that the liquid burns outside of the flame, then if the loop be slowly brought in contact with the lower outer edge of the flame, no green tinge should be discernible.

Chlorinated products. If a small strip of filter paper folded in the form of a taper and saturated with Benzaldehyde be placed in a small porcelain dish, and a clean beaker, moistened on the inner surface with distilled water, be inverted over the smaller dish immediately after igniting the taper, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S.

Assay.—Introduce into a tared 150 Cc. flask 10 Cc. of purified kerosene, note the exact weight, add 12 drops of Benzaldehyde, and again note the weight; add 20 Cc. of distilled water with 6 drops of rosolic acid T.S., and then neutralize the solution exactly by the addition of tenth-normal sodium hydroxide V.S., agitating the flask thoroughly. Add from a burette, gradually, a solution of sodium sulphite (1 in 5), alternating with half-normal hydrochloric acid V.S. from a second burette, until 10 Cc. of the sodium sulphite solution have been added, and enough half-normal hydrochloric acid V.S. to maintain the neutrality of the mixture; after adding a few drops of rosolic acid T.S., and agitating the flask frequently, allow it to stand two hours to insure a permanent condition of neutrality, and then note the number of cubic centimeters of the half-normal hydrochloric acid V.S. used. Carry out a blank test, identical with the foregoing, except that the Benzaldehyde is omitted, and note the amount of half-normal hydrochloric acid V.S. consumed. Subtract the number of cubic centimeters required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.0526 Gm. of Benzaldehyde. To find the percentage, multiply the above difference by 0.0526, and this product by 100, and divide by the weight of the Benzaldehyde taken.

Uses.—Benzaldehyde is largely used now in place of oil of bitter almond for flavoring purposes as it is much safer when pure, on account of the absence of hydrocyanic acid.

PRUNUS VIRGINIANA. U.S. Wild Cherry

The bark of *Prunus serotina* Ehrhart (*Prunus virginiana* Miller) (Fam. *Rosaceæ*), which should be collected in autumn and carefully dried and preserved.

Usually in transversely curved pieces from 3 to 7 Cm. long, 0.5 to 4 Mm. thick; outer surface pale green to greenish-brown, smooth, with numerous lenticels; inner surface light brown, somewhat reticulately striate or fissured; fracture short, granular; having a bitter-almond-like odor when macerated in water; taste astringent, aromatic, and agreeably bitter.

This bark contains amygdalin, emulsin, tannin, bitter principle, starch, resin, etc. As with bitter almond, contact with water results in the production of oil of bitter almond and hydrocyanic acid; as both of the latter principles are volatile and active, all the preparations of wild cherry should be made without heat. An insoluble precipitate of altered tannin is often noticed in old fluidextract of wild cherry. Wild cherry bark is sedative and tonic. Dose, thirty grains (2 Gm.).

Official Preparations

Infusum Pruni Virginianæ Infusion of Wild Cherry	Made with 40 Gm. of wild cherry, 50 Cc. of glycerin, and sufficient water to make 1000 Cc. (see page 331). Dose, two fluidounces (60 Cc.)
Syrupus Pruni Virginianæ Syrup of Wild Cherry	Made with 150 Gm. of wild cherry, 700 Gm. of sugar, 150 Cc. of glycerin, and water to make 1000 Cc. (see page 295). Dose, one fluidrachm (4 Cc.)
Fluidextractum Pruni Virginianæ Fluidextract of Wild Cherry	Made with a menstruum of water, glycerin, and alcohol (see page 410). Dose, thirty minims (2 Cc.)

ACIDUM HYDROCYANICUM DILUTUM. U. S. Diluted Hydrocyanic Acid

[DILUTED PRUSSIC ACID]

A liquid composed of not less than 2 percent., by weight, of absolute Hydrocyanic Acid [$HCN = 26.84$], and about 98 percent. of water. It should be kept in small, dark amber-colored, cork-stoppered vials in a cool place. It may be prepared extemporaneously by the following process:

	Metric	Old form
*** Silver Cyanide**	**6.00 Gm.**	93 grains
Diluted Hydrochloric Acid	**15.54 Cc.**	252 minims
Distilled Water	**44.10 Cc.**	1½ fl. oz.

Mix the Diluted Hydrochloric Acid with the Distilled Water, add the Silver Cyanide, and shake the whole together in a glass-stoppered bottle. When the precipitate has subsided, pour off the clear liquid.

Diluted Hydrocyanic Acid may be made by the U. S. P. 1890 process, in which a solution of potassium ferrocyanide was mixed in a retort with diluted sulphuric acid, heated, and the hydrocyanic acid condensed and collected in a well cooled receiver; the distillate was assayed and diluted with sufficient water to make a 2 percent solution.

$$\underset{\text{Potassium Ferrocyanide}}{(K_4FeCy_6)_2} + \underset{\text{Sulphuric Acid}}{(H_2SO_4)_6} = \underset{\text{Potassium Ferrous Ferrocyanide (Everitt's Salt)}}{K_2Fe_2Cy_6} + \underset{\text{Potassium Acid Sulphate}}{(KHSO_4)_6} + \underset{\text{Hydrocyanic Acid}}{6HCy}$$

Official Description.—A colorless liquid.

Odor, Taste, and Reaction.—Characteristic odor resembling that of bitter almonds. On account of its poisonous character *it should be tasted with great caution;* acid reaction.

Tests for Identity.—It is completely volatilized by heat.

If to 1 Cc. of the Acid, rendered alkaline by potassium hydroxide T.S., a few drops of ferrous sulphate T.S. be added, and the mixture boiled and then acidulated with hydrochloric acid, a blue precipitate will be formed.

Quantitative Test.—If 5 Gm. of Diluted Hydrocyanic Acid be diluted with distilled water to measure 50 Cc., then 26.9 Cc. (26.84 Cc.) of this solution, after the addition of 5 Cc. of ammonia water and 3 drops of potassium iodide T.S., should require for the production of a slight permanent precipitate, the addition of not less than 10 Cc. of tenth-normal silver nitrate V.S.

It is a solution of the very poisonous compound HCN in water. *Cyanogen*, CN or Cy, does not exist ready formed in nature, but compounds of it are found in plants and animal fluids. It is generally the product of chemical reaction, and was the first compound radical discovered. It is more closely related to the halogens in the character of its combinations than any other class of bodies. It unites with hydrogen to form hydrocyanic acid, HCN, and the compounds with metals and bases are termed cyanides. These have been considered in the previous chapters.

Scheele's hydrocyanic acid is a stronger solution, containing about 5 percent. of the anhydrous acid. Its use should be discouraged as unnecessary, tending to create confusion, and dangerous. Diluted hydrocyanic acid frequently becomes decomposed upon keeping, a black insoluble precipitate which contains paracyanogen forming in the bottle. This decomposition may be prevented by the addition of a small quantity of sulphuric or hydrochloric acid. The use of cork-stoppered vials is said to be an advantage. Alcohol has not proved a good preservative, and hence is not used in the U. S. P. formula.

Uses.—Diluted hydrocyanic acid is sedative in doses of one to three minims (0.05 to 0.2 Cc.). Potassium cyanide is often prescribed in combination with an acid and syrup, so that hydrocyanic acid may be generated and dissolved.

SINAPIS ALBA. U.S. White Mustard

The seed of *Sinapis alba* Linné (Fam. *Cruciferæ*).

Subglobular, 1 to 2 Mm. in diameter; testa yellowish, minutely pitted; embryo yellowish, oily, with a curved hypocotyl and two conduplicate cotyledons; inodorous; taste mildly pungent and acrid.

The powder contains few or no starch grains.

If 1 Gm. of powdered White Mustard be exhausted by slow percolation with alcohol, and the marc mixed with 200 Cc. of water and heated to boiling, and if, after cooling, sufficient cold water be added to make the mixture measure 1000 Cc., the addition of 4 Cc. of tenth-normal iodine V.S. should not produce a dark blue color (limit of *starch*).

White mustard seed contains *sinalbin*, $C_{30}H_{44}N_2O_{16}S_2$, a crystalline glucoside, which, under the influence of a peculiar ferment, *myrosin*, and water, is split into *acrinyl isothiocyanate*, C_8H_7,NOS, which is a pungent, volatile oil (this is not the official oil of mustard), *sinapine sulphate*, $C_{16}H_{23}NO_5H_2SO_4$, and glucose. The seed contains in addition 20 percent. of fixed oil, mucilage, gum, etc., but no starch. It is used as a stimulant, condiment, and emetic; externally, it is rubefacient. The emetic dose is two drachms (8 Gm.) mixed with a little water.

SINAPIS NIGRA. U.S. Black Mustard

The seed of *Brassica nigra* (Linné) Koch (Fam. *Cruciferæ*).

Subglobular, about 1.2 Mm. in diameter; testa deep red-brown, sometimes with a grayish tinge, minutely pitted; embryo greenish-yellow, oily, with a curved hypocotyl and two conduplicate cotyledons; odor while dry, slight, on moistening, powerfully irritating; taste strongly pungent and acrid.

The powder contains few or no starch grains.

If 1 Gm. of powdered Black Mustard be exhausted by slow percolation with alcohol, and the marc mixed with 200 Cc. of water and heated to boiling, and if, after cooling, sufficient cold water be added to make the mixture measure 1000 Cc., the addition of 4 Cc. of tenth-normal iodine V.S. should not produce a dark blue color (limit of *starch*).

Black mustard contains *sinigrin* or potassium myronate ($KC_{10}H_{19}NS_2O_{10}$), *myrosin*, a ferment, 25 percent. of fixed oil, mucilage, etc. Under the influence of the myrosin and water the potassium myronate is converted into *allyl isothiocyanate*, or volatile oil of mustard. This action takes place at ordinary temperatures, and explains the pungency of aqueous mixtures of ground mustard. The emetic dose is two drachms (8 Gm.).

Official Preparation

Charta Sinapis Mustard Paper	Made by first depriving the ground black mustard of fixed oil by percolation with petroleum benzin, drying, mixing with solution of rubber, and spreading on paper. It must be kept excluded from moisture, to prevent the generation of the volatile oil before it is needed (see Part V.)

OLEUM SINAPIS VOLATILE. U.S. Volatile Oil of Mustard

A volatile oil obtained from Black Mustard (freed from its fatty oil) by maceration with water and subsequent distillation, yielding, when assayed by the process given below, not less than 92 percent. of allyl isothiocyanate. It should be carefully kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Chemically, this oil is *allyl isothiocyanate*, or *allyl thiocarbamide* $CS.NC_3H_5$; it is also called *allyl sulphocyanide*. Its production is explained in the preceding article. It is prepared artificially by the action of *allyl iodide* upon a solution of *potassium sulphocyanate.*

Official Description.—A colorless or pale yellow, limpid, and strongly refractive liquid.
Odor and Taste.—Very pungent and acrid odor. Great caution should be exercised when smelling this Oil; it should not be tasted without being highly diluted.
Specific Gravity.—1.013 to 1.020 at 25° C. (77° F.).
Solubility.—*Alcohol.* Miscible in all proportions, forming a clear solution.
Test for Identity.—If to 3 Gm. of the Oil 6 Gm. of sulphuric acid be gradually added, the liquid being kept cool, the mixture, upon subsequent agitation, will evolve sulphur dioxide, but it will remain of a light yellow color, and although at first clear, it will afterwards become thick and occasionally crystalline, and the pungent odor of the Oil will disappear.
Impurities and Tests for Impurities.—*Alcohol, chloroform, petroleum, fatty oils, or more than traces of carbon disulphide.* If a portion of the Oil be heated in a flask connected with a well-cooled condenser, it should distil completely between 148° and 152° C. (298.4° and 305.6° F.), and both the first and the last portions of the distillate should have the same specific gravity as the original Oil.
Phenols. If a small portion of the Oil be diluted with 5 times its volume of alcohol, and a drop of ferric chloride T.S. be added, no blue or violet color should be produced.
Assay.—Weigh accurately about 2 Gm. of Volatile Oil of Mustard, and dilute this with sufficient alcohol to make 50 Cc. of the solution represent 1 Gm. of the Oil; of this solution, 5 Cc. are transferred to a 100 Cc. measuring flask, and 30 Cc. of tenth-normal silver nitrate V.S. and 5 Cc. of ammonia water are added. The flask is well stoppered and set aside in a dark place for twenty-four hours. It is then heated in a water-bath at a temperature of 80° C. (176° F.) for half an hour, shaking the flask frequently. The contents of the flask are diluted with water to the 100 Cc. mark and filtered. To 50 Cc. of the filtrate, 4 Cc. of nitric acid and a few drops of ferric ammonium sulphate T.S. are added, and finally sufficient tenth-normal potassium sulphocyanate V.S. to produce a permanent red color; not more than 5.6 Cc. of the latter reagent should be required (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 0.00492 gramme of allyl iso-thiocyanate).

Uses.—Volatile oil of mustard is used as a powerful rubefacient; it must be handled with great care; it is rarely given internally. Dose, one-eighth minim (0.008 Cc.).

Unofficial Volatile Oils, Drugs, and Allied Products

Allium Garlic. U. S. P. 1890	From the bulb of *Allium sativum.* Fam. Liliaceæ. Habitat, Europe and Asia. The yield of oil is about ¼ percent.
Oil of Asafetida	From the gum-resin of *Ferula Narthex.* Fam. Umbelliferæ. Habitat, Western Thibet. The yield is about 6 to 9 percent.
Bitter Candytuft	*Iberis amara* contains a sulphurated volatile oil

Unofficial Volatile Oils, Drugs, and Allied Products—*Continued*

Common Scurvy Grass	From the herb of *Cochlearia officinalis.* Fam. Cruciferæ. Habitat, Europe
Cress	The seed of *Lepidium sativum.* Fam. Cruciferæ. Contains a sulphurated volatile oil
Oil of Garlic Allyl sulphide, $(C_3H_5)_2S$	Obtained artificially by decomposing allyl iodide with an alcoholic solution of potassium sulphide
Hedge Garlic	*Alliaria officinalis.* Fam. Cruciferæ. Contains a sulphurated oil
Horseradish	From the root of *Cochlearia Armoracia.* Fam. Cruciferæ. Habitat, Europe. The yield is about $\frac{1}{20}$ percent.
Radish	*Raphanus sativa* contains a sulphurated volatile oil
Sagapenum	From *Ferula persica.* The yield of volatile oil is small
Shepherd's Purse	The seeds of *Capsella bursa-pastoris* contain a sulphurated volatile oil
Wallflower	The seed of *Cheiranthus annuus* contains a sulphurated volatile oil
Wild Mustard	The seed of *Sisymbrium nasturtium* contains a sulphurated volatile oil
Wild Radish	The seed of *Raphanus Raphanistrum* contains a sulphurated volatile oil
Allyl Tribromide, $C_3H_5Br_3$	A slightly yellowish liquid, identical with *Tribromhydrin ;* sedative and anodyne in its action. Dose, five or six drops
Apiol, $C_{12}H_{14}O_4$	A stearoptene obtained from the fruit of *Petroselinum sativum.* It forms colorless needles very soluble in alcohol, ether, fixed and volatile oils, but insoluble in water. Used as an emmenagogue and and antiperiodic. Dose, four grains (0.25 Gm.). *Liquid Apiol* is an alcoholic extract of the parsley fruit
Apiol Camphor (crystallized), $C_{12}H_{14}O_4$	Dose, fifteen grains (1 Gm.)
Thiosinamin, Allyl-sulpho-urea, Allyl-sulpho-carbamide, $CS\left\{\begin{matrix}NH_2\\NH(C_3H_5)\end{matrix}\right.$	Used in tuberculous diseases, by subcutaneous injection, of four and one-half to seven grains (0.3 to 0.45 Gm.), in 15 percent. alcoholic solution

CHAPTER LVI

OFFICIAL DRUGS AND PRODUCTS CONTAINING VOLATILE OIL WITH SOFT RESIN

PIPER. U. S. Pepper

[Black Pepper]

The dried, unripe fruit of *Piper nigrum* Linné (Fam. *Piperaceæ*).

Nearly globular, 4 to 5 Mm. in diameter, externally brownish- or grayish-black; pericarp thin, coarsely wrinkled, enclosing a single whitish, more or less imperfectly developed seed; odor strong, penetrating, provoking sneezing; taste aromatic and very pungent

The starch grains present in the powder are nearly spherical and about 0.002 Mm. in diameter; ash not more than 7 percent.

Black pepper contains piperine, a feebly basic substance, 2 percent. of volatile oil, and a pungent resin soluble in alcohol and ether.

The volatile oil is a terpene, $C_{10}H_{16}$. Its principal use is as a condiment. Dose, eight grains (0.5 Gm.).

Official Preparation

Oleoresina Piperis Oleoresin of Pepper	Made by percolating pepper with acetone and evaporating the acetone (see page 428). The yield is about 5 percent. Dose, one-half grain (0.03 Gm.)

PIPERINA. U. S. Piperine

$C_{17}H_{19}NO_3 = 283.04$

[Piperinum, Pharm. 1890].

A feebly basic substance [$CH_2O_2.C_6H_3.CH:CH.CH:CH.CON.C_5H_{10}$] obtained from Pepper and other plants of the *Piperaceæ*.

Preparation.—Piperine is obtained by treating pepper with alcohol, evaporating the tincture to the consistence of an extract, submitting the extract to the action of an alkaline solution, by which the oleaginous matter is converted into soap, washing the undissolved portion with cold water, separating the liquid by filtration, treating the matter left on the filter with alcohol, and allowing the solution thus obtained to evaporate spontaneously, or by a gentle heat. Crystals of piperine are deposited, and may be purified by alternate solution in alcohol or ether, and crystallization.

Piperine is decomposed by alkalies in alcoholic solution into *piperic acid*, $C_{12}H_{10}O_4$, and *piperidine*, $C_5H_{11}N$. It is considered to be an alkaloid of feeble power.

Official Description.—Colorless or pale yellowish, glistening, monoclinic crystals; permanent in the air and containing no water of crystallization. Optically inactive

Odor, Taste, and Reaction.—When put into the mouth, it is at first tasteless, but on prolonged contact develops a sharp, biting taste; odorless; neutral reaction.

Solubility.—*Water.* Insoluble.

Alcohol. In 15 parts at 25° C. (77° F.); in 4.4 parts at 60° C. (140° F.).

. *Other solvents.* In 36 parts of ether and 1.7 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—It melts at 130° C. (266° F.). Upon ignition, it emits alkaline vapors, and is completely consumed.

Its alcoholic solution is neutral to litmus paper.

Sulphuric acid dissolves Piperine with the formation of a blood-red color, which disappears on dilution with water.

On heating Piperine with alcoholic potassium hydroxide, it is converted into piperinic acid and piperidine, the latter recognizable by its alkaline, pepper-like odor, and the former by its melting point, 215° C. (419° F.).

On adding a crystal of Piperine to sulphuric acid containing about half its volume of solution of formaldehyde, a permanently green liquid is formed.

On adding a crystal of Piperine to sulphuric acid containing a fragment of potassium dichromate, it at once acquires a purple color, and, on stirring, dissolves, forming a reddish-brown solution, which becomes greenish on adding water to it.

On adding a crystal of Piperine to sulphuric acid containing a trace of selenous acid, it turns brown, changing at once to violet, and dissolves, forming a brown solution changing to green.

When heated with nitric acid, Piperine is colored at first orange, then red, and the acid acquires a yellow color, deepening to reddish as the crystals dissolve. On adding to this solution an excess of potassium hydroxide T.S., the color is at first yellow, but upon boiling, it becomes blood-red.

Uses.—Piperine has been used as a stimulant and an antiperiodic. Its virtues, however, in this connection depend principally upon its impurities,—*i.e.*, adhering resin and oil. When absolutely pure and colorless it has but little medicinal action. Dose, three grains (0.2 Gm.).

MATICO. U.S. Matico

The leaves of *Piper angustifolium* Ruiz and Pavon (Fam. *Piperaceæ*).

From 10 to 15 Cm. long, short-petiolate, oblong-lanceolate; apex pointed, base unequally heart-shaped, margin very finely crenulate; tessellated above, reticulate beneath, the meshes small, and the veins densely brownish-hairy; aromatic, spicy, bitterish, and astringent.

Matico leaves contain about 2 percent. of volatile oil, a pungent resin, a crystalline principle, *artanthic acid*, and tannin. It is stimulant and hæmostatic and given in doses of one drachm (4 Gm.).

Official Preparation

Fluidextractum Matico Fluidextract of Matico	Made with a menstruum consisting of 3 parts of alcohol and 1 part of water (see page 405). Dose, one-half to one fluidrachm (2 to 4 Cc.)

CUBEBA. U.S. Cubeb

The dried unripe, but fully grown, fruit of *Piper Cubeba* Linné filius (Fam. *Piperaceæ*).

From 10 to 13 Mm. long, the upper portion globoidal, 4 to 5 Mm. in diameter, contracted at the base into a slender stem-like portion, about 6 or 8 Mm. long; pericarp reticulately wrinkled, blackish-gray, about 0.3 Mm. thick; internally light brown, smooth, oily, one-seeded; brittle; of a strongly aromatic, somewhat camphoraceous odor and taste.

The powder contains few or no starch grains, and on treatment with sulphuric acid the fragments become wine-colored.

This useful fruit, or berry as it is commonly called, contains about 10 percent. of volatile oil, 3 percent. of resin, cubebin, *cubebic acid*, wax, fat, etc. The virtues of cubeb reside in the cubebic acid, resin, and oil, cubebin when pure being destitute of activity. Cubebic acid, cubebic resin, and cubebin are all colored red by strong sulphuric acid. Cubeb is used as a diuretic, stimulant, and expectorant in doses of fifteen to sixty grains (1 to 4 Gm.).

Official Preparations

Fluidextractum Cubebæ Fluidextract of Cubeb	Made with a menstruum of alcohol (see page 393). Dose, fifteen minims to one fluidrachm (1 to 4 Cc.)
Oleoresina Cubebæ Oleoresin of Cubeb	Made by percolating cubeb with alcohol, distilling off, and evaporating the alcohol (see page 427). The yield is 18 to 25 percent. Dose, five to fifteen minims (0.3 to 1 Cc.)
Trochisci Cubebæ Troches of Cubeb	Each troche contains about ¼ grain of oleoresin of cubeb (see Trochisci, Part V.)

OLEUM CUBEBÆ. U.S. Oil of Cubeb

A volatile oil distilled from Cubeb. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

The oil contains a small amount of a hydrocarbon, $C_{10}H_{16}$, boiling at 158° to 163° C. (316.4° to 325.4° F.), and two oils of the formula, $C_{15}H_{24}$, boiling at 262° to 265° C. (503.6° to 509° F.), one of which unites with HCl, while the other does not. Upon standing, it sometimes deposits rhomboidal prismatic crystals of a stearoptene. The crystals have the formula $C_{30}H_{48} + 2H_2O$, are fusible at 67° to 68° C. (152.6° to 154.4° F.), and volatilize without change at 148° to 150° C. (298.4° to 302° F.).

Official Description.—A colorless, pale green, or yellow liquid.
Odor, Taste, and Reaction.—Characteristic odor of cubeb, and a warm, camphoraceous, aromatic taste. An alcoholic solution is neutral to litmus paper.
Specific Gravity.—0.905 to 0.925 at 25° C. (77° F.).
Test for Identity.—It is lævogyrate, the angle of rotation varying from —25° to —40° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—Oil of cubeb is an aromatic stimulant and carminative. Dose, eight minims (0.5 Cc.).

CAPSICUM. U.S. Capsicum

[CAYENNE PEPPER]

The dried, ripe fruit of *Capsicum fastigiatum* Blume (Fam. *Solanaceæ*), deprived of its calyx.

Oblong-conical, from 10 to 20 Mm. long, with a red, shining, membraneous and translucent pericarp; two-celled, and containing 10 to 20 flat, reniform, yellowish seeds attached to a thick, central placenta; odor distinct; taste intensely pungent. Few or no starch grains or sclerenchymatous fibres should be present in the powder.

The principle constituents of capsicum are capsaicin, $C_9H_{14}O_2$, traces of a volatile alkaloid and a volatile oil, fixed oil, resin, coloring matter, etc. *Capsaicin* is in colorless crystals, volatile, intensely acrid, and soluble in alcohol, ether, and fixed oils. Capsicum is stimulant and rubefacient. Dose, one grain (0.065 Gm.). It is used in the pills of belladonna, podophyllum, and capsicum and is the active ingredient used in the following official preparations:

Official Preparations

Emplastrum Capsici Capsicum Plaster	Made by spreading adhesive plaster upon muslin, cooling, and applying a thin coating of oleoresin of capsicum
Fluidextractum Capsici Fluidextract of Capsicum	Made with alcohol (see page 387). Dose, one-half to one minim (0.03 to 0.05 Cc.)
Oleoresina Capsici Oleoresin of Capsicum	Made by percolating powdered capsicum with acetone, distilling, and evaporating (see page 427). Yield, 5 percent. Dose, one-fourth to one minim (0.015 to 0.05 Cc.)
Tinctura Capsici Tincture of Capsicum	Made by percolating 100 Gm. of powdered capsicum with a menstruum of 950 Cc. of alcohol and 50 Cc. of water until 1000 Cc. are obtained (see page 347). Dose, eight to thirty minims (0.5 to 2 Cc.)

COPAIBA. U.S. Copaiba

[Balsam of Copaiba Copaiva]

An oleoresin derived from one or more South American species of *Copaiba* (Fam. *Leguminosæ*).

Copaiba is mostly imported from Para in Brazil, Maracaibo in Venezuela, and other South American ports. It contains *copaivic acid*, volatile oil, and a bitter principle. Copaivic acid, $C_{20}H_{30}O_2$, the resinous mass left after distilling the oil, forms a series of amorphous salts. (See Massa Copaibæ.) It may be obtained pure by exposing a mixture of nine parts of copaiba and two parts of aqueous ammonia (sp. gr. 0.95) to a temperature of 10° C. (50° F.). Copaiba is often adulterated.

Official Description.—A pale yellow to brownish-yellow, more or less transparent and viscid liquid, sometimes fluorescent.

Odor and Taste.—Peculiar, aromatic odor; persistent, bitter, and acrid taste.

Specific Gravity.—0.950 to 0.995 at 25° C. (77° F.).

Solubility.—*Water.* Insoluble.

Other solvents. Soluble, or showing at most a slight opalescence, in absolute alcohol, carbon disulphide, petroleum benzin, and in fixed and volatile oils; completely soluble in chloroform and ether.

Tests for Identity.—When heated on a water-bath, it should evolve no odor of turpentine, and after forty-eight hours should leave a resinous mass weighing not less than 50 percent. of its original weight.

One Gm. of Copaiba, when dissolved in 50 Cc. of alcohol, should require not less than 2.3 Cc., and not more than 3.2 Cc. of half-normal alcoholic potassium hydroxide V.S. for neutralization, using 1 Cc. of phenolphthalein T.S. as indicator (presence of a normal proportion of *acid resin*).

Impurities and Test for Impurities.—*Gurjun balsam.* When 1 drop of nitric acid (sp. gr. 1.40 and 3 Cc. of glacial acetic acid are mixed in a test-tube, and 4 drops of Copaiba are carefully poured on top of the liquid, no reddish zone should appear; nor should the fluid assume a red or purple color after being shaken.

Paraffin oils. If 5 Cc. of Copaiba be shaken with 15 Cc. of alcohol, and heated to boiling for one minute, no drops of oil should separate after cooling and standing for an hour.

Fixed oils. If 20 drops of Copaiba be boiled with 1 Cc. of an alcoholic potassium hydroxide solution (1 in 10) for two minutes and cooled, and then twice its volume of ether be added to the liquid, no gelatinization should occur.

Limit of resin. If 1 Gm. of Copaiba be shaken with 10 Cc. of ammonia water in a stoppered vial, and allowed to stand for twenty-four hours, the liquid will become turbid, but it should not gelatinize, nor should a firm mass be formed.

Uses.—Copaiba is stimulant and diuretic, and has a special irritant action upon the mucous membranes of the urinary passages. Dose, from fifteen minims to one fluidrachm (1 to 4 Cc.).

OLEUM COPAIBÆ. U.S. Oil of Copaiba

A volatile oil distilled from Copaiba. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil is a hydrocarbon, consisting of $C_{10}H_{16}$ and $C_{15}H_{24}$.

Official Description.—A colorless or pale yellow liquid.

Odor and Taste.—Characteristic odor of copaiba; aromatic, slightly bitter and pungent taste.

Specific Gravity.—0.895 to 0.905 at 25° C. (77° F.), increasing with age.

Test for Identity.—It is lævogyrate.

Uses.—It is used as a stimulant, and for the same purposes as copaiba. Dose, five to ten minims (0.3 to 0.6 Cc.).

OLEUM SANTALI. U.S. Oil of Santal

[Oil of Sandalwood]

A volatile oil distilled from the wood of *Santalum album* Linné (Fam. *Santalaceæ*), yielding, when assayed by the process given below, not less than 90 percent.

of alcohols, calculated as santalol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This is an oxygenated oil, consisting of an aldehyde, $C_{15}H_{24}O$, and santalol, $C_{15}H_{26}O$. It is often grossly adulterated; the proportion of santalol is recognized by an official assay (see below).

Official Description.—A pale yellow, somewhat thick liquid.
Odor, Taste, and Reaction.—Peculiar, aromatic odor; pungent, spicy taste; slightly acid reaction.
Specific Gravity.—0.965 to 0.980 at 25° C. (77° F.).
Solubility.—*Alcohol.* Readily soluble: soluble in 5 volumes of 70 percent. alcohol.
Impurities and Tests for Impurities.—*Other varieties of sandalwood oil, etc.* The oil is lævogyrate; its angle of rotation should be not less than —16° nor more than —20° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Chlorinated products. The presence of chloroform may be detected in the following manner: If a small strip of filter paper folded in the form of a taper and saturated with Oil of Santal be placed in a small porcelain dish, and a clean beaker, moistened on the inner surface with distilled water, be inverted over the small dish immediately after igniting the taper, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S.

Assay for Santalol.—Introduce 10 Cc. of Oil of Santal into a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 2 Gm. of anhydrous sodium acetate, and boil the mixture gently during one hour and a half. Allow it to cool, wash the acetylized oil with distilled water, and afterwards with sodium hydroxide T.S., until the mixture is slightly alkaline to phenolphthalein T.S., and then dry it with the aid of fused calcium chloride, and filter. Transfer to a tared 100 Cc. flask 3 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil gently during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 50 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 11.026, and divide by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of santalol in the Oil of Santal.

Note.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide V.S. consumed by the acetylized oil.

Uses.—It is used as a stimulant to the mucous membranes, especially in the treatment of gonorrhœa. It is generally administered in capsules. Dose, five to fifteen minims (0.3 to 1 Cc.).

BUCHU. U.S. Buchu

The dried leaves of *Barosma betulina* (Thunberg) Bartling and Wendland (Fam *Rutaceæ*).

About 15 Mm. long, varying between oval and obovate, yellowish-green, apex obtuse, margin crenate or serrate with a gland at the base of each tooth, the base more or less wedge-shaped; coriaceous, both surfaces beset with numerous slight projections; odor strong and characteristic; taste somewhat mint-like, pungent and bitterish.

This drug owes its valuable properties to the presence of a volatile oil and resin. It also contains a bitter principle, mucilage, etc. The stearoptene *diosphenol* is colored dark green by ferric chloride.

Uses.—Buchu is used as a diuretic. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Buchu Fluidextract of Buchu	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 385). Dose, one fluidrachm (2 Cc.)

SERPENTARIA. U.S. Serpentaria

[Virginia Snakeroot]

The dried rhizome and roots of *Aristolochia Serpentaria* Linné (Virginia Serpentaria), or of *Aristolochia reticulata* Nuttall (Texas Serpentaria) (Fam *Aristolochiaceæ*).

Virginia Serpentaria.—Rhizome of oblique growth, about 2 Cm. long and about 2 Mm. in diameter; externally yellowish-brown, slightly annulate, the upper surface with numerous stem-scars or stem-bases, the lower surface bearing a dense tress of thin, branching roots from 4 to 7 Cm. long; fracture short, yellowish brown; xylem in the roots 5-rayed; odor camphoraceous; taste bitter and aromatic.

Texas Serpentaria.—The rhizome is about twice as large as that of Virginia Serpentaria, of a grayish-brown color, and the roots are fewer, less interlacing, and thicker.

This rhizome, when fresh, contains 1 percent. of volatile oil, a bitter principle, starch, sugar, etc. It yields its virtues to alcohol and diluted alcohol. It is an ingredient in compound tincture of cinchona.

Uses.—It is a stimulant tonic. Dose, fifteen grains (1 Gm.).

Official Preparations

Fluidextractum Serpentariæ Fluidextract of Serpentaria	Made with a menstruum of 4 parts of alcohol and 1 part of water (see page 419). Dose, fifteen to thirty minims (1 to 2 Cc.)
Tinctura Serpentariæ Tincture of Serpentaria	Made by percolating 200 Gm. of powdered serpentaria with sufficient menstruum (65 alcohol and 35 water) to make 1000 Cc. (see page 363). Dose, one fluidrachm (4 Cc.)

HUMULUS. U.S. Hops

The carefully dried strobiles of *Humulus Lupulus* Linné (Fam. *Moraceæ*), bearing their natural glandular trichomes.

Ovoid-cylindrical, about 3 Cm. long, consisting of a thin, hairy flexuous rachis and numerous yellowish-green to pale brown obliquely ovate, membranaceous scales with a glandular hairy base, frequently infolded on one side, enclosing a subglobular, light brown, very glandular akene; odor strong and agreeable; taste aromatic and bitter.

Hops owe their sedative virtues to a small quantity of volatile oil; their bitterness is due to the resin and lupulin present. Dose, thirty grains (2 Gm.).

LUPULINUM. U.S. Lupulin

The glandular trichomes separated from the fruit of *Humulus Lupulus* Linné (Fam. *Moraceæ*).

A granular powder, bright brownish-yellow becoming yellowish-brown, and resinous; its component trichomes somewhat globular or ellipsoidal, 0.1 to 0.3 Mm. in diameter, multicellular; having the characteristic odor and taste of hops.

Not less than 60 percent. of Lupulin is soluble in ether, and when incinerated, it should yield not more than 10 percent. of ash.

Lupulin contains 10 percent. of volatile oil, which, on exposure, yields valeric acid, trimethylamine, a bitter principle (lupamaric acid), $C_{82}H_{50}O_7$, resin, wax, and an alkaline liquid termed *lupuline.* Alcohol and ether are the best solvents. Dose, eight grains (0.5 Gm.).

Official Preparations

Fluidextractum Lupulini Fluidextract of Lupulin	Made with a menstruum of alcohol (see page 405). Dose, eight to fifteen minims (0.5 to 1 Cc.)
Oleoresina Lupulini Oleoresin of Lupulin	Made by percolating lupulin with acetone, distilling, and evaporating the acetone. The yield is about 50 percent. (see page 428). Dose, three to ten minims (0.2 to 0.6 Cc.)

CANNABIS INDICA. U.S. Indian Cannabis

[Indian Hemp]

The dried flowering tops of the pistillate plants of *Cannabis sativa* Linné (Fam. *Moraceæ*), grown in the East Indies and gathered while the fruits are yet undeveloped, and carrying the whole of their natural resin.

In dark green or more or less brownish compressed masses, consisting of the densely paniculate branchlets, about 5 Cm. or more in length, and the inflorescence more or less agglutinated with a resinous exudation; commonly with a few undeveloped digitate leaves of one or more linear-lanceolate leaflets; clothed with numerous sheathing, pointed bracts, each containing two small mature but unfertilized pistillate flowers; odor agreeably narcotic; taste characteristic.

In the powder few or no pollen grains or stone-cells should be present.

Indian cannabis contains a resinous substance, *cannabinine*, volatile oil, and tetanocannabinine. Alcohol is the best solvent for the active principles.

Uses.—It is used as an anodyne and nervous stimulant. Dose, one grain (0.065 Gm.).

Official Preparations

Extractum Cannabis Indicæ Extract of Indian Cannabis	Made by percolating Indian Cannabis with alcohol, distilling the alcohol from the percolate, and evaporating to a pilular consistence (see page 443). Dose, one-fifth grain to two grains (0.01 to 0.125 Gm.)
Fluidextractum Cannabis Indicæ Fluidextract of Indian Cannabis	Made with alcohol (see page 387). Dose, one-half to one minim (0.03 to 0.05 Cc.)
Tinctura Cannabis Indicæ Tincture of Indian Cannabis	Made by percolating 100 Gm. of Indian Cannabis with sufficient alcohol to make 1000 Cc. (see page 347). Dose, ten minims (0.3 Cc.)

VALERIANA. U.S. Valerian

The dried rhizome and roots of *Valeriana officinalis* Linné (Fam. *Valerianaceæ*).

Rhizome from 2 to 4 Cm. long, and 1 to 2 Cm. thick, upright, subglobular or obconical, truncate at both ends, brown or yellowish-brown, internally whitish or pale brownish, with a narrow circle of white wood under the thin bark. Roots numerous, slender, brittle, brown, with a thick bark, and slender, ligneous cord. Odor peculiar, becoming stronger and more unpleasant on keeping the drug; taste camphoraceous and somewhat bitter.

Valerian contains about 1 percent. of volatile oil, valeric acid, resin, starch, tannin, etc.; there are also present some acetic and formic acids. Alcohol and ether are good solvents for the active principles.

Uses.—It is used as a nervine. Dose, thirty grains (2 Gm.).

Official Preparations

Fluidextractum Valerianæ Fluidextract of Valerian	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 423). Dose, thirty minims (2 Cc.)
Tinctura Valerianæ Tincture of Valerian	Made by percolating 200 Gm. of powdered valerian with a mixture of 3 parts of alcohol and 1 part of water until 1000 Cc. of tincture have been obtained (see page 365). Dose, one fluidrachm (4 Cc.)
Tinctura Valerianæ Ammoniata Ammoniated Tincture of Valerian	Made by percolating 200 Gm. of powdered valerian with aromatic spirit of ammonia until 1000 Cc. of tincture have been obtained (see page 365). Dose, thirty minims (2 Cc.)

VIBURNUM OPULUS. U.S. Viburnum Opulus

[CRAMP-BARK]

The dried bark of *Viburnum Opulus* Linné (Fam. *Caprifoliaceæ*).

In somewhat transversely curved pieces, occasionally in quills, of variable length, and 0.5 to 2 Mm. thick; outer surface grayish-brown, longitudinally wrinkled, with large brown lenticels and brownish-black fruit-heads of a lichen; inner surface light brown, longitudinally striate; fracture uneven, fibrous; transverse sections showing several bands of bast fibres; odor slight; taste somewhat astringent and bitter.

Dose, thirty grains (2 Gm.). (See next article.)

Official Preparation

Fluidextractum Viburni Opuli Fluidextract of Viburnum Opulus	Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 423). Dose, one-half to one fluidrachm (2 to 4 Cc.)

VIBURNUM PRUNIFOLIUM. U. S. Viburnum Prunifolium

[Black Haw, Viburnum]

The dried bark of the root of *Viburnum prunifolium* Linné, or of *Viburnum Lentago* Linné (Fam. *Caprifoliaceæ*).

In irregular or quilled pieces, rarely exceeding 4 Mm. thick; externally dingy brown, shallowly fissured and slightly scaly; inner surface rust-brown; fracture weak, short, and uneven, the inner layer whitish, the middle rust-brown, the outer dark brown; groups of stone cells readily distinguishable in transverse section; odor slight, peculiar; taste very bitter, somewhat astringent.

Viburnum contains valeric acid, a bitter, resinous principle, *viburnin*, tannin, etc. Alcohol is the best solvent for its active principles.

Uses.—It is used like valerian, as a nervine and tonic; it has also diuretic properties. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Viburni Prunifolii Fluidextract of Viburnum Prunifolium	Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 424). Dose, one-half to one fluidrachm (2 to 4 Cc.)

OLEUM CHENOPODII. U. S. Oil of Chenopodium

[Oil of American Wormseed]

A volatile oil distilled from *Chenopodium anthelminticum* Linné (Fam. *Chenopodiaceæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil consists of a terpene, $C_{10}H_{16}$, and an oxygenated portion, $C_{10}H_{16}O$.

Official Description.—A thin, colorless or yellow liquid.

Odor and Taste.—Peculiar, penetrating, somewhat camphoraceous odor; pungent and slightly bitter taste.

Uses.—It is used as an anthelmintic. It is best administered as an emulsion, first mixing the oil with twice its volume of olive oil. Its taste is so offensive to children, to whom it is almost exclusively given, in the treatment against intestinal worms, that the emulsion should be flavored with methyl salicylate, aromatic oils or other substances. The oil has caused death in doses of half a fluidrachm. In some cases the diluted oil may be given in capsules. Dose, three minims (0.2 Cc.).

OLEUM JUNIPERI. U. S. Oil of Juniper

A volatile oil distilled from the fruit of *Juniperus communis* Linné (Fam. *Coniferæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

Oil of juniper (berries) is a terpene, $C_{10}H_{16}$.

Official Description.—A colorless, faintly green or yellow liquid.

Odor and Taste.—Characteristic odor of juniper; warm, aromatic, somewhat terebinthinate and slightly bitter taste.

Specific Gravity.—0.860 to 0.880 at 25° C. (77° F.).

Uses.—It has diuretic and stimulant properties. Dose, three minims (0.2 Cc.).

Official Preparations

Spiritus Juniperi Spirit of Juniper	Made by mixing 50 Cc. of oil of juniper with 950 Cc. of alcohol (see page 316). Dose, one-half to two fluidrachms (2 to 8 Cc.)
Spiritus Juniperi Compositus Compound Spirit of Juniper.	Made by mixing 8 Cc. of oil of juniper and 1 Cc. each of oils of fennel and caraway with 1400 Cc. of alcohol and sufficient water to make 2000 Cc. (see page 316). Dose, one to four fluidrachms (4 to 16 Cc.)

SABINA. U.S. Savin

The tops of *Juniperus Sabina* Linné (Fam. *Coniferæ*).

Short, thin, subquadrangular branchlets bearing leaves which are rather dark green, in four rows, opposite, scale-like, ovate-lanceolate, more or less acute, appressed, imbricated, having on the back a shallow groove containing an oblong or roundish gland ; odor peculiar, terebinthinate ; taste disagreeable, resinous, and bitter.

Savin contains a terpene, $C_{10}H_{16}$, and resin, with a trace of tannin. Alcohol is the best menstruum. Dose, eight grains (0.5 Gm.).

Official Preparation

Fluidextractum Sabinæ Fluidextract of Savin	Made with a menstruum of alcohol (see page 415). Dose, three to eight minims (0.2 to 0.5 Cc.)

OLEUM SABINÆ. U. S. Oil of Savin

A volatile oil distilled from the fresh tops of Savin. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil is a terpene, $C_{10}H_{16}$.

Official Description.—A colorless or yellowish liquid.
Odor and Taste.—Peculiar, terebinthinate odor: pungent, bitter and camphoraceous taste.
Specific Gravity.—0.903 to 0.923 at 25° C. (77° F.).
Solubility.—*Alcohol.* In about one-half volume or more of 90 percent. alcohol.
Tests for Identity.—The Oil is dextrogyrate, the angle of rotation varying between $+40°$ and $+60°$ in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—It is used as a stimulant and emmenagogue. Owing to its having been frequently used to produce abortion, it should not be dispensed except upon the order of a physician. Dose, one to five minims (0.05 to 0.3 Cc.).

Unofficial Substances containing Volatile Oil and Resin

Agaricus Albus White Agaric	A fungus from *Polyporus officinalis*, which grows on the trunks of old trees
Alisma Water Plantain	From *Alisma Plantago*, indigenous to Europe. Contains an acrid resin
Oil of Water Plantain	A pungent oil
Aralia Racemosa American Spikenard	The rhizome of *A. racemosa*, found in North America. It contains volatile oil, resin, etc.
Chenopodium American Wormseed. U. S. P. 1890	The fruit of *Chenopodium ambrosioides* Linné, and variety anthelminticum Gray (Fam. Chenopodiaceæ) and contains a volatile oil which is official, resin and a bitter principle. Used as an anthelmintic
Cunila Dittany	From *C. Mariana*, found in the United States. It contains volatile oil and resin
Galanga Galangal	The rhizome of *Alpinia officinarum*, grown in China. It contains ½ percent. of volatile oil, and a pungent, soft resin, etc.
Oil of Galangal, $C_{10}H_{18}O$	A pale yellow or brownish-yellow volatile oil
Iris Florentina Florentine Orris	The rhizome of different species of *Iris*, grown in Europe. It contains a volatile oil, soft, acrid resin, etc.
Juniperus	The fruit of *J. communis* (Fam. *Conifera*)
Juniperus Virginiana Red Cedar	The tops of *J. virginiana*, grown in Canada and the United States. It contains volatile oil, resin, etc.
Oil of Red Cedar	Distilled from the wood of *Juniperus virginiana*
Laserpitium White Gentian	From *L. latifolium*, found in Europe. It contains volatile oil and a bitter principle
Laurocerasus Cherry Laurel	From *Prunus Laurocerasus*, found in Western Asia. It contains volatile oil, resin, etc.
Laurus Laurel	The leaves and fruit of *L. nobilis*, indigenous to the Levant. It contains volatile and fixed oils, also resin, etc.
Oil of Laurel	A pale yellow oxygenated oil, sp. gr. 91. The yield is about 2 percent.
Levisticum Lovage	From *L. officinale*, found in Europe. It contains volatile oil, resins, etc.
Liatris Liatris	From different species of *Liatris*, indigenous to North America

Unofficial Substances containing Volatile Oil and Resin—*Continued*

Myrica Bayberry	The leaves of *M. cerifera*, found near Lake Erie and the Atlantic coast. It contains volatile oil, resin, etc.
Myrtus Myrtle	From *M. communis*, found along the Mediterranean. It contains a volatile oil, resin, etc.
Piper Methysticum Kava-Kava	The root of *P. Methysticum*, indigenous to the Sandwich Islands. It contains a volatile oil and acrid resin
Ava-Kava	An intoxicating liquor, made from the root of *Piper Methysticum*
Psoralea Psoralea	From different species of *Psoralea*, found in the United States. It contains a volatile oil and resin
Ptelea Shrubby Trefoil	From *P. trifoliata*, found in North America. It contains a volatile oil and pungent resin
Ruta Graveolens Rue	The herb of *R. graveolens*
Oleum Rutæ Oil of Rue	A volatile oil from *Ruta graveolens*, sp. gr. 0.880, more soluble in water than most volatile oils. It is methyl-nonyl-ketone, $CH_3.CO.C_9H_{19}$
Sambucus Elder. U. S. P. 1890	The flowers of *Sambucus canadensis* Linné (Fam. Caprifoliaceæ). It contains small amounts of volatile oil, resin, sugar, and mucilage
Santalum Album Sandalwood	The wood of *S. album*. It contains an oxygenated volatile oil and resin. (See Oleum Santali)
Thuja Arbor Vitæ	The fresh tops of *Thuja occidentalis* Linné (Fam. *Coniferæ*)
Wintera Winter's Bark	The bark of *Drimys Winteri*, grown in South America
Oil of Winter's Bark	The yield of volatile oil is about 1½ percent.

Official Drugs and Products containing Volatile Oil associated with Bitter Principle or Extractive

ARNICA. U.S. Arnica

[Arnicæ Flores, Pharm. 1890 Arnica Flowers]

The dried flower-heads of *Arnica montana* Linné (Fam. *Compositæ*).

Subglobular, about 2 Cm. long; involucre campanulate-turbinate; bracts in 1 to 2 ranks, oblong, dark green, pubescent; receptacle slightly convex, deeply pitted, densely short-hairy; rays about 16, bright yellow, the ligulate portion 2 to 2.5 Cm. long, nearly 6 Mm. broad, 3-toothed, 7- to 9-nerved, pistillate; disk flowers perfect, 5-toothed, of a deeper yellow, their akenes nearly 6 Mm. long, slender, tapering sharply to the base, flattened, 5-ribbed, pubescent, the pappus nearly a half longer than the akene, of a single circle of nearly white barbellate bristles; odor characteristic and agreeable; taste bitter.

Arnica flowers contain a trace of volatile oil, and a bitter principle, *arnicin*, with resin, coloring matter, etc. Alcohol and water extract their virtues. It is rarely used internally. Dose, fifteen grains (1 Gm.).

Official Preparation

Tinctura Arnicæ Tincture of Arnica	Made by percolating 200 Gm. of powdered arnica with sufficient diluted alcohol to make 1000 Cc. (see page 343). Dose, fifteen minims (1 Cc.)

CALENDULA. U.S. Calendula

[Marigold]

The dried ligulate florets of *Calendula officinalis* Linné (Fam. *Compositæ*).

Florets, 15 to 25 Mm. long, yellow or orange-colored, one- to three-toothed, the short hairy tube occasionally enclosing the remnants of a filiform style and bifid stigma; odor slight and somewhat heavy; taste slightly bitter and faintly saline.

Calendula contains a small quantity of a volatile oil, a bitter principle, gum, sugar, etc. *Calendulin* is not the active principle, having very little taste. Dose, fifteen grains (1 Gm.).

Official Preparation

Tinctura Calendulæ Tincture of Calendula	Made by percolating 200 Gm. of powdered calendula with sufficient alcohol to make 1000 Cc. (see page 346). Used externally

OLEUM ERIGERONTIS. U.S. Oil of Erigeron

[OIL OF FLEABANE]

A volatile oil distilled from the fresh, flowering herb of *Erigeron canadensis* Linné (Fam. *Compositæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.

This oil consists of a terpene, $C_{10}H_{16}$, and an oxygenated portion.

Official Description.—A pale yellow, limpid liquid, rapidly becoming darker and thicker by age and exposure to the air.

Odor, Taste, and Reaction.—Peculiar, aromatic, persistent odor; aromatic, slightly pungent taste.

Specific Gravity.—0.845 to 0.865 at 25° C. (77° F.).

Solubility.—*Alcohol.* In an equal volume.

Tests for Identity.—Soluble in an equal volume of alcohol (distinction from *oil of fireweed* derived from *Erechthites hieracifolia* Rafinesque (Fam. *Compositæ*) and from *oil of turpentine*).

It is dextrogyrate, the angle of rotation being not below + 45° in a 100 Mm. tube, at a temperature of 25° C. (77° F.).

Uses.—It is used in uterine hemorrhage as a hæmostatic. It is best administered in capsules. Dose, fifteen minims (1 Cc.).

ANTHEMIS. U. S. Anthemis

[CHAMOMILE ENGLISH CHAMOMILE ROMAN CHAMOMILE]

The dried flower-heads of *Anthemis nobilis* Linné (Fam. *Compositæ*), collected from cultivated plants.

Subglobular, 1.5 to 2 Cm. broad, consisting of an imbricated involucre and numerous white, strap-shaped, obscurely three-toothed ray-florets, and usually a few tubular disk-florets, inserted upon a chaffy, conical, solid receptacle; odor agreeable; taste strongly aromatic and bitter.

Anthemis contains a volatile oil, and a bitter principle which has been called *anthemic acid.* The volatile oil is frequently blue in color.

Uses.—It is used as a tonic, often in infusion. Dose, thirty grains (2 Gm.).

MATRICARIA. U.S. Matricaria

[GERMAN CHAMOMILE]

The dried flower-heads of *Matricaria Chamomilla* Linné (Fam. *Compositæ*).

About 6 or 8 Mm. broad, exclusive of the rays, with a flattish imbricated involucre, a conical, hollow, and naked receptacle, 10 to 20 white ligulate and reflexed pistillate ray-florets which are about 8 Mm. long, and numerous yellow, tubular, perfect disk-florets without pappus; odor somewhat disagreeably aromatic; taste strongly aromatic and bitter.

The similar flower-heads of *Anthemis arvensis* Linné, and *Maruta Cotula* De Candolle (Fam. *Compositæ*), have conical, solid, and chaffy receptacles.

Matricaria contains a dark blue volatile oil, which is soluble in alcohol; the bitter principle is termed *anthemic acid.*

Uses.—It is a tonic and stimulant. Dose, four drachms (16 Gm.).

EUPATORIUM. U.S. Eupatorium

[BONESET THOROUGHWORT]

The dried leaves and flowering tops of *Eupatorium perfoliatum* Linné (Fam. *Compositæ*).

Usually occurring in fragments; leaves opposite, the pair united at the base, from 8 to 20 Cm. long and 1.5 to 5 Cm. broad, tapering regularly from near the base to an acute apex, crenate-serrate, rugosely veined, rough and bright green above, yellowish-gray-green, tomentose and resinous-dotted beneath; flower-heads small, numerous, corymbed, with a campanulate involucre of lance-linear imbricated scales and with from 10 to 15 tubular yellowish-white florets, having a bristly pappus in a single row; odor faintly aromatic; taste strongly bitter.

This plant contains a volatile oil and resin, *eupatorin*, gum, tannin, sugar, etc. Alcohol, diluted alcohol, and water extract its virtues. It is tonic and laxative. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Eupatorii Fluidextract of Eupatorium	Made with a menstruum of diluted alcohol (see page 396). Dose, one-half to two fluidrachms (2 to 8 Cc.)

GRINDELIA. U.S. Grindelia

The dried leaves and flowering tops of *Grindelia robusta* Nuttall, or of *Grindelia squarrosa* (Pursh) Dunal (Fam. *Compositæ*).

Leaves about 5 Cm. or less long, varying from broadly spatulate or oblong to lanceolate, sessile or clasping, obtuse, more or less sharply serrate, often spinosely toothed, or even laciniate-pinnatifid, pale green, smooth, finely dotted, somewhat coriaceous, brittle; heads more or less resinous-viscid, many-flowered, either conical-urceolate (*G. squarrosa*), or depressed-urceolate (*G. robusta*); the involucre hemispherical, about 10 Mm. broad, composed of numerous imbricated, squarrosely tipped or spreading scales; ray-florets yellow, ligulate, pistillate, sometimes absent; disk-florets yellow, tubular, perfect; pappus of two or three mostly unequal awns about the length of the disk-florets; odor balsamic; taste pungently aromatic and bitter.

Grindelia contains a volatile oil and a bitter and resinous principle. Alcohol is the best menstruum. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Grindeliæ Fluidextract of Grindelia	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 399). Dose, one-half to one fluidrachm (2 to 4 Cc.)

ERIODICTYON. U.S. Eriodictyon

[YERBA SANTA]

The dried leaves of *Eriodictyon californicum* (Hooker and Arnott) Greene (Fam. *Hydrophyllaceæ*).

Usually occurring in fragments; entire leaf oblong-lanceolate, 5 to 15 Cm. long and 1 to 3 Cm. broad, acute at the apex, narrowed below into a short, broad petiole, the margin more or less incurved, entire or irregularly serrate, or crenate-dentate; upper surface yellowish-green, smooth, covered with a brownish resin; lower surface whitish or yellowish-white, conspicuously reticulated and densely tomentose; brittle, but flexible in a damp and warm atmosphere; odor somewhat aromatic; taste balsamic and sweetish.

Eriodictyon is also known as *mountain balm;* it contains a bitter resin, volatile oil, and extractive. Its preparations are often used to disguise the taste of quinine.

Uses.—It is given in doses of fifteen to sixty grains (1 to 4 Gm.) as a stimulating tonic.

Fluidextractum Eriodictyi Fluidextract of Eriodictyon	Made with a menstruum of 4 parts of alcohol to 1 part of water (see page 395). Dose, fifteen minims to one fluidrachm (1 to 4 Cc.)

MEZEREUM. U.S. Mezereum

The dried bark of *Daphne Mezereum* Linné, and of other European species of *Daphne* (Fam. *Thymelæaceæ*).

In long, thin, flexible, tough bands, the edges fringed with partly detached bast fibres; outer surface yellowish- or reddish-brown, obliquely striate or wrinkled, with numerous lenticels and occasional brownish-black fruit-heads of a lichen; inner surface yellowish-green or whitish, satiny-lustrous, finely striate; fracture tough, fibrous, the periderm readily separable from the yellowish-green cortex, inner bark lamellated; odor slight; taste very acrid.

Mezereum contains *daphnin*, $C_{31}H_{34}O_{19}$, a glucoside, associated with an acrid soft resin and oil. Alcohol is the best menstruum for extracting the activity. Mezereum is rarely given internally alone, being usually combined with other drugs, as in the official compound fluidextract of sarsaparilla. The dose is eight grains (0.5 Gm.).

Official Preparation

Fluidextractum Mezerei **Fluidextract of Mezereum**	Made with a menstruum of 4 parts of alcohol and 1 part of water (see page 406). Dose, one minim (0.05 Cc.). Principally used externally

ASPIDIUM. U.S. Aspidium

[MALE FERN]

The dried rhizome of *Dryopteris Filix-mas* (Linné) Schott, or of *Dryopteris marginalis* (Linné) Asa Gray (Fam. *Filices*).

Before being peeled, 10 to 15 Cm. long by 5 to 7 Cm. thick, including the densely imbricated, dark brown, cylindraceous, slightly curved stipe-bases and the dense mass of brownish, glossy, transparent, soft, chaffy scales; when peeled, 1 to 2 or 3 Cm. thick, cylindraceous and nearly straight, or curved and tapering toward one end, roughly scarred with the remains of the stipe-bases, or bearing several coarse longitudinal ridges and grooves; pale green when first peeled, becoming pale brown; fracture sharp, pale green, the texture rather spongy, exhibiting from 6 to 10 steles in a loose and interrupted circle; odor disagreeable; taste bittersweet, astringent, acrid, and nauseous.

The chaff, together with the dead portions of the rhizome and stipes, should be removed, and only such portions used as have retained their internal green color. Powdered Aspidium should be freshly prepared and have a bright green color.

Aspidium contains *filicic acid*, $C_{14}H_{18}O_5$, filicin, filitannic acid, fixed oil, etc. The green portions of the rhizome alone are active.

Uses.—It is used as a tænifuge. Dose, one drachm (4 Gm.).

Official Preparation

Oleoresina Aspidii Oleoresin of Aspidium	Made by exhausting aspidium with acetone, distilling, and evaporating (see page 428). Yield, 10 to 15 percent. Dose, one-half to one fluidrachm (2 to 4 Cc.)

CYPRIPEDIUM. U.S. Cypripedium

[LADY'S SLIPPER]

The dried rhizome and roots of *Cypripedium hirsutum* Miller (*Cypripedium pubescens* Wildenow) or of *Cypripedium parviflorum* Salisbury (Fam. *Orchidaceæ*).

Rhizome of horizontal growth, curved, 3 to 10 Cm. long, 2 to 6 Mm. thick, orange-brown to dark brown, the upper side beset with numerous circular, cup-shaped scars, closely covered below with simple wiry roots varying from 3 to 15 Cm. in length; fracture of rhizome short, white, that of roots somewhat fibrous; odor distinct, heavy, valerian-like; taste sweetish, bitter, and somewhat pungent.

This rhizome contains resins, an acid principle, volatile oil, tannin, starch, etc. Alcohol extracts its virtues.

Uses.—It is stimulant and diaphoretic. Dose fifteen grains (1 Gm.).

Official Preparation

Fluidextractum Cypripedii Fluidextract of Cypripedium	Made with diluted alcohol (see page 394). Dose, fifteen minims (1 Cc.)

PHYTOLACCA. U.S. Phytolacca

[PHYTOLACCÆ RADIX, PHARM. 1890 POKE ROOT]

The dried root of *Phytolacca decandra* Linné (Fam. *Phytolaccaceæ*), collected in autumn.

Cylindrical, somewhat tapering, sparingly branched, 3 to 7 Cm. thick, mostly in transverse or longitudinal slices; externally yellowish-brown, finely longitudinally or spirally wrinkled and thickly annulate with lighter colored, low ridges; fracture fibrous, characterized by alternating layers of fibrovascular tissue and parenchyma, the layers of the latter being much retracted; odor slight; taste sweetish, afterwards highly acrid.

This root contains an acrid resin, asparagin, tannin, mucilage, etc.

Uses.—It is used as an alterative, in doses of two grains (0.125 Gm.), and as an emetic, in doses of fifteen grains (1 Gm.).

Official Preparation

Fluidextractum Phytolaccæ Fluidextract of Phytolacca	Made with diluted alcohol (see page 408). Dose, one and a half to fifteen minims (0.1 to 1 Cc.)

ZEA. U.S. Zea

[CORN SILK]

The fresh styles and stigmas of *Zea Mays* Linné (Fam. *Gramineæ*).

A matted mass of slender filaments, 5 to 15 Cm. long, thread-like, yellowish or brownish; nearly inodorous; taste faintly sweetish with a characteristic flavor.

Corn silk when dried contains *maizenic acid*, fixed oil, resin, chlorophyll, sugar, gum, extractive, etc. It is a mild diuretic, in doses of one to two drachms (4 to 8 Gm.).

STILLINGIA. U.S. Stillingia

[QUEEN'S ROOT]

The dried root of *Stillingia sylvatica* Linné (Fam. *Euphorbiaceæ*).

Slenderly fusiform, usually in cut pieces, of variable length and 0.5 to 3 Cm. in diameter; externally reddish-brown, longitudinally wrinkled; fracture fibrous, bark light reddish-brown, 0.5 to 4 Mm. thick, spongy, finely fibrous, with numerous resin cells, easily separable from the porous, radiate wood; odor distinct; taste bitter, acrid, and pungent.

Stillingia contains an acrid resin, sylvacrol, starch, fixed oil, etc.

Uses.—It is used as an alterative, in doses of thirty grains (2 Gm.).

Official Preparation

Fluidextractum Stillingiæ Fluidextract of Stillingia	Made with diluted alcohol (see page 420). Dose, fifteen to forty minims (1 to 2.5 Cc.)

PYRETHRUM. U.S. Pyrethrum

[PELLITORY]

The root of *Anacyclus Pyrethrum* (Linné) De Candolle (Fam. *Compositæ*).

Somewhat fusiform, nearly simple, 5 to 10 Cm. long, 3 to 20 Mm. in diameter; externally dark brown or grayish-brown, longitudinally wrinkled and somewhat furrowed, crown somewhat annulate and sometimes tufted with coarse fibres or with soft woolly hairs; fracture short; bark dark brown, resinous, 0.5 to 1 Mm. thick, closely adhering to the light yellow, radiate, porous wood; odor distinct; taste pungent, very acrid, producing a prompt sialagogue effect.

This root contains an acrid brown resin, *pyrethrine*, and fixed oils, inulin, mucilage, etc.

Uses.—It is used as a sialagogue and stimulant, in doses of fifteen to forty grains (1 to 2.6 Gm.).

Official Preparation

Tinctura Pyrethri Tincture of Pyrethrum	Made by percolating 200 Gm. of pyrethrum with sufficient alcohol to make 1000 Cc. (see page 361). It is used externally, and in tooth-washes

XANTHOXYLUM. U.S. Xanthoxylum

[PRICKLY ASH]

The dried bark of *Xanthoxylum americanum* Miller (Northern Prickly Ash), or of *Fagara Clava-Herculis* (Linné) Small (Southern Prickly Ash) (Fam. *Rutaceæ*).

Northern Prickly Ash.—In curved or quilled fragments, about 1 Mm. thick; outer surface brownish-gray, with whitish patches, and minute, black dots, faintly furrowed, with some brown, glossy, straight, two-edged spines, linear at the base, and about 5 Mm. long; inner surface whitish, smooth; fracture short, non-fibrous, green in the outer and yellowish in the inner layer; inodorous; taste bitterish, very pungent.

Southern Prickly Ash.—In very large quills or sheets, 1 to 2 Mm. thick, externally of a light purplish-gray with large silvery-gray patches, and marked by many large corky projections, frequently 2 Cm. high, which often bear stout brown spines; otherwise like the Northern Prickly Ash.

Xanthoxylum should not be confounded with the bark of *Aralia spinosa* Linné (Fam. *Araliaceæ*), which is nearly smooth externally, and beset with slender prickles in transverse rows.

Xanthoxylum owes its virtues to a soft resin, a crystalline resin, a bitter principle, and an acrid green oil. There are also present sugar, tannin, gum, etc.

Uses.—It is a sialagogue, stimulant, and alterative. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Xanthoxyli Fluidextract of Xanthoxylum	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 424). Dose, one-half to one fluidrachm (2 to 4 Cc.)

SABAL. U.S. Sabal

[SAW PALMETTO]

The partially dried ripe fruit of *Serenoa serrulata* (Roemer and Shultes) Hooker filius (Fam. *Palmæ*).

Irregularly spherical to oblong-ovoid; 10 to 25 Mm. long, 10 to 15 Mm. in diameter; externally blackish-brown, shrivelled, somewhat oily; epicarp thin; sarcocarp about 1 Mm. thick, greenish-yellow, soft-spongy; endocarp thin, friable; seed hard, chocolate-brown; odor aromatic; taste sweetish, acrid, and oily.

Sabal contains a volatile oil, fixed oil, resin, and an alkaloidal principle. It is used as a diuretic and tonic in doses of fifteen to thirty grains (1 to 2 Gm.).

CIMICIFUGA. U.S. Cimicifuga

[BLACK COHOSH BLACK SNAKEROOT]

The dried rhizome and roots of *Cimicifuga racemosa* (Linné) Nuttall (Fam. *Ranunculaceæ*).

Rhizome horizontal in growth, 2 to 15 Cm. long, 1 to 2.5 Cm. thick, with numerous thick, erect or ascending branches about 2.5 Cm. long, each terminated by a deep, cup-shaped scar; roots numerous, brittle, obtusely quadrangular, and about 2 Mm. thick; the whole brownish-black; fracture of rhizome horny, of root short, the rhizome exhibiting a rather large pith, surrounded by numerous whitish, radially sublinear xylem plates; bark thin, firm; the roots having a thick bark and usually a four-rayed wood; odor slight but heavy; taste bitter and acrid.

Cimicifuga contains resin, an acrid principle (possibly an alkaloid), starch, tannin, gum, etc.

Uses.—It is used as a sedative and alterative. Dose fifteen grains (1 Gm.).

Official Preparations

Extractum Cimicifugæ Extract of Cimicifuga	Made by evaporating 100 Cc. of fluidextract of cimicifuga to dryness and adding enough powdered glycyrrhiza to make 25 Gm. of extract (see page 443). Dose, three to ten grains (0.2 to 0.6 Gm.)
Fluidextractum Cimicifugæ Fluidextract of Cimicifuga	Made with a menstruum of alcohol (see page 388). Dose, fifteen to thirty minims (1 to 2 Cc.)
Tinctura Cimicifugæ Tincture of Cimicifuga	Made by percolating 200 Gm. of cimicifuga with sufficient alcohol to make 1000 Cc. (see page 348). Dose, one to four fluidrachms (4 to 16 Cc.)

APOCYNUM. U.S. Apocynum

[Canadian Hemp]

The dried rhizome of *Apocynum cannabinum* Linné, or of closely allied species of Apocynum (Fam. *Apocynaceæ*).

Of varying length, 3 to 8 Mm. thick, cylindrical or with a few angles produced by drying, lightly wrinkled longitudinally, and usually more or less fissured transversely; orange-brown, becoming gray-brown on keeping; brittle; fracture sharply transverse, exhibiting a thin brown layer of cork, the remainder of the bark nearly as thick as the radius of the wood, white or sometimes pinkish, starchy, containing lacticiferous ducts; the wood yellowish, having several rings, finely radiate and very coarsely porous; almost inodorous, the taste starchy, afterwards becoming bitter and somewhat acrid.

Apocynum contains resin, *apocynin*, *apocynein*, bitter extractive, tannin, etc. Alcohol is a good menstruum for it.

Uses.—It is emetic and antiperiodic. Dose, five to twenty grains (0.3 to 1.3 Gm.).

Official Preparation

Fluidextractum Apocyni Fluidextract of Apocynum	Made with a menstruum of 60 parts of alcohol, 30 parts of water, and 10 parts of glycerin (see page 383). Dose, five to twenty minims (0.3 to 1.2 Cc.)

LACTUCARIUM. U.S. Lactucarium

The concrete milk-juice of *Lactuca virosa* Linné (Fam. *Compositæ*).

Usually in quarter sections of hemispherical masses, or in irregular, angular pieces; externally dull reddish-brown or grayish-brown; internally light brown or yellowish, the cut surface having a waxy lustre and somewhat porous; odor distinct, opium-like; taste strongly bitter.

Lactucarium is partly soluble in alcohol and in ether. When triturated with water it yields a turbid mixture. When boiled with water it softens and yields a brownish-colored liquid which, after cooling, is not colored blue by iodine T.S.

Lactucarium is a complex substance. It contains a bitter resinous principle, *lactucin*, $C_{11}H_{12}O_3.H_2O$, *lactucic acid* (bitter and crystalline), *lactucopicrin* (bitter and amorphous), *lactucerin* in large quantity, nearly 60 percent. (this principle is inert and crystallizable), caoutchouc, resin, asparagin, volatile oil, mucilage, etc.

Uses.—It is used as a sedative, in doses of fifteen grains (1 Gm.).

Official Preparations

Tinctura Lactucarii Tincture of Lactucarium	Made by treating 500 Gm. lactucarium with purified petroleum benzin to extract the inert resinous lactucerin, then mixing with sand, and percolating with a mixture of alcohol, water, and glycerin until 1000 Cc. are obtained (see page 356). Dose, thirty minims (2 Cc.)
Syrupus Lactucarii Syrup of Lactucarium	Made by mixing 100 Cc. of tincture of lactucarium with 200 Cc. of glycerin, then adding 50 Cc. of orange flower water in which 1 Gm. of citric acid has been dissolved, filtering, and adding sufficient syrup to make 1000 Cc. (see page 290). Dose, two fluidrachms (8 Cc.)

Unofficial Volatile Oils and Drugs containing Volatile Oil, Bitter Principle, and Extractive

Absinthium Wormwood. U. S. P. 1890	The leaves and tops of *Artemisia absinthium* Linné (Fam. Compositæ). It contains t percent. oxygenated volatile oil, chiefly *absinthol* and a bitter principle *absinthin*, $C_{40}H_{58}O_9$
Achillea Yarrow	A perennial herb of the Family Compositæ, *Achillea Millefolium*, growing in America and Europe. It contains *achilleine.*
Arnicæ Radix Arnica Root. U. S. P. 1890	The rhizome and roots of *Arnica montana* Linné (Fam. Compositæ). It contains 1 percent. of volatile oil, a bitter principle *arnicin*, acrid resin, etc.
Asclepias Pleurisy Root. U. S. P. 1890	The root of *Asclepias tuberosa* Linné (Fam. Asclepiadeæ). The root contains resins, volatile principles, tannin, etc. Expectorant and anodyne. Dose, thirty grains (2 Gm.)
Oleum Achilleæ Oil of Yarrow	A blue or dark green volatile oil. The yield is about $\frac{1}{10}$ percent.
Angustura Angustura Bark	The bark of *Galipea Cusparia*, from the mountains near the Orinoco River
Oil of Angustura, $C_{13}H_{24}O$	The yield of oil is about $\frac{1}{2}$ percent.
Apocynum Androsæmifolium Dogsbane	A root which grows in New England and Canada
Artemisia Mugwort	From *Artemisia vulgaris.* It contains volatile oil, bitter principle, etc.
Bela Bael	From *Ægle marmelos*, grown in the Himalaya Mountains. It contains tannin, bitter principle, and volatile oil
Boldus Boldo	From *Boldus fragrans*, grown in Chili. It contains volatile oil, glucoside, etc.
Carthamus American Saffron. Safflower	Used in infusion. Made in the proportion of two drachms to a pint of boiling water
Chekan Cheken	The leaves of *Eugenia Chekan*, grown in Chili. It contains volatile oil, bitter principle, chekenon, chekenin, chekenetin, and cheken-bitter. Dose of the fluidextract, one to three fluidrachms (4 to 12 Cc.)
Clematis Virgin's Bower	The herb from different species of *Clematis*
Coto Coto Bark	A bark belonging to the Lauraceæ. It contains cotoin ($C_{22}H_{18}O_6$) and paracotoin
Oil of Coto Bark	A pale yellow oil of a peppery taste
Erigeron Erigeron	The leaves and tops of *Erigeron canadensis.* Diuretic, tonic, astringent. Dose, in substance, one drachm (4 Gm.)
Euphrasia Eyebright	*Euphrasia officinalis*, indigenous to Europe
Genista Dyers' Broom	The young branches of *Genista tinctoria*, indigenous to Asia and Europe. It contains a yellowish-green volatile oil
Geum Water Avens	The rhizome of *Geum rivale*, grown in America and Europe. It contains volatile oil and bitter principle
Gnaphalium Life-Everlasting	From different species of *Gnaphalium*, grown in North America. It contains volatile oil and bitter principle
Helianthemum Frostwort	The herb of *Helianthemum canadensis*, indigenous to Canada. It contains a bitter principle
Hypericum St. John's Wort	From *Hypericum perforatum*, grown in Europe. It contains hypericum red, volatile oil, etc.
Inula Elecampane. U. S. P. 1890	The root of *Inula Helenium* Linné (Fam. Compositæ). It contains acrid resin and volatile oil, also *helenin*, C_6H_8O, which is inactive
Iris Blue Flag. U. S. P. 1890	The rhizome and roots of *Iris versicolor* Linné (Fam. Irideæ). It contains a bitter resin, sugar, gum, etc. Dose, as alterative, fifteen grains (1 Gm.)
Parthenium Feverfew	The flowering herb of *Pyrethrum Parthenium*, growing in waste places in Europe. It contains volatile oil and bitter principle
Phytolaccæ Fructus Poke Berries. U. S. P. 1890	The fruit of *Phytolacca decandra* Linné (Fam. Phytolaccaceæ). It contains coloring matter, sugar, gum, etc. Used as an alterative
Primula Primrose	From *Primula officinalis*, indigenous to Europe and Asia. It contains a volatile oil and primulin
Pulsatilla Pulsatilla. U. S. P. 1890	The herb of *Anemone Pulsatilla* and *A. pratensis* Linné (Fam. Ranunculaceæ), collected soon after flowering. It contains an acrid resin, gum, etc.
Ranunculus Crowfoot	From *Ranunculus bulbosus*, found in North America. It contains a golden yellow volatile oil and a bitter principle
Senecio Groundsel	From *Senecio aureus*, grown in Europe. It contains bitter principle, etc.

Unofficial Volatile Oils and Drugs containing Volatile Oil, Bitter Principle, and Extractive—*Continued*

Tanacetum Tansy. U. S. P. 1890	The leaves and tops of *Tanacetum vulgare* Linné (Fam. Compositæ). The bitter principle is *tanacetin*
Teucrium Germander	From *Teucrium Marum*, indigenous to Europe. It contains volatile oil and bitter principle
Tilia Linden Flowers	From *Tilia americana*. It contains volatile oil, bitter principle, etc.
Trillium Beth Root	The rhizome of *Trillium erectum*. It contains resinous, fatty, and acrid principles, etc.
Turnera Damiana	The leaves of *Turnera microphylla*. It contains volatile oil, resin, etc.
Verbascum Mullein	The flowers of *Verbascum phlomoides*, found in Europe. It contains volatile oil, etc.

CHAPTER LVII

RESINS, OLEORESINS, GUM RESINS, AND BALSAMS

RESINS are natural or induced solid or semi-solid exudations from plants, characterized by being insoluble in water, mostly soluble in alcohol, uncrystallizable, and softening or melting at a moderate heat. They are usually the *oxidized terpenes* of plants, and, owing to their insolubility in water, have little taste; they are, chemically, mixed products; some of them are acids, and combine with alkalies, forming soaps, as in the case of common rosin.

Resins, when pure, are usually transparent; when they contain water, they are opaque, and no longer hard and brittle.

Natural oleoresins are mixtures of oils and resin, generally obtained by incising the trunks of the trees in which they are found, as turpentine, copaiba, etc.

Gum resins are natural mixtures of gum and resin, usually obtained as exudations from plants, as myrrh, asafetida, etc.

Balsams are resinous substances which contain benzoic, cinnamic, or an analogous acid, as balsam of tolu, balsam of Peru, etc.

The official resins, oleoresins, gum-resins, and balsams will now be considered, followed by a condensed table of unofficial allied products.

TEREBINTHINA. U.S. Turpentine

A concrete oleoresin obtained from *Pinus palustris* Miller, and from other species of *Pinus* (Fam. *Pinaceæ*).

White turpentine contains abietic anhydride, which may be converted into abietic acid, $C_{44}H_{64}O_5$, a bitter principle, and 25 percent. of volatile oil.

Official Description.—In yellowish, opaque masses, brittle in the cold; lighter internally, sticky and more or less glossy.
Odor, Taste, and Reaction.—Odor and taste terebinthinate; acid reaction.

Uses.—It is used as an ingredient in compound rosin cerate and in some unofficial plasters, and is sometimes administered in pill form. Dose, fifteen to thirty grains (1 to 2 Gm.).

OLEUM TEREBINTHINÆ. U.S. Oil of Turpentine

A volatile oil recently distilled from turpentine. It should be kept in well-stoppered bottles.

This important oil has the composition $C_{10}H_{16}$, and, as has been already stated, is the type of the terpenes. It is used as a solvent in pharmacy.

Official Description.—A thin, colorless liquid.
Odor and Taste.—Characteristic odor and taste, both of which become stronger and less pleasant by age and exposure to the air.
Specific Gravity.—0.860 to 0.870 at 25° C. (77° F.).
Solubility.—*Alcohol.* In 3 times its volume.

Tests for Identity.—When Oil of Turpentine is distilled, the larger part should pass over between 155° and 162° C. (311° and 323.6° F.).

If 5 Cc. of Oil of Turpentine be shaken with an equal volume of potassium hydroxide T.S., its color should not become darker than a light straw-yellow upon standing twenty-four hours.

Impurities and Tests for Impurities.—*Petroleum, paraffin oils, or rosin.* If 1 Cc. of the Oil be evaporated in a small dish on a water-bath, it should leave not more than a very slight residue.

Kerosene or rosin oil. Three drops of Oil of Turpentine, placed on a sheet of clean white filter paper and exposed to the air, should evaporate entirely without leaving a permanent stain.

Petroleum benzin, kerosene, or similar hydrocarbons. If 5 Cc. of Oil of Turpentine be placed in a small beaker, and 20 Cc. of sulphuric acid be gradually added, with agitation, while the beaker is cooled by immersion in cold water, and the contents, after cooling and renewed agitation, be transferred to a burette, graduated in tenths, the clear layer which forms after the dark mass has settled should not measure more than 0.35 Cc.

Uses.—Oil of turpentine is used externally in liniments as a stimulant and counterirritant. The rectified oil of turpentine should be used internally.

Official Preparations

Linimentum Terebinthinæ Turpentine Liniment	Made by mixing 650 Gm. of rosin cerate with 350 Gm. of oil of turpentine (see page 323)
Oleum Terebinthinæ Rectificatum Rectified Oil of Turpentine	For process see below

OLEUM TEREBINTHINÆ RECTIFICATUM. U.S. Rectified Oil of Turpentine

* **Oil of Turpentine,** a convenient quantity
Solution of Sodium Hydroxide, a sufficient quantity

Shake the Oil of Turpentine thoroughly with an equal volume of Solution of Sodium Hydroxide, and introduce the mixture into a copper still connected with a well-cooled condenser. Recover about *three-fourths* of the Oil by distillation, separate the clear Oil from the water, and filter. Keep the product in well-stoppered, amber-colored bottles, in a cool place.

Rectified Oil of Turpentine should always be dispensed when oil of turpentine is required for internal use.

Official Description.—A thin, colorless liquid, which should conform to the properties and tests given under *Oleum Terebinthinæ*.
Specific Gravity.—0.860 to 0.865 at 25° C. (77° F.).
Test for Identity.—If about 10 Cc. of the Oil be evaporated in a dish on a water-bath, no weighable residue should be left.

Uses.—It is used as a stimulant, diuretic, and anthelmintic, and may be given in the dose of fifteen minims (1 Cc.). The object of this preparation is merely to provide a purer form of oil for internal use.

Official Preparation

Emulsum Olei Terebinthinæ Emulsion of Oil of Turpentine	Made by emulsifying 15 Cc. of rectified oil of turpentine and 5 Cc. of expressed oil of almond with the aid of 15 Gm. of acacia, 25 Cc. of syrup, and enough water to make 100 Cc. Dose, one fluidrachm (4 Cc.)

TEREBENUM. U.S. Terebene

A liquid consisting of dipentene and other hydrocarbons, obtained by the action of concentrated sulphuric acid on oil of turpentine and subsequent rectification with steam.

Terebene should be kept in well-stoppered bottles, in a cool place, protected from light.

Terebene is made by acting on oil of turpentine with sulphuric acid.

Official Description.—A colorless, thin liquid.
Odor and Taste.—Rather agreeable, thyme-like odor; aromatic, somewhat terebinthinate taste.
Specific Gravity.—From 0.860 to 0.865 at 25° C. (77° F.).
Solubility.—*Water.* Only slightly soluble.
Alcohol. Soluble in three times its volume of alcohol.
Tests for Identity.—It boils from 160° to 170° C. (320° to 338° F.).
On exposure to light and air, Terebene gradually becomes resinified, and acquires an acid reaction
Impurities and Tests for Impurities.—*Acids.* Terebene should possess its characteristic agreeable odor, and should not redden moistened blue litmus paper.
Unaltered oil of turpentine. It should be completely inactive toward polarized light.
More than traces of resinous substances. If about 10 Cc. of Terebene be evaporated in a porcelain dish, on a water-bath, not more than a slight residue should be left.

Uses.—Terebene is a valuable stimulating expectorant, given in capsules or emulsion in doses of eight to sixty minims (0.5 to 4 Cc.) during the day.

TERPINI HYDRAS. U.S. Terpin Hydrate

$C_{10}H_{20}O_2 + H_2O = 188.74$

The hydrate [$C_{10}H_{18}(OH)_2 + H_2O$] of the diatomic alcohol terpin. Terpin Hydrate should be kept in well-stoppered bottles.

Terpin hydrate is made by acting on a mixture of oil of turpentine and alcohol with nitric acid; after standing three or four days the crystals which form are purified by recrystallization.

Official Description.—Colorless, lustrous, rhombic prisms; permanent in the air.
Odor, Taste, and Reaction.—Nearly odorless; slightly aromatic and somewhat bitter taste. Its hot, aqueous solution should not redden blue litmus paper.
Solubility.—*Water.* In about 200 parts at 25° C. (77° F.), and in 32 parts of boiling water.
Alcohol. In 10 parts at 25° C. (77° F.), and in 2 parts of boiling alcohol.
Other solvents. In about 100 parts of ether, 200 parts of chloroform, or 1 part of boiling glacial acetic acid.
Tests for Identity.—Terpin Hydrate melts when quickly heated at 116° to 117° C. (240.8° to 242.6° F.), with the loss of water, and, at the temperature of boiling water, sublimes in fine needles.
When heated in a flask adapted for distillation, it first loses water. At 258° C. (496.4° F.) anhydrous terpin distils over without decomposition, soon solidifying to a crystalline, hygroscopic mass, which melts at 102° to 105° C. (215.6° to 221° F.). When strongly heated on platinum foil, it burns with a bright, smoky flame, leaving no residue.
If to its hot, aqueous solution a few drops of sulphuric acid be added, the liquid will become turbid and develop a strongly aromatic odor.
Terpin Hydrate should not have the odor of turpentine.

Uses.—Terpin hydrate is used in bronchitis, in doses of two or three grains (0.125 to 0.2 Gm.).

RESINA. U.S. Rosin

[COLOPHONY RESIN]

The residue left after distilling off the volatile oil from turpentine.
Resin consists of abietic anhydride, which passes into abietic acid when treated with diluted alcohol.
Usually in sharp, angular fragments, translucent, amber-colored, usually covered with a yellowish dust; at ordinary temperatures brittle, pulverizable; fracture shiny and shallow-conchoidal; odor and taste faintly terbinthinate.
The specific gravity of Rosin is 1.070 to 1.080; it is easily fusible, and burns with a dense yellowish smoke, yielding no appreciable ash; soluble in alcohol, ether, benzene, carbon disulphide, acetic acid, fixed or volatile oils, and in solutions of potassium or sodium hydroxide; acid number not less than 150. (See U. S. P. Test No. 98, Chap. LXII.)

Uses.—It is used to give adhesiveness to unofficial plasters, and in cerates and ointments, as in cantharides cerate and in the following:

Official Preparations

Ceratum Resinæ Rosin Cerate	Made by melting together 350 Gm. of rosin, 150 Gm. of yellow wax, and 500 Gm. of lard. (See Cerata)
Ceratum Resinæ Compositum Compound Rosin Cerate	Made by melting together 225 Gm. each of rosin and yellow wax, 300 Gm. of prepared suet, and 115 Gm. of turpentine, and adding 135 Gm. of linseed oil and stirring until cold. (See Cerata)

TEREBINTHINA CANADENSIS. U.S. Canada Turpentine

[BALSAM OF FIR CANADA BALSAM]

A liquid oleoresin obtained from *Abies balsamea* (Linné) Miller (Fam. *Coniferæ*).

Canada turpentine contains resin, is associated with a terpene, $C_{10}H_{16}$, and a small quantity of a bitter principle.

Official Description.—Viscid, pale yellowish or greenish-yellow, transparent.
Odor and Taste.—Odor agreeable; taste terbinthinate, bitter, and slightly acrid.
Solubility.—*Other solvents.* Completely soluble in ether, chloroform, or benzene.
Tests for Identity.—When exposed to the air, Canada Turpentine gradually dries and forms a transparent varnish; it solidifies on being mixed with 20 percent. of its weight of magnesium oxide previously moistened with water.

Uses.—It is used principally as an external application and for mounting microscopic objects. It is an ingredient in flexible collodion.

MASTICHE. U. S. Mastic

A concrete resinous exudation from *Pistacia Lentiscus* Linné (Fam. *Anacardiaceæ*).

In subglobular, lenticular, elongated or pear-shaped tears, about 3 Mm. in diameter, pale yellow or greenish-yellow, transparent, having a glass-like lustre, the surface sometimes very slightly dusty; brittle, becoming plastic when chewed; odor slight, balsamic; taste mild, terebinthinate.

Mastic is completely soluble in ether and almost completely soluble in alcohol. The acid number should not be less than 65 (see U. S. P. Test No. 98, Chap. LXII).

Mastic contains a resin (mastichic acid, $C_{20}H_{32}O_2$), which is soluble in strong alcohol; also masticin, a resinous principle which is insoluble in alcohol; a small quantity of volatile oil is likewise present. It is used in pills of aloes and mastic to modify the action of the aloes; in the arts it is employed to form a varnish. Dose, thirty grains (2 Gm.).

ASAFŒTIDA. U. S. Asafetida

A gum-resin obtained from the root of *Ferula fœtida* (Bunge) Regel, and probably other species of *Ferula* (Fam. *Umbelliferæ*).

In irregular masses composed of tears of variable size embedded in a yellowish-brown or reddish-brown matrix; when fresh, the tears are tough, yellowish-white and translucent, or milky-white and opaque, changing gradually on exposure to pinkish and finally reddish-brown; the freshly fractured surface becomes greenish on the application of a few drops of a 40 percent. nitric acid solution; becoming hard and brittle by drying; odor persistent, alliaceous; taste bitter, alliaceous, and acrid.

When triturated with water, Asafetida yields a milk-white emulsion which becomes yellowish on the addition of ammonia water. Not less than 50 percent. should dissolve in alcohol. When incinerated, Asafetida should yield not more than 15 percent. of ash.

A volatile oil is found containing sulphides in this gum resin, also about 20 percent. of gum, and 70 percent. of resin. The gum is partially soluble in water; the resin is soluble in alcohol, and yields resorcinol by treatment with potassium hydroxide, and umbelliferone by dry distillation. The asafetida which reaches this country is usually grossly adulterated. The valuable principles in asafetida are soluble in alcohol; with water an emulsion may be formed, which possesses its virtues.

Uses.—It is used as an antispasmodic. Dose, four grains (0.25 Gm.).

Official Preparations

Emulsum Asafœtidæ Emulsion of Asafetida	Made by rubbing 40 Gm. of asafetida with 1000 Cc. of water (see page 302). Dose, half a fluidounce (16 Cc.)
Tinctura Asafœtidæ Tincture of Asafetida	Made by macerating 200 Gm. of asafetida with 750 Cc. of alcohol, and adding sufficient alcohol to make 1000 Cc. (see page 344)
Pilulæ Asafœtidæ Pills of Asafetida	Each pill contains about 3 grains of asafetida and 1 grain of soap

MYRRHA. U. S. Myrrh

A gum-resin obtained from *Commiphora Myrrha* (Nees) Engler (Fam. *Burseraceæ*).

In roundish or irregular tears or masses, dusty, brownish-yellow or reddish-brown; fracture waxy, somewhat splintery, translucent on the edges, sometimes marked with whitish veins; odor balsamic; taste aromatic, bitter and acrid.

When triturated with water, Myrrh yields a brownish-yellow emulsion; with alcohol it yields a brownish-yellow tincture which acquires a purplish-red tint on the addition of nitric acid.

It does not swell or dissolve in water.

Myrrh is a gum resin, and contains 3 percent. of an oxygenated volatile oil, a bitter principle, and about 30 percent. of gum and 60 percent. of resin. Alcohol is the best solvent for the oil and resin, which are its active principles. The gum left after macerating myrrh in alcohol may be used for making a good mucilage. It is used in compound iron mixture, pills of aloes and myrrh, compound pills of rhubarb, and in tincture of aloes and myrrh, etc.

Uses.—Myrrh is stimulant, and vulnerary. Dose, eight grains (0.5 Gm.).

Official Preparation

Tinctura Myrrhæ Tincture of Myrrh	Made by macerating 200 Gm. of myrrh with alcohol to obtain 1000 Cc. (see page 358). Dose, fifteen minims (1 Cc.)

ELASTICA. U. S. Rubber

[India Rubber]

The prepared milk-juice of several species of *Hevea* Aublet (Fam. *Euphorbiaceæ*), known in commerce as Para Rubber.

Rubber was first introduced into the U. S. P. 1890. Its solution in purified benzin and carbon disulphide is used in making mustard paper. Rubber is not used in medicine officially. The milky juice of the plants by combination with sulphur furnishes ordinary soft rubber; this, upon heating, becomes hard rubber.

Official Description.—In flask-shaped or roundish masses, or in pieces of the same having sharply incised surfaces and exhibiting a laminated structure; floating on water; externally brownish to brownish-black; internally of a lighter tint, mottled.

Odor and Taste.—Odor creosote-like; nearly tasteless.

Solubility.—*Water.* Pure Para Rubber is insoluble in water.

Other solvents. Insoluble in dilute acids, or dilute solutions of the alkalies; soluble in chloroform, carbon disulphide, oil of turpentine, petroleum benzin, and benzene.

Test for Identity.—When heated to about 125° C. (257° F.) it melts, remaining soft and adhesive after cooling.

GUAIACUM. U. S. Guaiac

[GUAIACI RESINA, PHARM. 1890 GUAIAC RESIN]

The resin of the wood of *Guaiacum officinale* Linné, or of *Guaiacum sanctum* Linné (Fam. *Zygophyllaceæ*).

Usually in irregular masses; externally greenish-gray brown; brittle, the fracture having a glassy lustre, in recent Guaiac yellowish-green or reddish-brown; transparent in thin splinters; fusible; odor balsamic; taste slightly acrid.

The powder is grayish, turning green on exposure to air.

Not more than 15 percent. of Guaiac is insoluble in alcohol, and the alcoholic solution becomes blue on the addition of tincture of ferric chloride; acid number not less than 70 nor more than 80; ash not more than 4 percent. The filtrate obtained on macerating the powder with 4 or 5 times its weight of petroleum benzin should be colorless, and should not give a green color on the addition of an equal volume of solution (1 in 1000) of cupric acetate (absence of *rosin*).

This resin is usually prepared by boiling guaiac chips in salt water; the resinous scum is collected, melted, and strained. It consists of *guaiacic acid* ($C_{12}H_{16}O_6$), *guaiaconic acid* ($C_{19}H_{20}O_5$), *guaiaretic acid* ($C_{20}H_{26}O_4$), beta resin, gum, etc. Alcohol and alkaline solutions are the best solvents for guaiac. A solution of guaiac resin is colored blue by oxidizing agents, due to the presence of guaiaconic acid.

Uses.—Guaiac is used as a remedy in rheumatism in doses of fifteen grains (1 Gm.).

Official Preparations

Tinctura Guaiaci Tincture of Guaiac	Made by macerating 200 Gm. of guaiac in alcohol for three days, filtering, and adding sufficient alcohol to make 1000 Cc. (see page 353). Dose, one to two fluidrachms (4 to 8 Cc.)
Tinctura Guaiaci Ammoniata Ammoniated Tincture of Guaiac	Made by macerating 200 Gm. of guaiac in aromatic spirit of ammonia to obtain 1000 Cc. (see page 353). Dose, one-half to two fluidrachms (2 to 8 Cc.)

BALSAMUM TOLUTANUM. U.S. Balsam of Tolu

A balsam obtained from *Toluifera Balsamum* Linné (Fam. *Leguminosæ*).

Balsam of tolu contains *cinnamic* and *benzoic acids*, resins, a volatile oil called *benzyl benzoate*, $C_7H_5(C_7H_7)O_2$, *benzyl cinnamate*, a terpene, $C_{10}H_{16}$, termed *tolene*, and other unimportant constituents.

Official Description.—A yellowish-brown, plastic solid, becoming brittle when old, dried, or exposed to cold. It is transparent in thin layers.

Odor and Taste.—Pleasant, aromatic odor, recalling that of vanilla; mild, aromatic taste.

Solubility.—*Water.* Nearly insoluble.

Alcohol. Readily, the solution showing an acid reaction.

Other solvents. In chloroform and solutions of the fixed alkalies; almost completely in ether, but nearly insoluble in petroleum benzin; partially in carbon disulphide.

Impurities and Tests for Impurities.—*Rosin.* If 0.5 Gm. of the Balsam be shaken with 25 Cc. of carbon disulphide and allowed to stand for thirty minutes, and the liquid then filtered, the residue obtained by evaporating the filtrate to dryness, when dissolved in glacial acetic acid, should not yield a green color on the addition of a few drops of sulphuric acid.

Rosin and copaiba. If 1 Gm. of the Balsam be shaken with 8 Cc. of petroleum benzin for five minutes, the supernatant liquid should not be colored green when shaken with an equal volume of an aqueous solution of copper acetate (1 in 1000).

Limit of acidity. If to 1 Gm. of the Balsam dissolved in 50 Cc. of alcohol, 1 Cc. of phenolphthalein T.S. be added, not less than 4 Cc. nor more than 6 Cc. of half-normal alcoholic potassium hydroxide V.S. should be required to produce a red color.

Limit of saponifiable substances. If to this liquid more half-normal alcoholic potassium hydroxide V.S. be added, until the total amount has reached exactly 20 Cc., and the liquid heated in a water-bath for half an hour, and allowed to cool, then not less than 13.2 Cc. nor more than 14.5 Cc. of half-normal sulphuric acid V.S. should be required to neutralize the excess of potassium hydroxide V.S., phenolphthalein T.S. being used as indicator.

Uses.—It is used as a stimulant and expectorant in doses of fifteen grains (1 Gm.); also as a pill coating in the pills of ferrous iodide and phosphorus and in the following:

Official Preparations

Tinctura Tolutana Tincture of Tolu	Made by dissolving 200 Gm. of balsam of tolu in enough alcohol to make 1000 Cc. (see page 365). Dose, thirty minims (2 Cc.)
Syrupus Tolutanus Syrup of Tolu	Made by triturating 50 Cc. of tincture of tolu with 10 Gm. of magnesium carbonate and 60 Gm. of sugar, treating the moist powder with 450 Cc. of water, filtering, dissolving 760 Gm. of sugar in the filtrate, and adding enough water to make 1000 Cc. (see page 298)

BALSAMUM PERUVIANUM. U.S. Balsam of Peru

A balsam obtained from *Toluifera Pereiræ* (Royle) Baillon (Fam. *Leguminosæ*).

Balsam of Peru contains *cinnamic* and *benzoic acids*, *benzyl cinnamate*, $C_9H_7(C_7H_7)O_2$, resin, *benzyl benzoate*, stilbene, etc.

Official Description.—A viscid liquid of a dark brown color; free from stringiness or stickiness; transparent and reddish-brown in thin layers. It does not harden on exposure to the air.

Odor, Taste, and Reaction.—Agreeable vanilla-like odor; bitter, acrid taste, with a persistent after-taste. When swallowed, it leaves a burning sensation in the throat. Water, when agitated with the Balsam, shows an acid reaction.

Specific Gravity.—1.140 to 1.150 at 25° C. (77° F.).

Solubility.—*Alcohol.* In 5 parts, with not more than a slight opalescence; completely in absolute alcohol.

Other solvents. Completely in chloroform and glacial acetic acid; only partially in ether and petroleum benzin.

Impurities and Tests for Impurities.—*Fixed oils.* If 10 drops of the Balsam be triturated with 20 drops of sulphuric acid, a tough, homogeneous, brownish-red mass should result, which, when washed with cold water, should develop a violet color upon its surface, and, when drained, be converted into a brittle, resinous mass.

Rosin. If 1 Gm. of the Balsam be shaken with 5 Cc. of petroleum benzin, the mixture warmed on a water-bath for ten minutes, and a sufficient quantity of the solvent added to replace loss by evaporation, then if 2 Cc. of the benzin solution be evaporated, and treated with a drop of nitric acid (sp. gr. 1.42), a permanent green or bluish-green color should not be produced.

Rosin, turpentine, storax, fatty oils, etc. The remaining 3 Cc. of the benzin solution when shaken with an equal volume of an aqueous solution of copper acetate (1 in 1000) should not be colored green or bluish-green.

Rosin, storax, or copaiba. On mixing the Balsam with half its volume of calcium hydroxide and heating for half an hour on a water-bath, a solid mass should not be formed.

Limit of acid resins. If 1 Gm. of the Balsam be dissolved in 100 Cc. of alcohol and 1 Cc. of phenolphthalein T.S. be added, not more than 2 Cc. of half-normal alcoholic potassium hydroxide should be required to produce a pink color.

Quantitative Test.—Mix 3 Gm. of the Balsam with 30 Cc. of sodium hydroxide T.S. and shake the mixture for a few minutes with 60 Gm. of ether. Transfer 51.5 Gm. of the ether solution to a flask and evaporate to dryness. The residue, when dried to constant weight by a gentle heat, should weigh not less than 1.4 Gm. (presence of at least 56 per cent. of *cinnamein*). If this residue be dissolved in 25 Cc. of alcohol, then mixed with 25 Cc. of half-normal alcoholic potassium hydroxide V.S., and heated carefully during half an hour on a water-bath, it should require not more than 13.2 Cc. of half-normal hydrochloric acid V.S. to exactly neutralize the liquid, 1 Cc. of phenolphthalein T.S. being used as indicator.

Uses.—Balsam of Peru is very apt to be adulterated. It is used as a preservative for fats, ointments, etc.; internally, it is stimulant and aromatic. Dose, fifteen grains (1 Gm.).

BENZOINUM. U.S. Benzoin

A balsamic resin obtained from *Styrax Benzoin* Dryander, and another unidentified species of *Styrax* (Fam. *Styraceæ*).

In pebble-like bodies or tears, mostly 0.5 to 5 Cm. long and about one-fourth as thick, slightly flattened, straight or curved, yellowish- to rusty-brown externally, milky-white on fresh fracture, separate or very slightly agglutinated (Siam Benzoin), or embedded in a dry resinous mass, which varies from reddish-brown to reddish-gray or grayish-brown; opaque or slightly translucent and more or less lustrous (Sumatra Benzoin); brittle, becoming soft on warming, and yielding benzoic acid on sublimation; odor agreeable, balsamic (vanilla-like in the Siam variety); taste slightly acrid.

Benzoin is almost wholly soluble in 5 parts of warm alcohol, the solution showing an acid reaction to blue litmus paper; soluble in solutions of sodium or potassium hydroxide. It should not, on incineration, yield more than 2 percent. of ash.

Benzoin contains benzoic acid, cinnamic acid ($C_9H_8O_2$), a fragrant volatile oil, and resins. In some varieties vanillin is found. Alcohol is the best solvent for its active principles.

Uses.—It is a valuable stimulant and expectorant. Dose, fifteen grains (1 Gm.).

Official Preparations

Adeps Benzoinatus Benzoinated Lard	Made by digesting 20 Gm. of benzoin in 1000 Gm. of melted lard, straining through muslin, and stirring occasionally while cooling
Tinctura Benzoini Tincture of Benzoin	Made by macerating 200 Gm. of Benzoin in alcohol to obtain 1000 Cc. (see page 345). Dose, fifteen minims (1 Cc.)
Tinctura Benzoini Composita Compound Tincture of Benzoin	Made by macerating 100 Gm. benzoin, 20 Gm. purified aloes, 80 Gm. storax, and 40 Gm. balsam of tolu in alcohol to obtain 1000 Cc. (see page 346). Dose, thirty minims (2 Cc.)

STYRAX. U.S. Storax

A balsam obtained from the wood and inner bark of *Liquidambar orientalis* Miller (Fam. *Hamamelidaceæ*).

Storax contains cinnamic acid, benzoic acid, *styracin*, $C_9H_7(C_9H_9)O_2$, *storesin*, $C_{36}H_{58}O_3$, *ethyl cinnamate*, $C_9H_7(C_2H_5)O_2$, *phenyl-propyl cinnamate*, $C_9H_7(C_9H_{17})O_2$, *styrol*, C_8H_8, a fragrant hydrocarbon, and a resinous substance not yet investigated. A large quantity of water is usually present.

Official Description.—A semi-liquid, grayish, sticky, opaque mass, depositing, on standing, a heavy, dark brown stratum; transparent in thin layers.

Odor and Taste.—Agreeable odor; balsamic taste.

Solubility.—*Water.* Insoluble.

Alcohol. Completely soluble (with the exception of accidental impurities) in an equal weight of warm alcohol.

Tests for Identity.—If the alcoholic solution, which has an acid reaction, be cooled, filtered, and evaporated, it should leave not less than 60 percent. of the original weight of the balsam, in the form of a brown, semi-liquid residue almost completely soluble in ether and in carbon disulphide, but partially soluble in petroleum benzin.

When heated on a water-bath Storax becomes more fluid, and if it be then agitated with warm petroleum benzin, the supernatant liquid, on being decanted and allowed to cool, will be colorless, and will deposit white crystals of cinnamic acid and cinnamic esters.

Uses.—Storax is used in compound tincture of benzoin. It is stimulant and expectorant. It may be used, like benzoin, to protect fatty substances from rancidity. Dose, fifteen grains (1 Gm.).

ACIDUM BENZOICUM. U.S. Benzoic Acid

$HC_7H_5O_2 = 121.13$

An organic acid [$C_6H_5.COOH$], obtained from benzoin by sublimation, or prepared artificially. It should be kept in dark amber-colored, well-stoppered bottles, in a cool place.

Preparation.—Benzoic acid is found naturally in benzoin, balsam of tolu, balsam of Peru, gum acroides, storax, and other resinous substances. It may be obtained from these by the process described on page 162; but, owing to the small yield afforded in this way, commercial benzoic acid is made artificially in several ways:

1. From the urine of cattle, by mixing it with lime in excess, evaporating and decomposing the lime hippurate with hydrochloric acid. The separated hippuric acid, after purification with animal charcoal, is treated with hydrochloric acid, when benzoic acid and *glycocine* are produced, the hydrochloric acid not being decomposed.

$$\underset{\text{Hippuric Acid}}{C_9H_9NO_3} + \underset{\text{Water}}{H_2O} = \underset{\text{Benzoic Acid}}{C_7H_6O_2} + \underset{\text{Glycocine}}{C_2H_5NO_2}$$

The benzoic acid is sometimes sublimed with benzoin to mask its disagreeable odor and imitate the acid sublimed from benzoin.

2. Benzoic acid may be made from *naphthalene*, $C_{10}H_8$, which, on treatment with nitric acid, yields *phthalic acid;* this, when heated with excess of calcium hydroxide, yields calcium benzoate and carbonate. The calcium benzoate is treated with hydrochloric acid and the benzoic acid is precipitated.

3. Benzoic acid is also largely made from toluene, C_7H_8, a coal tar hydrocarbon. Benzotrichloride is first formed, and this when heated with water in close vessels yields benzoic acid.

$$\underset{\text{Benzotrichloride}}{C_6H_5.CCl_3} + \underset{\text{Water}}{2H_2O} = \underset{\text{Benzoic Acid}}{C_6H_5.COOH} + \underset{\text{Hydrochloric Acid}}{3HCl}$$

Official Description.—White, or yellowish-white, lustrous scales or friable needles: somewhat volatile at a moderately warm temperature, and acquiring a yellow color on exposure to light.

Odor, Taste, and Reaction.—Nearly odorless, or having a slight characteristic odor resembling that of benzoin; acid, pungent taste; acid reaction.

Solubility.—*Water.* In 281 parts at 25° C. (77° F.); in 15 parts of boiling water.

Alcohol. In 1.8 parts at 25° C. (77° F.); in 1 part of boiling alcohol.

Other solvents. In 3 parts of ether, 7 parts of chloroform; readily in carbon disulphide, benzene, fixed and volatile oils; sparingly in petroleum benzin.

Tests for Identity.—Benzoic Acid volatilizes freely with the vapor of water. On heating it to 100° C. (212° F.) it begins to sublime. From 120° to 122° C. (248° to 251.6° F.) it melts, and at a higher temperature it is consumed without leaving a residue.

The acid sublimed from benzoin has a lower melting point, and a greater solubility in water, than that prepared artificially.

On heating Benzoic Acid gradually with 3 parts of freshly slaked lime in a dry test-tube, benzene is evolved.

Benzoic Acid is freely soluble in solutions of alkali hydroxides. On carefully neutralizing such a solution, and adding ferric chloride T.S., previously diluted with 2 volumes of water, and neutralized, if necessary, by ammonia water, a flesh-colored precipitate of ferric benzoate is produced.

Impurities and Tests for Impurities.—*Readily carbonizable, organic matters.* A solution of Benzoic Acid in pure, cold sulphuric acid, when gently warmed, should not turn darker than light brown; if it is then poured into water, the Benzoic Acid should separate as a white precipitate, and the liquid should be colorless.

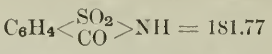
More than traces of chlorine. If 0.5 Gm. of the Acid and 0.8 Gm. of calcium carbonate be mixed with a little distilled water in a crucible, the mixture dried, gently ignited, and then dissolved in 20 Cc. of distilled water, with the aid of nitric acid in slight excess, and filtered, the addition of silver nitrate T.S. should not produce much more opalescence than is produced by the same quantity of the same reagent in a solution measuring 20 Cc., prepared by dissolving 0.8 Gm. of the same calcium carbonate in distilled water with the aid of nitric acid.

Cinnamic acid. On warming 0.5 Gm. of the Acid with 5 Cc. of water, and 0.5 Gm. of potassium permanganate in a test-tube, loosely stoppered, and placing it in a water-bath heated to about 45° C. (113° F.) for about ten minutes, then tightly stoppering, and cooling the test-tube with cold water, upon removing the stopper, no odor of oil of bitter almond should be discernible.

Uses.—This acid is useful in forming *benzoates*, a class of salts which have been employed frequently during the last few years. It is stimulant, expectorant, and irritant to the mucous membranes. Dose, ten grains (0.6 Gm.), administered in thick mucilage or syrup.

BENZOSULPHINIDUM. U.S. Benzosulphinide Saccharin

[GLUSIDUM SACCHARINE]



$$C_6H_4<\begin{matrix}SO_2\\CO\end{matrix}>NH = 181.77$$

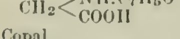
The anhydride of ortho-sulphamide-benzoic acid (benzol sulphonicimide).

Saccharin, as it is commercially named, is made from the coal tar product, toluene, by converting it into toluene-sulphonic chloride. This is treated with ammonia, whereby the sulphamide is formed, which by oxidation is converted into the sulphinide, saccharin being the anhydride of ortho-sulphamide-benzoic acid. The official name (benzosulphinide) is a contraction, but it is probable that the name saccharin will always be used.

Official Description.—A white, crystalline powder.
Odor and Taste.—Nearly odorless; intensely sweet taste even in dilute solutions.
Solubility.—*Water.* In 250 parts at 25° C. (77° F.); in 24 parts at 100° C. (212° F.).
Alcohol. In 25 parts at 25° C. (77° F.).
Other solvents. Slightly in ether or chloroform at 25° C. (77° F.) It is easily soluble in ammonia water, in alkali hydroxide solutions, and in a solution of sodium bicarbonate, with the evolution of carbon dioxide.
Impurities and Tests for Impurities.—*Inorganic impurities.* Heated between 219° and 220° C. (426.2° and 428° F.) it melts, and at higher temperatures burns with an odor of oil of bitter almond, without leaving a weighable residue.
Carbohydrates. If 0.2 Gm. of Benzosulphinide be dissolved with agitation in 10 Cc. of pure sulphuric acid, and the solution kept at a temperature of from 48° to 50° C. (118.4° to 122° F.), on a water-bath, it should not, within ten minutes, show a brown color.
Glucose. If 0.2 Gm. of Benzosulphinide be dissolved in 5 Cc. of potassium hydroxide T.S., the solution should be clear, and not become colored, even on prolonged heating.
Glucose or milk-sugar. A similar solution mixed with 5 Cc. of alkaline cupric tartrate V.S. should not, on heating, deposit any red cuprous oxide.
Benzoic or salicylic acids. If to a hot aqueous solution of Benzosulphinide, ferric chloride T.S. be added, drop by drop, no precipitation or violet color should appear.

Uses.—Benzosulphinide is used for sweetening various products. It is said to have nearly three hundred times the sweetening power of sugar. It is given in diabetes, but its use is not without some danger. The dose is three grains (0.2 Gm.).

Unofficial Products from Oils and Substances containing Resins

Alkanet	The root of *Anchusa tinctoria.* Used exclusively for coloring oils, ointments, and plasters, which are beautifully reddened by $\frac{1}{40}$ of their weight of the root
Ammoniacum Ammoniac. U. S. P. 1890	A gum-resin obtained from *Dorema Ammoniacum* Don (Fam. Umbelliferæ). It contains 25 percent. gum, 70 percent. resin, and about 3 percent. volatile oil. It is expectorant and stimulant. Dose, fifteen grains (1 Gm.)
Annatto	A coloring substance, consisting of the pulp which surrounds the seeds in the fruit of *Bixa Orellana.* Used for coloring cheese and butter, and for dyeing silk and cotton orange-yellow
Bdellium Bdellium	From *Balsamodendron Mukul*, grown in India. It contains volatile oil and resin
Benzoyl Glycocoll,  $CH_2<\begin{matrix}NH.C_7H_5O\\COOH\end{matrix}$	The dose of benzoyl glycocoll, or *sodium hippurate*, is ten grains (0.6 Gm.) three times a day
Copal	A resinous substance, brought principally from the East Indies. Used for making varnish
Doundaké	An astringent and tonic febrifuge
Elemi Elemi	From *Cannarium commune*, grown in the Philippine Islands. It contains 10 percent. of volatile oil, $C_{10}H_{16}$, and 25 percent. of resin
Euphorbium Euphorbium	From *Euphorbium resinifera*, found in Morocco. It contains 18 percent. of gum and 38 percent. of resin, etc.
Galbanum Galbanum	From *Ferula galbaniflua.* It contains 8 percent. of volatile oil and 85 percent. of resin. Dose, fifteen grains (1 Gm.)
Guaiaci Lignum Guaiacum Wood. U. S. P. 1890	The heart-wood of *Guaiacum officinale* Linné, and of *G. sanctum* Linné (Fam. Zygophyllaceæ). It contains about 25 percent. of resin, and is used as an antirheumatic and alterative in doses of thirty grains (2 Gm.)

Unofficial Products from Oils and Substances containing Resins—*Continued*

Gurjun Wood Oil	From *Dipterocarpus turbinatus.* It contains about 40 percent. of volatile oil and resin
Gutta-Percha Gutta-Percha	From *Isonandra Gutta.* Its solution in chloroform was formerly official
Hippuric Acid, $(C_9H_9NO_3)$	Suggested as a remedy in the uric acid diathesis
Labdanum Ladanum	A stimulant expectorant. At present used only in plasters
Lac Lacca	A reddish-brown resin. Formerly used in medicine, but at present chiefly for making varnish; also in making sealing wax
Liquidambar Styraciflua (Copalm Balsam)	Stimulant and expectorant. The bark of the tree is astringent, and is used in diarrhœa and dysentery, especially for children, given in the form of a syrup
Olibanum Frankincense	From several species of *Boswellia,* found in Africa. It contains 6 percent. of volatile oil and 56 percent. of resin
Pix Burgundica Burgundy Pitch. U. S. P. 1890	The prepared resinous exudation of *Abies excelsa* Poiret (Fam. Coniferæ). Used in making plasters
Pix Canadensis Canada Pitch	From *Abies canadensis.* Used in making plasters
Resina Draconis Dragon's Blood	The resin from the fruit of *Calamus Draco.* It contains a peculiar resin, $C_{20}H_{20}O_2$, etc.
Retinol	A yellowish oil, boiling at 280° C. Mildly antiseptic. Good solvent of phosphorus
Sagapenum	Stimulant, antispasmodic. Dose, ten to thirty grains (0.6 to 2 Gm.). Used also externally in plasters as a discutient
Sandarach Gum Juniper	Used chiefly as a varnish and as incense. Formerly given internally, and used in ointments and plasters
Succinum Amber	Contains succinic acid, and a volatile oil which is stimulant and antispasmodic, or rubefacient when applied externally
Terpinol, $(C_{10}H_{16})_2 + H_2O$	Derivative of oil of turpentine. In colorless crystals. Dose, three to four grains (0.2 to 0.26 Gm.)
Viscum Album Mistletoe	Oxytocic. Dose, a fluidrachm (4 Cc.) of the fluidextract

Eclectic Resinoids

These so-called active principles are made by adding a concentrated alcoholic tincture of the drug to a large quantity of water, and collecting the precipitate. They are largely used by the eclectic practitioners, and vary greatly in properties and effects. *They must not be confounded with true active principles,* although the names are often exactly the same; this fact often leads to annoyance in dispensing, and has been the cause of dangerous mistakes. A list of the *resinoids* most frequently used is appended.

Alnuin	From the bark of *Alnus rubra.* The dose is about one to three grains (0.065 to 0.2 Gm.)
Ampelopsin	From the branches and bark of *Ampelopsis quinquefolia.* The dose is from two to eight grains (0.125 to 0.5 Gm.)
Apocynin	From the root of *Apocynum androsæmifolium.* It yields about one ounce of apocynin from two pounds of drug. The dose is from one-half to two grains (0.03 to 0.125 Gm.)
Asclepidin	From the root of *Asclepias tuberosa.* The dose is from one to five grains (0.065 to 0.3 Gm.)
Baptisin	From the root of *Baptisia tinctoria.* It is of a yellowish-brown color. The dose is from one-third to one grain (0.022 to 0.065 Gm.)
Barosmin	From the leaves of *Barosma betulina* and other species. The dose is from one to four grains (0.065 to 0.26 Gm.)
Caulophyllin	From the root of *Caulophyllum thalictroides.* It yields about 12 percent. of caulophyllin. The dose is from one-quarter to one grain (0.016 to 0.065 Gm.)
Ceanothin	From the root of *Ceanothus americanus.*
Cerascin	From the bark of *Cerasus virginiana.* The dose is from five to ten grains (0.3 to 0.6 Gm.)
Chelonin	From the herb of *Chelone glabra.* The dose is from one to two grains (0.065 to 0.125 Gm.)
Chimaphilin	From the leaves of *Chimaphila umbellata.* The dose is from one to four grains (0.065 to 0.26 Gm.)
Cimicifugin	From the rhizome of *Cimicifuga racemosa.* It yields about 5 percent. It is also called Macrotin. The dose is from one to six grains (0.065 to 0.4 Gm.)

Collinsonin	From the herb of *Collinsonia canadensis*. The dose is about three grains (0.2 Gm.)
Cornin	From the bark of the root of *Cornus florida*. The dose is about five grains (0.3 Gm.)
Corydalin	From the tubers of *Dicentra canadensis*. It yields about one-half ounce of corydaline from two pounds of the tubers. The dose is from one-half to two grains (0.03 to 0.125 Gm.)
Cypripedin	From the rhizome of *Cypripedium pubescens*. The dose is about two grains (0.125 Gm.)
Dioscorein	From the root of *Dioscorea villosa*. The dose is from two to five grains (0.125 to 0.3 Gm.)
Euonymin	From the bark of *Euonymus atropurpureus*. The dose is from one-fourth to four grains (0.016 to 0.26 Gm.)
Eupatorin	From the leaves and flowering tops of *Eupatorium perfoliatum*. The dose is from two to four grains (0.125 to 0.26 Gm.)
Euphorbin	From the root of *Euphorbia corollata*. The dose is from one-half to two grains (0.03 to 0.125 Gm.)
Fraserin	From the root of *Frasera Walteri*. The dose is from one to five grains (0.065 to 0.3 Gm.)
Gelsemin	From the rhizome of *Gelsemium sempervirens*. The dose is from one-half to two grains (0.03 to 0.125 Gm.)
Hamamelin	From the root of *Hamamelis virginiana*. The dose is about five grains (0.3 Gm.)
Helonin	From the root of *Helonias dioica*. The dose is from one-half to two grains (0.03 to 0.125 Gm.)
Hydrastin	From the rhizone of *Hydrastis canadensis*. The dose is from three to five grains (0.2 to 0.3 Gm.)
Juglandin	From the bark of the root of *Juglans cinerea*. The dose is from two to five grains (0.125 to 0.3 Gm.)
Leptandrin	From the root of *Leptandra virginica*. The dose is from two to four grains (0.125 to 0.26 Gm.)
Lupulin	From the strobiles of *Humulus Lupulus*. The dose is from five to ten grains (0.3 to 0.6 Gm.)
Lycopin	From *Lycopus virginicus*. The dose is from three to five grains (0.2 to 0.3 Gm.)
Macrotin	See Cimicifugin
Menispermin	From *Menispermum canadense*. The dose is about two grains (0.125 Gm.)
Myricin	From *Myrica cerifera*. The dose is from two to eight grains (0.125 to 0.5 Gm.)
Phytolaccin	From *Phytolacca decandra*. The dose is from one-quarter to one grain (0.016 to 0.065 Gm.)
Populin	From the bark of *Populus tremuloides*. The dose is from two to five grains (0.125 to 0.3 Gm.)
Prunin	From *Cerasus serotina*. The dose is about two grains (0.125 Gm.)
Ptelein	From the root of *Ptelea trifoliata*
Rhein	From different species of *Rheum*. The dose is from two to four grains (0.125 to 0.26 Gm.)
Rhusin	From the leaves of *Rhus glabra*. It is said to be a light brown powder
Rumin	From *Rumex crispus*. The dose is about two grains (0.125 Gm.)
Sanguinarin	From *Sanguinaria canadensis*. The dose is from one-half to two grains (0.032 to 0.125 Gm.)
Scutellarin	From the herb of *Scutellaria lateriflora*. The dose is from three to six grains (0.2 to 0.4 Gm.)
Senecin	From *Senecio gracilis*. The dose is from three to five grains (0.2 to 0.3 Gm.)
Senecionin	From *Senecio gracilis*. The dose is from one to five grains (0.065 to 0.3 Gm.)
Smilacin	From different species of *Smilax*. The dose is from two to five grains (0.125 to 0.3 Gm.)
Stillingin	From *Stillingia sylvatica*. The dose is one-half to one grain (0.032 to 0.065 Gm.)
Trillin	From *Trillium pendulum*. The dose is from three to six grains (0.2 to 0.4 Gm.)
Viburnin	From *Viburnum Opulus*. The dose is about two grains (0.125 Gm.)

CHAPTER LVIII

FIXED OILS, FATS, AND SOAPS

FIXED oils and fats are obtained from both the vegetable and the animal kingdom. They are greasy to the touch, and leave a permanent oily stain on paper; they are insoluble in water, but dissolve in ether, chloroform, carbon disulphide, benzene, petroleum benzin, oil of turpentine, and volatile oils; they usually mix with one another without separating.

When pure, they are generally colorless or have a pale yellow color; they have a distinctive odor and taste, which is often caused by impurities with which they are associated, as the process of refining deprives them of odor and taste.

When heated moderately, if solid they melt, or if liquid they become thinner; if heated strongly in air they are decomposed, evolve offensive vapors, and then burn with a sooty flame, much heat being generated. Their specific gravity varies from 0.870 to 0.985, thus being lighter than water. By exposure to air they acquire an acrid, disagreeable taste and become acid to litmus paper. This change, termed *rancidity*, is believed to be due to the presence of impurities (like albuminous substances), which act as ferments, induce decomposition, liberate the fatty acids, and produce volatile, odorous acids, like caproic, caprylic, butyric, and valeric acids. Oils which have become rancid may often be purified by shaking them thoroughly with hot water and then with a cold solution of sodium carbonate, and subsequently washing them with cold water.

Chemically, the fixed oils and fats are esters of higher members of the fatty acids, the alcohol being glycerin and the radical glyceryl. In most cases they consist of two or three proximate principles,—olein, palmitin, or stearin. These are sometimes termed the glycerides of oleic, palmitic, and stearic acids. Olein is liquid, and palmitin and stearin are both solid; hence the consistence of fixed oils and fats is due to the relative proportion of these principles; thus, almond oil, being composed principally of olein, is always liquid at ordinary temperatures, while tallow, being largely stearin, is solid.

Olein, $C_3H_5(C_{18}H_{33}O_2)_3$, is the oleate of the triad radical glyceryl, and constitutes the liquid principle of oils. It is extremely difficult to obtain it pure. Being in most oils associated with the solids stearin and palmitin, it has to be separated by pressure and other mechanical means, and this is not easily effected. As ordinarily procured, therefore, olein contains more or less of palmitin or stearin, or both. It is obtained either by the agency of alcohol or by expression. When one of the oils, olive oil, for example, is dissolved in boiling alcohol, the solution, on cooling, deposits the concrete principles, retaining the olein, which it yields upon evaporation. The other method consists in compressing one of the solid fats, or of the liquid oils rendered concrete by cold, between folds of bibulous paper, which absorb the olein, and give it up afterwards by compression under water. Olein is a liquid of oily consistence, congealing at —6° C. (21.2° F.), colorless when pure, with little odor and a sweetish taste, insoluble in water, soluble in boiling alcohol and ether.

Palmitin.—Palmitic acid occurs in the more liquid fats, such as palm oil and cocoanut oil, as glyceride; while in spermaceti and some forms of wax it is combined with monatomic alcohol radicals. Palmitin is the *glyceride of palmitic acid* or *glyceryl tripalmitate.*

Stearin.—This exists abundantly in tallow and other animal fats, and it is made on an immense scale for use in candles by cooling lard and tallow, and separating the olein by hydraulic pressure. It may be obtained pure by dissolving suet in hot oil of turpentine, allowing the solution to cool, submitting the solid matter to expression in unsized paper, repeating the treatment several times, and finally dissolving in hot ether, which deposits the stearin on cooling. This is white, opaque in mass, but of a pearly appearance as crystallized from ether, pulverizable, fusible at 66.5° C. (152° F.), soluble in boiling alcohol and ether, but nearly insoluble in those liquids cold, and quite insoluble in water. It consists of glyceryl and stearic acid, as a glyceride, $C_3H_5(C_{18}H_{35}O_2)_3$, and has been formed synthetically by heating a mixture of these two materials to 280° to 300° C. (536° to 572° F.).

Margarin.—What was long known under this name was shown by Heintz, in 1852, to be a mixture of stearin and palmitin. The true *margaric acid*, $C_{17}H_{34}O_2$, has been obtained by synthesis, and according to Ebert is found in *adipocere*, a waxy substance formed in the tissues of dead animals.

Stearic acid, $C_{18}H_{36}O_2$, is a firm white solid, like wax, fusible at 69.4° C. (157° F.), greasy to the touch, pulverizable, soluble in alcohol, very soluble in ether, but insoluble in water. In the impure state it is used as a substitute for wax in making wax candles. (See Acidum Stearicum.) *Palmitic acid*, $C_{16}H_{32}O_2$, forms a white scaly mass, and melts at 62° C. (143.6° F.). *Oleic acid*, $C_{18}H_{34}O_2$, is an oily liquid, insoluble in water, soluble in alcohol and ether, lighter than water, crystallizable in needles a little below 0° C. (32° F.), and having a slight smell and a pungent taste. (See Acidum Oleicum.) *Glycerin* is described under a separate head. (See Glycerinum.)

AMYGDALA DULCIS. U.S. Sweet Almond

The ripe seed of *Prunus Amygdalus* Stokes, var. *dulcis* De Candolle (Fam. *Rosaceæ*).

Closely resembling the Bitter Almond (see *Amygdala Amara*), but usually broader, with lighter seed-coat, having a bland, sweetish taste and giving no odor of hydrocyanic acid when triturated with water.

Sweet almond contains about 40 percent. of fixed oils, protein compounds (*conglutin* and *amandin*), sugar, mucilage, etc. Tannin is present in the integuments.

The protein compounds aid in emulsionizing the fixed oil which is present, and simple trituration is all that is necessary to form a mixture.

Official Preparation

Emulsum Amygdalæ **Emulsion of Almond**	Made by blanching 60 Gm. of sweet almond, adding 10 Gm. of acacia and 30 Gm. of sugar, and triturating with 1000 Cc. of distilled water (see page 302). Dose, two to eight fluidounces (60 to 240 Cc.)

OLEUM AMYGDALÆ EXPRESSUM. U. S. Expressed Oil of Almond

A fixed oil expressed from Bitter or Sweet Almond. It should be kept in well-stoppered containers, in a cool place.

Preparation.—This oil is obtained equally pure from sweet and bitter almonds. The almonds, having been deprived of a reddish-brown powder adhering to their surface, by being rubbed together in a piece of coarse linen, are ground in a mill, and then pressed in canvas sacks between plates of steel slightly heated. The oil, which is at first turbid, is clarified by rest and filtration. Sweet almond yields about 40 percent. and bitter almond 35 percent. of fixed oil.

A colorless oil may be obtained by expressing almonds which have been *blanched,—i.e.,* deprived of their testa by soaking them in hot water and slightly pressing them, and afterwards drying in a stove to evaporate the water. The fixed oil from peach kernels is frequently sold for expressed oil of almond. While a useful product, it is not intended by the U. S. P. (8th Rev.) that it should be substituted for oil of sweet almond (see official test below).

Official Description.—A clear, pale straw-colored or colorless oily liquid.

Odor and Taste.—Almost inodorous; mild, nut-like taste.

Specific Gravity.—0.910 to 0.915 at 25° C. (77° F.).

Solubility.—*Alcohol.* Only slightly soluble.

Other solvents. In all proportions in ether, chloroform, and benzene.

Tests for Identity.—If 2 Cc. of the Oil be vigorously shaken with a mixture of 1 Cc. of fuming nitric acid and 1 Cc. of water, a whitish mixture should be formed, which, after standing for some hours at about 10° C. (50° F.), should separate into a solid, white mass and a slightly colored liquid (distinction from the fixed oils of *peach* and *apricot kernels,* which give a red color, and *sesame* and *cotton seed oils,* which are colored brown).

If 10 Cc. of the Oil be mixed with 15 Cc. of a solution of sodium hydroxide (1 in 6) and 10 Cc. of alcohol, and the mixture be allowed to stand at a temperature of 35° to 40° C. (95° to 104° F.), with occasional agitation, until it becomes clear, and if then diluted with 100 Cc. of water, the clear solution thus obtained upon the subsequent addition of an excess of hydrochloric acid will set free a layer of oleic acid. This, when separated from the aqueous liquid, washed with warm water, and clarified by heating on a water-bath, will remain liquid if cooled to 15° C. (59° F.).

One volume of this oleic acid, when mixed with 1 volume of alcohol, should yield a clear solution, which at 15° C. (59° F.) should not deposit any fatty acids, nor become turbid upon the further addition of 1 volume of alcohol (distinction from *olive, arachis, cotton seed, sesame,* and *other fixed oils*).

Impurities and Tests for Impurities.—*Olive oil or lard oil.* It should remain clear at —10° C. (14° F.), and it does not congeal until cooled to nearly —20° C. (—4° F.).

Saponification Value.—Expressed Oil of Almond, saponified by alcoholic potassium hydroxide T.S., should show a saponification value of 191 to 200 (see U. S. P. Test No. 99, Chap. LXII).

Iodine Absorption Value.—If 0.3 Gm. of Expressed Oil of Almond be dissolved in 10 Cc. of chloroform in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours protected from the light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 95 nor more than 100 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Expressed oil of almond, or *oil of sweet almond,* as it is usually called, is used as an emollient, and also as a laxative, in doses of one fluidounce (30 Cc.). It is an ingredient in emulsion of chloroform, emulsion of oil of turpentine, ointment of rose water, and veratrine ointment.

OLEUM OLIVÆ. U.S. Olive Oil

A fixed oil expressed from the ripe fruit of *Olea europæa* Linné (Fam. *Oleaceæ*). It should be kept in well-stoppered bottles, in a cool place.

Preparation.—Although pure olive oil is still found occasionally, there is good reason to believe that the so-called olive oil is mainly cotton seed oil, or other similar substitute, judiciously flavored ; it is often called *sweet oil*. Pure olive oil is made by expressing olives and clarifying the oil by subsidence ; but the detection of admixtures of other fixed oils is attended with discouraging results. The exportation of over six million gallons of cotton seed oil annually to Mediterranean ports contiguous to the olive oil industry is a significant fact. The Pharmacopœia furnishes the following tests.

Official Description.—A pale yellow or light greenish-yellow oily liquid.

Odor and Taste.—Slight, peculiar odor, and a nut-like, oleaginous taste, with a faintly acrid after-taste.

Specific Gravity.—0.910 to 0.915 at 25° C. (77° F.).

Solubility.—*Alcohol.* Very sparingly soluble.

Other solvents. Readily soluble in ether, chloroform, or carbon disulphide.

Test for Identity.—When cooled to from 8° to 10° C. (46.4° to 50° F.), the Oil becomes somewhat cloudy from the separation of crystalline particles, and at 0° C. (32° F.), it forms a whitish, granular mass.

Impurities and Tests for Impurities.—*Appreciable quantities of cotton seed oil and most other seed oils.* If 2 Cc. of Olive Oil be shaken vigorously with an equal volume of nitric acid (sp. gr. 1.37), the Oil should retain a light yellow color, not becoming orange or reddish-brown, and after standing for six hours should change into a yellowish-white solid mass and an almost colorless liquid.

More than about 5 percent. of cotton seed oil. If 5 Cc. of the Oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol and adding 2 drops of nitric acid), and the mixture be heated for about five minutes in a water-bath, the Oil should retain its original pale color, not becoming reddish or brown, nor should any dark color be produced at the line of contact of the two liquids.

Cotton seed oil. If 2 Cc. of the Oil be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, no reddish color should develop in from ten to fifteen minutes.

Sesame oil. If 2 Cc. of the Oil be mixed with 1 Cc. of hydrochloric acid (sp. gr. 1.18) containing 1 percent. of sugar, and the mixture be shaken for half a minute and allowed to stand for five minutes, and then 3 Cc. of water added and the whole again shaken, the acid layer should not show a pink color.

Saponification Value.—Olive Oil, saponified by alcoholic potassium hydroxide T.S., should show a saponification value of 191 to 195 (see U. S. P. Test No. 99, Chap. LXII).

Iodine Absorption Value.—If 0.3 Gm. of Olive Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 80 nor more than 88 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Olive oil is used in making cerates, ointments, liniments, and plasters. It is used in the official oleates of atropine, cocaine, and veratrine, and in diachylon ointment. It is a bland, agreeable oil, well suited for emollient purposes.

OLEUM GOSSYPII SEMINIS. U.S. Cotton Seed Oil

A fixed oil expressed from the seeds of *Gossypium herbaceum* Linné, or of other species of *Gossypium* (Fam. *Malvaceæ*), and subsequently purified. It should be kept in well-closed containers.

Preparation.—This oil is made commercially in the southern part of the United States upon a very large scale. The seeds contain 15 percent. of oil.

The testa of the seeds is first separated, and the kernels are exposed to powerful expression in hydraulic presses.

Official Description.—A pale yellow, oily liquid.

Odor and Taste.—Without odor, and having a bland, nut-like taste.

Specific Gravity.—0.915 to 0.921 at 25° C. (77° F.).

Solubility.—*Alcohol.* Very sparingly soluble.

Other solvents. Readily in ether, chloroform, or carbon disulphide.

Tests for Identity.—On cooling the Oil to a temperature below 12° C. (53.6° F.), particles of solid fat will separate. At about 0° to —5° C. (32° to 23° F.), the Oil becomes nearly or quite solid.

If sulphuric acid (specific gravity 1.6 to 1.7) be added to the Oil, preferably diluted with carbon disulphide, a reddish-brown color is rapidly produced.

If 6 Gm. of the Oil be thoroughly shaken in a test-tube for about ten minutes with a mixture of 1.5 Gm. of nitric acid and 0.5 Gm. of water, then heated in a bath of boiling water for not more than fifteen minutes, the Oil will assume an orange or reddish-brown color, and after standing for twelve hours at the ordinary temperature, will form a semi-solid mass.

If 5 Cc. of the Oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol and adding 2 drops of nitric acid), and if the mixture be heated for about five minutes on a water-bath, the Oil will assume a red or reddish-brown color.

If 2 Cc. of the Oil be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, a red color will develop in from ten to fifteen minutes.

Saponification Value.—Cotton Seed Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of from 191 to 196 (see U. S. P. Test No. 99, Chap. LXII).

Iodine Absorption Value.—If 0.3 Gm. of Cotton Seed Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours protected from the light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S. an iodine value of not less than 102 nor more than 108 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Cotton seed oil is used officially in camphor liniment and ammonia liniment. It is sometimes given internally in the dose of four fluidrachms (16 Cc.).

OLEUM LINI. U.S. Linseed Oil

[Oil of Flaxseed]

A fixed oil expressed from Linseed. It should be kept in well-stoppered containers. Linseed Oil which has been "boiled" should not be used nor dispensed.

Preparation.—It will be noticed that the U. S. P. (8th Rev.) does not exclude linseed oil made by pressing the seed between hot plates. "Raw oil" is preferred. It does, however, exclude "boiled linseed oil."

Linseed oil is a drying oil, and consists mainly of *linolein*, which, by exposure, becomes *linoxyn*, $C_{32}H_{54}O_{11}$; *myristin* and *palmitin* are also present.

Official Description.—A yellowish, oily liquid. When exposed to the air, it gradually thickens, darkens in color, and acquires a strong odor and taste.

Odor, Taste, and Reaction.—Peculiar odor and a bland taste. It should not more than slightly redden blue litmus paper previously moistened with alcohol (limit of *free acid*).

Specific Gravity.—0.925 to 0.935 at 25° C. (77° F.).

Solubility.—*Alcohol.* In about 10 parts of absolute alcohol.

Other solvents. In all proportions of ether, chloroform, petroleum benzin, carbon disulphide, and oil of turpentine.

Test for Identity.—It does not congeal at temperatures above —20° C. (—4° F.).

Impurities and Tests for Impurities.—*Non-drying oils.* If spread in a thin layer on a glass plate and allowed to stand in a warm place, it is gradually converted into a hard, transparent resin.

Mineral oils and rosin oil. The oil should be completely saponifiable with alcoholic potassium hydroxide T.S., and the resulting soap should be completely soluble in water without leaving an oily residue.

Rosin or rosin oils. If 2 Cc. of the oil be warmed and shaken in a test-tube with an equal volume of glacial acetic acid, and if to this mixture, after cooling, 1 drop of sulphuric acid be added, a greenish color should be produced (a violet color under these circumstances indicates the presence of *rosin or rosin oils*).

Saponification Value.—Linseed Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of from 187 to 195 (see U. S. P. Test No. 99, Chap. LXII).

Iodine Absorption Value.—If 0.15 Gm. of Linseed Oil be dissolved in 10 Cc. of chloroform in a 250 Cc. flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for sixteen hours protected from the light, 20 Cc. of potassium iodide T.S. be introduced and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 170 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Linseed oil is used in the preparation of compound solution of cresol, in soft soap, and is an ingredient in compound rosin cerate and lime liniment. It is used as a laxative, in doses of one to two fluidounces (30 to 60 Cc.).

PEPO. U.S. Pepo

The ripe seed of *Cucurbita Pepo* Linné (Fam. *Cucurbitaceæ*).

Broadly ovate, flat, somewhat biconvex, about 20 Mm. long and 2 Mm. thick; externally whitish or yellowish-white, nearly smooth, with a shallow groove parallel to, and within 1 Mm. of, the margin; seed-coat consisting of a white coriaceous outer layer, and a membranaceous inner layer; embryo whitish, straight, with a conical hypocotyl and two plano-convex cotyledons; slightly odorous when contused; taste bland and oily.

This seed contains about 40 percent. of fixed oil, starch, protein compounds, a little acrid resin, sugar, etc. Pumpkin seed is used as a tænifuge by beating the kernels with water and adding sugar so as to make a mixture like almond mixture; a more elegant method, however, is to emulsify the fixed oil, which is now an article of commerce, and made by percolating the ground seeds with ether. Dose, one ounce (30 Gm.).

OLEUM RICINI. U.S. Castor Oil

A fixed oil expressed from the seed of *Ricinus communis* Linné (Fam. *Euphorbiaceæ*). It should be kept in well-stoppered containers.

Preparation.—Castor oil has been obtained from the seed in four ways. 1. By cold expression. 2. By expression with heat. 3. By percolation with alcohol. 4. By decoction. The first method produces the best oil; a powerful hydraulic press (see page 249) is generally used, and the oil clarified by subsidence. It contains *ricinolein* and palmitin. The purgative action is due to the presence of an acrid principle, which has not yet been isolated; a given weight of the seeds is more active than the same quantity of oil.

Official Description.—A pale yellowish or almost colorless, transparent, viscid liquid.

Odor and Taste.—Faint, mild odor; bland, afterwards slightly acrid and generally offensive taste.

Specific Gravity.—0.945 to 0.965 at 25° C. (77° F.).

Solubility.—*Alcohol.* In an equal volume of alcohol, and in all proportions in absolute alcohol; also soluble, at 25° C. (77° F.), in 3 times its volume of 92.5 percent. alcohol (absence of more than about 5 percent. of *most other fixed oils*).

Other solvents. In all proportions in glacial acetic acid.

Tests for Identity.—With an equal volume of petroleum benzin, it forms at 15° C. (59° F.) a turbid mixture, but at 17° C. (62.6° F.) it yields a clear solution.

When cooled to 0° C. (32° F.) it becomes turbid, with the separation of crystalline flakes, and at about —18° C. (—0.4° F.) it congeals to a yellowish mass.

Impurities and Test for Impurities.—*Absence of foreign oils.* If 3 Cc. of the Oil be shaken for a few minutes with 3 Cc. of carbon disulphide and 1 Cc. of sulphuric acid, the mixture should not acquire a blackish-brown color.

Saponification Value.—Castor Oil saponified by alcoholic postassium hydroxide T.S. should show a saponification value of 179 to 183 (see U. S. P. Test No. 99, Chap. LXII).

Iodine Absorption Value.—If 0.3 Gm. of Castor Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for eight hours, protected from light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 84 nor more than 89 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Castor oil is used as a purgative, in doses of one-half to one fluidounce (16 to 30 Cc.). It is used in the official flexible collodion.

OLEUM TIGLII. U.S. Croton Oil

A fixed oil expressed from the seeds of *Croton Tiglium* Linné (Fam. *Euphorbiaceæ*). It should be kept in small, well-stoppered bottles, and should be handled with caution.

Preparation.—Croton oil is prepared by expression or by percolating the ground seeds with carbon disulphide and distilling the percolate. Neither the purgative principle nor the vesicating principle has been isolated; by the decomposition of the fatty substances present, tiglinic, valeric, formic, acetic, myristic, stearic, isobutyric, lauric, and palmitic acids have been detected; crotonol, $C_{18}H_{28}O_4$, is said to be present.

Official Description.—A pale yellow or brownish-yellow, somewhat viscid, and slightly fluorescent liquid.

Odor, Taste, and Reaction.—Slight fatty odor; mild, oily, afterwards acrid and burning taste (*great caution is necessary in tasting*). It reddens blue litmus paper moistened with alcohol.

Specific Gravity.—0.935 to 0.950 at 25° C. (77° F.).

Solubility.—*Alcohol.* When fresh it is soluble in from 55 to 60 parts of alcohol, the solubility increasing by age.

Other solvents. Freely soluble in ether, chloroform, carbon disulphide, and in fixed or volatile oils.

Tests for Identity.—When applied to the skin, it produces rubefaction, or a pustular eruption. When gently heated with twice its volume of absolute alcohol, it forms a clear solution from which the Croton Oil should separate on cooling.

Impurity and Test.—*Other non-drying oils.* If to 2 Cc. of Croton Oil 1 Cc. of fuming nitric acid and 1 Cc. of water be added, and the mixture vigorously shaken, it should not solidify either completely or partially, after standing for one or two days.

Saponification Value.—Croton Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of from 203 to 215 (see U. S. P. Test No. 99, Chap. LXII).

Iodine Absorption Value.—If 0.3 Gm. of Croton Oil be dissolved in 10 Cc. of chloroform in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be added and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 103 nor more than 109 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Internally in doses of one minim (0.05 Cc.), croton oil is a powerful purgative; externally, when applied to the skin, it is rubefacient and vesicant.

OLEUM THEOBROMATIS. U.S. Oil of Theobroma

[Butter of Cacao Cacao Butter]

A fixed oil expressed from the roasted seeds of *Theobroma Cacao* Linné (Fam. *Sterculiaceæ*).

Preparation.—This is made by expressing the kernels of the "chocolate nut" between hot iron plates, and running the product into moulds. The yield is about 40 percent. Chemically, it is a mixture of stearin, palmitin, olein, arachin, and laurin, and, owing to its low fusing point, and its property of becoming solid at a temperature just below the fusing point, it is valuable in pharmacy in making suppositories. (See Suppositoria.)

Official Description.—A yellowish-white solid.
Odor, Taste, and Reaction.—Faint, agreeable odor; bland, chocolate-like taste; neutral reaction.
Specific Gravity.—0.970 to 0.976 at 25° C. (77° F.).
Solubility.—*Alcohol.* In 100 parts of cold, absolute alcohol, and in 20 parts of boiling absolute alcohol.
Other solvents. Readily in ether, chloroform, or benzene.
Test for Identity.—Oil of Theobroma should be brittle at temperatures below 15° C. (59° F.), and should melt at 30° to 35° C. (86° to 95° F.) to a clear liquid.
Impurities and Tests for Impurities.—*Wax, stearin, tallow, etc.* If 1 Gm. of Oil of Theobroma be dissolved in 3 Cc. of ether in a test-tube at a temperature of 17° C. (62.6° F.), and the tube frequently plunged into water at 0° C. (32° F.), the liquid should not become turbid nor deposit white flakes in less than three minutes: and if the mixture, after congealing, be again brought to 15° C. (59° F.), it should gradually form a perfectly clear liquid.
Saponification Value.—Oil of Theobroma, saponified by alcoholic potassium hydroxide T.S., should show a saponification value of 188 to 195 (see U. S. P. Test No. 99, Chap. LXII).
Iodine Absorption Value.—If 0.8 Gm. of Oil of Theobroma be dissolved in 10 Cc. of chloroform in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be added and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S. an iodine value of not less than 33 nor more than 38 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—In addition to its use as a vehicle for suppositories, butter of cacao is an excellent emollient application to the skin when inflamed. It is also used in massage.

LYCOPODIUM. U.S. Lycopodium

The spores of *Lycopodium clavatum* Linné or of other species of *Lycopodium* (Fam. *Lycopodiaceæ*).

A fine, pale yellowish, very mobile powder, nearly inodorous and tasteless, floating upon water and not wetted by it, but sinking on being boiled with it, and burning with a quick flash when thrown into a flame.

Spores tetrahedral with one convex side, the surface being delicately reticulated, from 0.025 to 0.040 Mm. in diameter. The microscope should show no pollen or starch grains or particles of sand.

The ash remaining upon ignition should not exceed 5 percent.

Lycopodium contains 47 percent. of fixed oil, with minute quantities of volatile bases. It is used as a dusting powder and to allay irritation of the skin through chafing, and for similar purposes.

Unofficial Fixed Oils

Oil of Bassia .	From *Bassia longifolia.* Fam. Sapotaceæ. A greenish oil is expressed from the seeds
Bayberry	From *Myrica cerifera.* Fam. Myricaceæ. Habitat, North America. The oil and wax are prepared by boiling the fruit with water until the oil collects on the surface. The yield of oil is about 30 percent.
Beech	From the fruit of *Fagus sylvatica.* Fam. Cupuliferæ. Habitat, Europe. It is of a yellow color and mild odor and taste. The yield of oil is about 20 percent.
Behen	From the fruit of *Moringa aptera.* Used in ointments and pomades
Ben	A fixed oil from the seeds of *Moringa pterygosperma.* Used for the same purposes as olive oil
Black Mustard	From the seed of *Brassica nigra* (Linné) Koch. Fam. Cruciferæ. Habitat, Europe. A yellow or brownish-yellow fixed oil. Sp. gr. 0.916. The yield of oil is about 20 percent.

Unofficial Fixed Oils—*Continued*

Oil of Brazil Nut	From the seed of *Bertholletia excelsa.* Fam. Lecythidaceæ. Habitat, Brazil. It is a pale yellow, bland oil. The yield of oil is about 50 percent.
Candle Nut	From *Aleurites triloba.* Habitat, islands of the Pacific Ocean. The yield of oil is about 60 percent.
Cardamom	From the fruit of *Elettaria repens.* Fam. Zingiberaceæ. The yield of oil is about 10 percent.
Chaulmugra	From the seed of *Gynocardia odorata.* Fam. Bixaceæ. Habitat, Malayan Peninsula. Prepared by subjecting the seeds to pressure and collecting the oil
Coco-nut	From *Cocos nucifera.* Fam. Palmæ. Habitat, tropical countries. Prepared by boiling the seeds with water and expressing. It is of a butyraceous consistence, white, and has a peculiar odor and a bland taste
Crab	From *Carapa guianensis.* Prepared by expressing the seed
Cucumber Seed	From the seed of *Cucumis sativus.* Fam. Cucurbitaceæ. Habitat, Central Asia
Ergot	From *Claviceps purpurea.* The yield of oil is about 25 percent.
Groundnut	From the kernels of the fruit of *Arachis hypogæa.* Prepared by expression
Hazelnut	From *Corylus avellana.* Fam. Cupuliferæ. Habitat, Europe. The yield of oil is about 50 percent.
Hemp Seed	From the seed of *Cannabis sativa.* Fam. Urticaceæ. Habitat, Europe and North America. The yield of oil is about 30 percent.
Horsechestnut	From the kernels of the fruit of *Æsculus Hippocastanum.* Fam. Sapindaceæ. The yield of oil is about $\frac{1}{10}$ percent.
Hydrastis	From *Hydrastis canadensis.* Fam. Ranunculaceæ. Habitat, United States
Hyoscyamus Seed	From the seed of *Hyoscyamus niger.* Fam. Solanaceæ. Habitat, Europe. The yield of oil is about 25 percent.
Juglans	From *Juglans cinerea.* Fam. Juglandaceæ. Habitat, United States. The yield of oil is about 15 percent.
Kurung	From *Pongamia glabra.* Fam. Leguminosæ. Habitat, India. It is a thickish, yellow oil, of sp. gr. 0.945
Larkspur Seed	From the seed of *Delphninium Consolida.* Fam. Ranunculaceæ. Habitat, Central Europe
Laurel	From *Laurus nobilis.* Fam. Lauraceæ. Habitat, Europe. Prepared by steeping the fruit in hot water and expressing
Mace	From the arillus of the fruit of *Myristica fragrans.* Fam. Myristicaceæ. Habitat, Molucca Islands
Madia	From *Madia sativa.* Fam. Compositæ. Habitat, Europe. The yield of oil is about 40 percent.
Mangosteen	From *Garcinia indica.* Fam. Guttiferæ. Habitat, India. The yield of oil is about 30 percent.
Melon Seed	From *Cucumis Melo.* Fam. Cucurbitaceæ. Habitat, Central Asia
Nicker Seed	From *Cæsalpinia Bonducella.* Fam. Leguminosæ
Nigella	From the seed of *Nigella sativa.* Fam. Ranunculaceæ. Habitat, Southern Europe. The yield of oil is about 35 percent.
Niger Seed	From *Guizotia oleifera.* Fam. Compositæ. Habitat, India. The yield of oil is about 40 percent.
Nutmeg	From the kernel of the seed of *Myristica fragrans.* Fam. Myristicaceæ. Habitat, Molucca Islands. The yield of oil is about 22 percent.
Palm	From the fruit of *Elais guineensis.* Fam. Palmæ. Habitat, West Africa. Sp. gr. 0.945
Peach	From *Persica vulgaris.* Fam. Rosaceæ. The oil resembles expressed oil of almond
Poppy Seed	From the seed of *Papaver somniferum.* Fam. Papaveraceæ. Habitat, Asia and Europe. It is of a yellow color, bland, and limpid. The yield is about 45 to 50 percent.
Pumpkin Seed	From the seed of *Cucurbita Pepo.* Fam. Cucurbitaceæ. Habitat, Asia and Europe. The yield of oil is about 45 percent.
Purging Nut	From the seed of *Curcas purgans.* Fam. Euphorbiaceæ. Habitat, West Indies. The yield is about 35 percent.
Rape Seed	From *Brassica campestris.* A fixed oil used for making green soft soap
Sesamum (Teel oil, Benné Oil). U. S. P. 1890	A fixed oil expressed from the seed of *Sesamum indicum* Linné. Fam. Pedaliaceæ. An inodorous, bland, and non-drying oil, of sp. gr. 0.919 to 0.925
Staphisagria	From the seed of *Delphinium Staphisagria.* Fam. Ranunculaceæ. Habitat, Europe. The yield of oil is about 30 percent.
Stramonium Seed	From the seed of *Datura Stramonium.* Fam. Solanaceæ. Habitat, United States. The yield of oil is about 25 percent.
Tonka	From the seed of *Dipterix odorata.* Fam. Leguminosæ. Habitat, Guiana. An odorous fixed oil. The beans contain coumarin. Used for flavoring. Narcotic. Used in whooping cough, in doses of five to eight grains (0.3 to 0.5 Gm.), given in the form of fluidextract

Unofficial Fixed Oils—*Continued*

Oil of Tucom	From the fruit of *Astrocaryum vulgare*. Habitat, South America. It has a bright red color and an agreeable odor
Watermelon Seed	From the seed of *Cucurbita Citrullus*. Fam. Cucurbitaceæ. Habitat, Southern Asia. The yield is about 30 percent.
White Mustard	From the seed of *Sinapis alba*. Fam. Cruciferæ. Habitat, Asia. The yield of oil is about 20 percent.

ACIDUM OLEICUM. U.S. Oleic Acid

$HC_{18}H_{33}O_2 = 280.14$

A monobasic organic acid, prepared in a sufficiently pure condition by cooling commercial Oleic Acid to about 5° C. (41° F.), then separating and preserving the liquid portion.

Preparation.—Oleic acid is generally obtained as a by-product in the manufacture of candles from fats, stearic and palmitic acids being the fatty substances sought for by the makers. The crude oleic acid is known as "red oil," the stearic and palmitic acids being separated by cooling the mixture and filtering.

Official Description.—A yellowish or brownish-yellow, oily liquid, becoming darker and absorbing oxygen on exposure to air.

Odor, Taste, and Reaction.—Peculiar, lard-like odor and taste; feebly acid reaction in alcoholic solution.

Specific Gravity.—About 0.895 at 25° C. (77° F.).

Solubility.—*Water.* Insoluble.

Alcohol. Soluble.

Other solvents. Soluble in chloroform, benzene, petroleum benzin, and fixed and volatile oils.

Tests for Identity.—When cooled to from 9° to 4° C. (48.2° to 39.2° F.), Oleic acid becomes semi-solid, and on further cooling, congeals to a whitish, solid mass.

When heated to a temperature of about 95° C. (203° F.), decomposition commences, and acrid vapors are produced. At a higher temperature it is completely dissipated.

Impurities and Tests for Impurities.—*Fixed oils.* Equal volumes of Oleic Acid and alcohol, mixed at 25° C. (77° F.) should yield a clear solution without the separation of any oily drops.

Notable quantities of palmitic and stearic acids. If 1 Gm. of Oleic Acid be heated with 20 Cc. of alcohol, and 2 drops of phenolphthalein T.S. be added, followed by a strong solution of sodium hydroxide (1 in 4), drop by drop, until the liquid has acquired a permanent red tint and the Acid is saponified, and if acetic acid be added until the red color of the liquid is just discharged, and the liquid be filtered, then 10 Cc. of the filtrate mixed with 10 Cc. of ether should not be rendered more than slightly turbid by shaking with 1 Cc. of lead acetate T.S.

Uses.—Oleic acid is used as the basis for the oleates, five of which—oleates of atropine, cocaine, mercury, quinine, and veratrine—are official (see page 323). It is also an ingredient in ammonia liniment. The oleates are very useful external remedies; they are used in various skin diseases, and also for communicating the constitutional effects of numerous remedies. Oleic acid is more quickly absorbed by the skin than any other similar base.

Unofficial Oleates

Aluminum Oleate, $Al(C_{18}H_{33}O_2)_3$	By decomposing sodium oleate with aluminum sulphate. It is a semi solid, of a dark brown color, and has a decidedly astringent action. Used in treating burns, scalds, foul ulcers, etc.
Silver Oleate, $AgC_{18}H_{33}O_2$	By precipitating sodium oleate with a saturated solution of silver nitrate, washing the precipitate with boiling water, drying it, and reducing to a fine powder. It is of a brownish-yellow color. Used externally
Arsenic Oleate, $As(C_{18}H_{33}O_2)_3$	By first preparing arsenous chloride by treating metallic arsenic with hydrochloric acid, and then adding sodium oleate and collecting the precipitate. It is of a yellowish color and has the consistence of butter
Bismuth Oleate, $Bi(C_{18}H_{33}O_2)_3$	By dissolving *crystallized* bismuth nitrate in glycerin, then diluting sodium oleate with water and adding the bismuth solution to the sodium mixture, warming, rejecting the aqueous layer, and, lastly, washing several times with warm water. It is of a white or a yellowish-white color, and has about the consistence of an ointment

Unofficial Oleates—*Continued*

Copper Oleate, $Cu(C_{18}H_{33}O_2)_2$	By adding sodium oleate to a saturated solution of copper sulphate, then washing the precipitate. It is a handsome, dark green, waxy solid. Used chiefly in the treatment for ringworm
Iron Oleate (Ferric), $Fe(C_{18}H_{33}O_2)_3$	By adding sodium oleate to a solution of ferrous sulphate and *boiling*. It is a dark red, soft, solid oleate. Used locally
Manganese Oleate	By adding to a solution of sodium oleate a solution of manganese sulphate, heating gently, and collecting the precipitate. It is of a light gray, slightly pinkish color, having a peculiar odor
Mercury and Morphine Oleate	By combining with a gentle heat 40 parts mercuric oleate, 3 parts morphine, and 13 parts oleic acid. It forms a very dark brown, soft solid
Nickel Oleate	By adding sodium oleate to a solution of nickel sulphate and collecting the precipitate. It is a green, amorphous, waxy substance. Used locally as an astringent
Lead Oleate, $Pb(C_{18}H_{33}O_2)_2$	By adding a *clear* solution of lead acetate to a solution of sodium oleate, boiling and washing the precipitate several times. It has the appearance of lead plaster
Sodium Oleate	By dissolving 1 part of pure Castile soap in 8 parts of hot water, cooling, and filtering from deposited sodium palmitate. The filtrate contains sodium oleate
Tin Oleate	By adding a solution of tin chloride to a solution of sodium oleate and collecting the precipitate. It has a grayish-yellow color, a soft consistence, and a decided metallic taste

ACIDUM STEARICUM. U.S. Stearic Acid

$HC_{18}H_{35}O_2 = 282.14$

A monobasic organic acid [$C_{17}H_{35}.COOH$], in its commercial, more or less impure form, usually obtained from the more solid fats, chiefly tallow.

Stearic acid was introduced in the U. S. P. 1890 solely because of its usefulness in making glycerin suppositories.

Official Description.—A hard, white, somewhat glossy solid; permanent in the air.
Odor and Taste.—Odorless and tasteless.
Solubility.—*Water.* Insoluble.
Alcohol. In about 16.6 parts at 25° C. (77° F.); readily in boiling alcohol.
Other solvents. Readily in ether.
Test for Identity.—Stearic Acid, when pure, melts at 69.2° C. (156.6° F.). The commercial Acid should have a melting point not lower than 56° C. (132.8° F.), and the melted Acid should become opaque and begin to congeal at a temperature not lower than 54° C. (129.2° F.).
Impurity and Test.—*Limit of undecomposed fat.* If 1 Gm. of Stearic Acid and 0.5 Gm. of monohydrated sodium carbonate be boiled with 30 Cc. of water, in a capacious flask, the resulting solution, while hot, should not be more than opalescent.

Uses.—See Suppositoria Glycerini, Part V.

GLYCERINUM. U.S. Glycerin Glycerol

A liquid obtained by the decomposition of vegetable or animal fats, or fixed oils, and containing not less than 95 per cent. of absolute Glycerol, a triatomic alcohol [$CH_2OH.CHOH.CH_2OH = 91.37$].

Preparation.—This valuable liquid has been made in several ways: 1. Through the saponification of fats and oils in making soap or lead plaster. 2. By the decomposition of fats and oils through pressure and superheated steam. Glycerin came into use in medicine and pharmacy about 1846, and it was first obtained on a commercial scale from the washings of lead plaster by Robert Shoemaker, of Philadelphia. In making the plaster, litharge, olive oil, and water are boiled together, when the olein of the oil is decomposed by the lead oxide, according to the following reaction:

$$\underset{\substack{\text{Glyceryl Oleate}\\\text{(Olive Oil)}}}{2C_3H_53C_{18}H_{33}O_2} + \underset{\substack{\text{Lead}\\\text{Oxide}}}{3PbO} + \underset{\text{Water}}{3H_2O} = \underset{\substack{\text{Lead Oleate (Lead}\\\text{Plaster)}}}{3Pb2C_{18}H_{33}O_2} + \underset{\substack{\text{Glycerin Hydroxide}\\\text{(Glycerin)}}}{2C_3H_53HO}$$

The plaster, while still hot and in the liquid state, contains glycerin diffused through it. When the liquid plaster is mixed with an equal measure of boiling water, and the mixture stirred briskly, a solution of glycerin is obtained, which, after having been decanted, and evaporated to a limited extent, is freed from lead by hydrogen sulphide. The liquid is then filtered to separate lead sulphide, heated to free it from hydrogen sulphide, and finally evaporated to expel the water.

The process most frequently used for making glycerin originated with R. A. Tilghman, of Philadelphia, and consists in subjecting fatty bodies to the action of water at a high temperature under pressure, whereby the fats, which are *glycerides* or esters of the fatty acids, are broken up into glycerin and fatty acids, the water supplying the elements of hydrogen and oxygen necessary for that change. The reaction is as follows in the case of a fat like stearin :

$$\underset{\text{Stearin}}{C_3H_53C_{18}H_{35}O_2} + \underset{\text{Water}}{3H_2O} = \underset{\text{Glycerin}}{C_3H_53HO} + \underset{\text{Stearic Acid}}{3HC_{18}H_{35}O_2}$$

Chemically, glycerin belongs to the class of alcohols, and is sometimes termed *glycerol*, or *glyceric alcohol*. It is the hydroxide of the radical glyceryl C_3H_5, is triatomic, and one, two, or three of the hydrogen atoms may be replaced by monad radicals.

Official Description.—A clear, colorless liquid, of a thick, syrupy consistence, smooth to the touch; when exposed to the air, it absorbs moisture.

Odor, Taste, and Reaction.—Odorless; sweet to the taste; and producing a sensation of warmth in the mouth; neutral reaction.

Specific Gravity.—Not less than 1.246 at 25° C. (77° F.).

Solubility.—*Water.* Soluble in all proportions.

Alcohol. Soluble in all proportions.

Other solvents. Soluble in a mixture of 3 parts of alcohol and 1 part of ether, but insoluble in ether, chloroform, carbon disulphide, petroleum benzin, benzene, and fixed and volatile oils.

Tests for Identity.—Glycerin is slowly volatilized from weak aqueous solutions, at or above 100° C. (212° F.), with the vapor of water. At boiling temperatures 70 percent. to 100 percent. Glycerin rapidly volatilizes; 95 percent. Glycerin boils at 165° C. (329° F.); anhydrous Glycerin boils at 290° C. (554° F.) without decomposition; under continued heat it is finally entirely decomposed and dissipated.

An aqueous solution of Glycerin is neutral to litmus paper.

If a fused bead of borax, on a loop of platinum wire, be moistened with Glycerin, and then held in the edge of a non-luminous flame, the latter will be transiently tinted a vivid green.

Impurities and Tests for Impurities.—*Mineral impurities.* Five Cc. of Glycerin, heated to boiling in an open porcelain or platinum dish, and then gently ignited, should vaporize, burn, and leave not more than a dark stain, which on stronger heating should disappear entirely.

Sugars. If 5 Cc. of Glycerin be mixed with 50 Cc. of water and 10 drops of hydrochloric acid in a small flask, and heated for half an hour on a water-bath, then 10 Cc. of the hot liquid, mixed with 2 Cc. of sodium hydroxide T.S. and 1 Cc. of alkaline cupric tartrate V.S., should show no yellowish-red cloudiness or precipitate within six hours.

Readily carbonizable impurities. If 5 Cc. of glycerin be mixed with an equal volume of concentrated sulphuric acid in a test-tube, the liquid should acquire, on standing for one hour, a color not darker than yellow.

Butyric acid. If 5 Cc. of Glycerin be mixed with the same volume of a mixture of equal parts of alcohol and diluted sulphuric acid, and gently heated, a fruity odor should not be recognizable.

Sulphuric acid. No color, cloudiness, or precipitate should appear when separate portions of its aqueous solution (1 in 10) are treated with barium chloride T.S.

Oxalic acid. Or calcium chloride T.S.

Calcium salts. Or ammonium oxalate T.S.

Chlorides. Or silver nitrate T.S.

Acrolein. Or silver ammonium nitrate T.S.

In the last-mentioned case, the test-tube, loosely stoppered to protect it from impurities, should be allowed to stand, protected from light, for at least five minutes.

Heavy metals. The aqueous solution (1 in 20), when acidified with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Arsenic. Five Cc. of the aqueous solution (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see U. S. P. Test No. 17, Chap. LXII).

Uses.—Glycerin is one of the most valuable liquids known to pharmacy. It is a solvent and antiseptic, scarcely inferior to alcohol. It is useful in keeping substances moist, owing to its tendency to absorb water from the air. Its agreeable taste and non-poisonous properties adapt it for many purposes. Its varied uses have been constantly referred to in the preceding pages.

SPIRITUS GLYCERYLIS NITRATIS. U.S. Spirit of Glyceryl Trinitrate

Spirit of Nitroglycerin

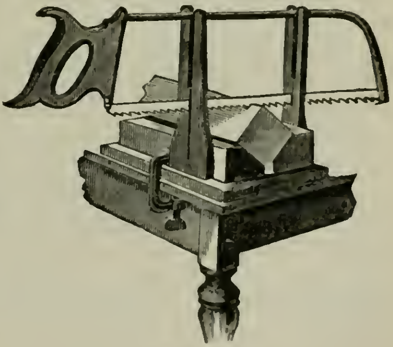
When glycerin is acted on by nitric acid, nitroglycerin, a powerful explosive, is formed. This is used in the preparation of dynamite and other high explosives; it is sometimes called *glonoin* and *trinitrine.* A 1 percent. alcoholic solution is official (see Spiritus Glycerylis Nitratis, page 315). It is a very useful solution medicinally, and is used as a cardiac stimulant, and in angina pectoris, asthma, etc., in doses of one to two minims (0.05 to 0.1 Cc.).

SAPO. U.S. Soap

[WHITE CASTILE SOAP]

Soap prepared from sodium hydroxide and olive oil.

Fig. 451



Soap cutter

Preparation.—Soap is made by boiling fats or oils with a solution of caustic alkali until a thick mass is formed. Then, by evaporating the water, or by adding solution of common salt, the soap is separated and caused to rise to the surface; when it has ceased to froth in boiling, it is ladled out into wooden frames to congeal, after which it is cut into bars by means of a wire. The soap, as first separated, is called *grain soap.* Fig. 451 shows a useful soap cutter made by the Woodward Lock Company, Clinton, Wisconsin. The "soap dust" and chippings from Castile soap are a very convenient form for use in making soap liniment, etc. Toilet soap is made by *milling* grain soap, or cutting it into small pieces; perfume is then added, thoroughly mixed, and the mixture forced by a plotting machine through an aperture, which forms it into rolls and cuts it into pieces. These are then moulded.

The official soap is known as Castile soap. The soaps in general use are made from animal fat, chiefly tallow. Soaps are made hard by using a fat containing much stearin, like tallow, and sodium hydroxide for the alkali; they are made soft by using fats containing a large proportion of olein, and potassium hydroxide for the alkali. When fats and oils undergo *saponification* by reaction with a salifiable base, the olein, palmitin, and stearin present are decomposed into stearic, palmitic, and oleic acids, which unite with the base to form the soap, and into glycerin, which is set free.

Soaps are divided into two classes, soluble and insoluble. The soluble soaps are combinations of the fatty acids with sodium or potassium hydroxides or ammonia; those which are insoluble consist of the same acids united with earths and metallic oxides. The soluble soaps only are detergent, and to these the name *soap* is usually applied. Several of the insoluble soaps are employed in pharmacy, as, for example, the soap of lead monoxide (litharge), or lead plaster, and the soap of lime, or lime liniment. (See Emplastrum Plumbi and Linimentum Calcis). The two official soaps are of the soluble kind. One is a soda soap, made with olive oil (Castile soap), the other a potash soap (Sapo Viridis). The soap of ammonia is noticed elsewhere. (See Linimentum Ammoniæ).

Official Description.—A white or whitish solid, hard, yet easily cut when fresh.

Odor, Taste, and Reaction.—Faint, peculiar odor free from rancidity; disagreeable, alkaline taste; alkaline reaction.

Solubility.—*Water.* Soluble; more readily with the aid of heat.
Alcohol. Soluble; more readily with the aid of heat.

Impurities and Tests for Impurities.—*An undue amount of water.* On placing 0.5 Gm. of Soap, together with about 10 Cc. of alcohol, in a tared beaker containing 1 Gm. of dry, clean sand, evaporating the resulting solution of the Soap to dryness, and drying the residue at 110° C. (230° F.), to a constant weight, the loss should not exceed 36 percent.

Animal fats. An alcoholic solution of Soap (1 in 25) should not gelatinize on cooling.

Metallic impurities. An aqueous solution of Soap (1 in 20) should remain unchanged in color upon the addition of ammonium sulphide T.S.; and upon acidulating another portion of the solution with hydrochloric acid and filtering, the filtrate should remain unchanged in color when an equal volume of hydrogen sulphide T.S. is added and the mixture is allowed to stand well stoppered in a warm place for half an hour.

Limit of sodium carbonate, etc. On dissolving 20 Gm. of Soap in alcohol, with the aid of heat, transferring the undissolved residue, if any, to a tared filter, and washing it thoroughly with boiling alcohol, it should, after drying, weigh not more than 0.8 Gm.

Limit of silica and other accidental impurities. Of this residue not more than 0.2 Gm. should be insoluble in water.

Limit of alkalinity. If a solution of 5 Gm. of Soap in 50 Cc. of hot water be mixed with 3 Cc. of tenth-normal oxalic acid V.S., the subsequent addition of a few drops of phenolphthalein T.S. should produce no pink or red tint.

Uses.—Soap is a laxative and antacid; it is used in pill masses, in combination with resins, to render them soluble and to modify their harsh action. It is also used in liniments, plasters, cerates, etc.

It is an ingredient in the making of lead plaster, compound extract of colocynth, and the pills of aloes, of asafetida, and of opium, and in the following:

Official Preparations

Emplastrum Saponis Soap Plaster	Made by rubbing 10 Gm. of powdered soap with water until semi-liquid, and then incorporating with 90 Gm. of melted lead plaster. (See Emplastra)
Linimentum Saponis Soap Liniment	Made by forming a gelatinous mass of 60 Gm. of dried and granulated soap and 200 Cc. of water with the aid of heat, and, while yet warm, dissolving it in 500 Cc. of alcohol, then adding 225 Cc. of alcohol, to which has been added 45 Gm. of camphor and 10 Cc. oil of rosemary, and finally enough water to make 1000 Cc. Filter (see page 323)

SAPO MOLLIS. U.S. Soft Soap

[SAPO VIRIDIS, PHARM. 1880 GREEN SOAP]

	Metric	Old form
* **Linseed Oil**	**400 Gm.**	40 oz. av.
Potassium Hydroxide	**95 Gm.**	9½ oz. av.
Alcohol	**40 Cc.**	4 fl. oz.
Water, a sufficient quantity		

Heat the Linseed Oil in a deep, capacious vessel, on a water-bath or steam-bath, to a temperature of about 70° C. (158° F.). Dissolve the Potassium Hydroxide in 450 Cc. [old form 3 pints] of Water, warm the solution to about 70° C. (158° F.), add it to the Linseed Oil, and mix thoroughly; then incorporate the Alcohol and continue the heat (without stirring) until a small portion of the mixture is found to be soluble in boiling Water without the separation of oily drops. Then allow the mixture to cool, and transfer it to suitable vessels.

The Potassium Hydroxide used in this process should be of the full strength directed by the Pharmacopœia (85 percent.). Potassium Hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 8075 by the percentage of absolute Potassium Hydroxide contained therein.

This is a soft soap, which is often imported from Germany; it is made from various oils which contain but little stearin. The official process does not make a product which is decidedly green in color. Hempseed oil, if used to replace linseed oil, will make a green soap. It should contain a little free alkali, but an excess must be avoided.

Official Description.—A soft, unctuous, yellowish-brown mass.
Odor, Taste, and Reaction.—Characteristic odor; alkaline taste; alkaline reaction.
Solubility.—*Water.* In hot water to nearly a clear liquid.
Alcohol. In hot alcohol without leaving more than 3 percent. of insoluble residue.
Impurity and Test.—*Limit of free alkali.* If to a solution of 5 Gm. of Soft Soap in 50 Cc. of water, 2 drops of phenolphthalein T.S. be added, not less than 2.3 Cc. nor more than 4.5 Cc. of tenth-normal oxalic acid V.S. should be required to discharge the red tint.

Uses.—Green soap is used in skin diseases, chiefly in eczema, and largely as a detergent in surgery.

Official Preparation

Linimentum Saponis Mollis Liniment of Soft Soap	Made by dissolving 650 Gm. of soft soap and 20 Cc. of oil of lavender flowers in sufficient alcohol to make 1000 Cc. (see page 323). Used externally

Unsaponifiable Fats and Petroleum Products

Under this head will be found several official products which cannot be classed properly with either the fixed or the volatile oils, yet which in some respects partake of the properties of both. Petrolatum in its several forms, paraffin, and petroleum benzin are products from petroleum, and are hydrocarbons belonging to the methane series.

PETROLATUM LIQUIDUM. U.S. Liquid Petrolatum

A mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off most of the lighter and more volatile portions from petroleum, and purifying the liquid residue.

Liquid Petrolatum is a purified residual liquid obtained in distilling petroleum (see *Petrolatum*).

Official Description.—A colorless, or very slightly yellowish, oily, transparent liquid.
Odor and Taste.—Without odor or taste, but giving off, when heated, a faint odor of petroleum.
Specific Gravity.—0.870 to 0.940 at 25° C. (77° F.).

Solubility.—*Water.* Insoluble.

Alcohol. Scarcely soluble in cold or hot alcohol, or in cold absolute alcohol, but soluble in boiling absolute alcohol.

Other solvents. Readily in ether, chloroform, carbon disulphide, oil of turpentine, petroleum benzin, benzene, and fixed or volatile oils.

Test for Identity.—When heated on platinum foil, Liquid Petrolatum is completely volatilized without emitting acrid vapors.

Impurities and Tests for Impurities.—*Acid impurities.* If a test-tube be half filled with Liquid Petrolatum and a piece of moistened blue litmus paper be introduced, upon shaking the liquid vigorously the paper should not be reddened.

In other respects Liquid Petrolatum has the characteristics of, and should respond to the tests given under, *Petrolatum.*

Uses.—Liquid petrolatum, *glycoline*, or *liquid albolene*, is used as a basis for medicinal unctuous preparations and for spraying the nasal passages. It is used officially in the preparation of cantharides cerate.

PETROLATUM. U. S. Petrolatum

[PETROLATUM MOLLE, PETROLATUM SPISSUM, PHARM. 1890 PETROLEUM OINTMENT]

A mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue.

Preparation.—The "residuums," as they are termed technically, which are obtained in the distillation of petroleum, are purified by first melting and then percolating them through recently burned bone black; this abstracts the odor and the color. The consistency is varied by mixing them with certain portions of the harder paraffins and stirring them until a homogeneous mixture is made. Petrolatum has a specific gravity which corresponds to the "Hard Petrolatum" of the U. S. P. 1890; only one consistence now being recognized.

Official Description.—An unctuous mass of about the consistence of an ointment, varying in color from yellowish to light amber, having not more than a slight fluorescence, even after being melted, transparent in thin layers, completely amorphous.

Odor, Taste, and Reaction.—Without odor or taste, but giving off, when heated, a faint petroleum-like odor; should not have an acid reaction.

Specific Gravity.—If liquefied and brought to a temperature of 60° C. (140° F.) it should have a specific gravity of from 0.820 to 0.850.

Solubility.—*Water.* Insoluble.

Alcohol. Scarcely in cold or hot alcohol or in cold absolute alcohol, but soluble in boiling absolute alcohol.

Other solvents. Readily in ether, chloroform, carbon disulphide, oil of turpentine, petroleum benzin, benzene, and fixed or volatile oils.

Tests for Identity.—The melting point of Petrolatum ranges between 45° and 48° C. (113° and 118.4° F.). If heated on platinum foil to a still higher temperature, Petrolatum should be completely volatilized without emitting any acrid odor.

If melted Petrolatum be well shaken with water the latter should not redden blue litmus paper.

Impurities and Tests for Impurities.—*Fixed oils or fats of animal or vegetable origin and of rosin.* If 10 Gm. of Petrolatum be digested at 100° C. (212° F.) for half an hour with 10 Gm. of sodium hydroxide and 50 Cc. of water, the aqueous layer separated and supersaturated with sulphuric acid, no oily or solid substance should separate.

Uses.—Petrolatum is used as a basis for ointments, for which it is well adapted. It is however not so readily absorbed as are other unctuous bases. It, with liquid petrolatum and crude petrolatum, is used also internally in the treatment of lung diseases, administered in the form of emulsions, capsules and in pills, mixed with solid ingredients. It is known commercially as *cosmoline*, *vaseline*, *petrolina*, *deodorolina*, *albolene*, etc. Officially it is an ingredient in adhesive plaster, blue ointment, ointment of yellow mercuric oxide, and ointment of red mercuric oxide.

PETROLATUM ALBUM. U.S. White Petrolatum

A colorless mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue.

A white unctuous mass, of about the consistence of an ointment, transparent in thin layers, completely amorphous; without odor or taste. In other respects White Petrolatum has the characteristics of, and should respond to the tests given under, *Petrolatum.*

Uses.—White petrolatum was introduced into the U. S. P. (8th Rev.) as a basis for ointments and cerates, being used officially in cerate, camphor cerate, cerate of lead subacetate, ointment of boric acid, ointment of ammoniated mercury, ointment of phenol, and ointment of zinc stearate.

PARAFFINUM. U.S. Paraffin

A mixture of solid hydrocarbons, chiefly of the methane series; usually obtained by chilling and pressing the distillates from petroleum having high boiling points, and purifying the solid press cake so obtained.

Hard *paraffin,* or paraffin wax, is a solid, white, diaphanous substance resembling white wax, which is made by distilling the residuum obtained from the refiners of petroleum and collecting and purifying the distillate. It can be mixed in all proportions with wax, stearin, palmitin, and rosin, but it is difficult to prevent the mixtures from "granulating," even after prolonged stirring.

Official Description.—A colorless, more or less translucent mass, crystalline when separating from solution.

Odor, Taste, and Reaction.—Without odor or taste, and slightly greasy to the touch. Its alcoholic solution should not redden moistened blue litmus paper.

Specific Gravity.—From 0.890 to 0.905 at 25° C. (77° F.).

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble in alcohol; slightly soluble in absolute alcohol.

Other solvents. Readily soluble in ether, petroleum benzin, benzene, carbon disulphide, volatile oils, and in warm fixed oils.

Tests for Identity.—When heated, it melts at from 51.6° to 57.2° C. (125° to 135° F.), and on stronger heating ignites, burning with a luminous flame and depositing carbon, but leaving no permanent residue.

If 0.5 Gm. of Paraffin be heated in a dry test-tube with an equal weight of sulphur, the mixture will become black from the separated carbon, with the evolution of hydrogen sulphide gas.

Paraffin is not acted upon or colored by concentrated sulphuric acid or nitric acid in the cold.

Impurity and Test.—*Stearic acid.* If 0.5 Gm. of Paraffin be heated and 0.1 Gm. of powdered fuchsin added to the fused mass, the latter should not assume a pink or red color.

Uses.—It is used in cerate of lead subacetate and ointment of boric acid.

BENZINUM. U.S. Petroleum Benzin

A distillate from American petroleum consisting of hydrocarbons, chiefly of the marsh-gas series [C_5H_{12}, C_6H_{14}, and homologous compounds]. It should be carefully kept in well-stoppered bottles or tin cans, in a cool place, remote from lights or fire.

Official Description.—A transparent, colorless, diffusive liquid. Petroleum benzin is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently.

Odor, Taste, and Reaction.—Strong, characteristic odor, slightly resembling that of petroleum, but much less disagreeable; neutral reaction.

Specific Gravity.—0.638 to 0.660 at 25° C. (77° F.).

Solubility.—*Water.* Insoluble.

Alcohol. In about 6 parts.

Other solvents. Readily in ether, chloroform, benzene, volatile oils, and fixed oils with the exception of castor oil.

Test for Identity.—Boiling point: 45° to 60° C. (113° to 140° F.).

Impurity and Test.—*Difference from, and absence of, benzene.* If 5 drops of Petroleum Benzin be added to a mixture of 40 drops of sulphuric acid and 10 drops of nitric acid, in a test-tube, the liquid warmed for about ten minutes, and then set aside for half an hour, on diluting it, in a shallow dish, with water, it should not evolve the bitter-almond-like odor of nitro-benzene.

Uses.—Petroleum benzin is a useful solvent for fats, resins, oils, caoutchouc, and similar bodies. It is officially used in making mustard paper. It is not identical with benzene, the product obtained in the destructive distillation of coal.

BENZINUM PURIFICATUM. U.S. Purified Petroleum Benzin

	Metric	Old form
*** Potassium Permanganate**	**10 Gm.**	146 grains
Sodium Hydroxide	**2 Gm.**	29 grains
Sulphuric Acid	**60 Cc.**	2 fl. oz.
Petroleum Benzin	**1000 Cc.**	2 pints
Water, a sufficient quantity		

Add the Acid to 550 Cc. [old form 17½ fl. oz.] of Water, and when the mixture has become cold, pour it into a bottle having the capacity of about 2 liters [old form 4 pints]. Add 8 Gm. [old form 117 grains] of Potassium Permanganate and agitate until it is dissolved, then add the Petroleum Benzin, in four portions, shaking the liquid after each addition. Allow the liquids to remain in contact for 24 hours, shaking the bottle at frequent intervals; then decant the Petroleum Benzin into another bottle of the same capacity, and having dissolved 2 Gm. [old form 29 grains] of Potassium Permanganate in 240 Cc. [old form 8 fl. oz.] of Water, in which the Sodium Hydroxide has previously been dissolved, mix the liquids and agitate the mixture frequently during several hours, then decant, repeat the washing with Water, and again decant the Purified Petroleum Benzin.

Odor.—Ethereal or faint, petroleum-like odor.

Test for Identity.—Purified Petroleum Benzin should respond to the tests given under *Benzinum.*

Impurities and Tests for Impurities.—*Heavy hydrocarbons.* On evaporating 10 Cc. of Purified Petroleum Benzin from a piece of clean filtering paper, no greasy stain should remain, and the odor should not be disagreeable or notably sulphuretted; no residue should be left upon evaporating Purified Petroleum Benzin from a warmed dish.

Pyrogenous products and sulphur compounds. When it is boiled for a few minutes with one-fourth its volume of spirit of ammonia and a few drops of silver nitrate T.S., the liquid should not turn brown.

Uses.—The object of introducing purified petroleum benzin into the U. S. P. (8th Rev.) was to furnish a solvent, which would not communicate a disagreeable odor to preparations, as is the case when commercial petroleum benzin is used. It is officially employed in making deodorized opium, tincture of deodorized opium, and tincture of lactucarium.

Unofficial Petroleum Products

Ceresin (Ozokerite) (Earth-wax)	A natural mineral product introduced into commerce as a substitute for wax. Sp. gr. 0.753 at 98° C.
Kandol Canadol	A very volatile fraction of petroleum. Used for rapidly freezing skin and subdermal tissues
Ligroine Ligroin	A petroleum product, boiling between 80° and 120° C. (176° and 248° F.). Chiefly used as a solvent.
Rhigolene	A very light, inflammable liquid, boiling at about 18° C. (64.4° F.). Used for producing cold by evaporation

CHAPTER LIX

DRUGS CONTAINING GLUCOSIDES OR NEUTRAL PRINCIPLES, WITH THEIR PREPARATIONS

GLUCOSIDES are bodies mostly found in plants, yielding glucose, $C_6H_{12}O_6$, as one of their products of decomposition when brought in contact with diluted acids or ferments. The other product which is formed at the same time differs in character from the original glucoside. Thus, *Salicin*, if boiled with diluted sulphuric acid, yields dextro-glucose and *saligenin*, or *saligenol.*

$$\underset{\text{Salicin}}{C_{13}H_{18}O_7} + \underset{\text{Water}}{H_2O} = \underset{\text{Saligenin}}{C_7H_8O_2} + \underset{\text{Glucose}}{C_6H_{12}O_6}$$

Glucosides may sometimes be split into glucose and the derived product by heating them with baryta water or alkaline solutions, by nitrogenous principles, which act as ferments, like *emulsin* or *synaptase*, or by treatment with yeast ferment or *ptyalin* found in saliva.

Glucosides are sometimes the active principles of the plants in which they are found, but they are more frequently associated with resins, oils, alkaloids, and bitter principles, and for this reason they have not been used to form a separate group for classification in this work. Frequent mention, however, will be made of them when the occasion arises, in connection with the drug containing them, and the official drugs containing neutral principles have been classed with them.

The following list gives a view of some of the glucosides, with their derivatives:

Glucosides

Glucoside	Source	Derivative
Adonidin	From *Adonis vernalis*	
Æsculin, $C_{15}H_{16}O_9$	From *Æsculus Hippocastanum*	Æsculetin
Amygdalin, $C_{20}NH_{27}O_{11}$	From *Prunus amygdalus*	Oil of bittter almond and hydrocyanic acid
Arbutin, $C_{12}H_{16}O_7$	From *Uva Ursi* and other Ericaceæ	Hydroquinone and methylhydroquinone
Bryonin, $C_{34}H_{48}O_9$	From *Bryonia alba* and *B. dioica*	Bryoretin and bryogenin
Colocynthin, $C_{56}H_{84}O_{23}$	From *Citrullus colocynthis*	Colocynthein
Convallamarin, $C_{23}H_{44}O_{12}$	From *Convallaria majalis*	Convallamaretin
Convallarin, $C_{34}H_{62}O_{11}$	From *Convallaria majalis*	Convallaretin
Convolvulin, $C_{31}H_{50}O_{16}$	From *Exogonium Purga*	Convolvulinic acid and methyl-ethyl acetic acid
Crocin, $C_{44}H_{70}O_{28}$	From *Crocus sativus*	Crocetin
Daphnin, $C_{15}H_{16}O_9$	From *Daphne Mezereum*	Daphnetin
Datiscin, $C_{21}H_{22}O_{12}$	From *Datisca cannabina*	Datiscetin
Digitalin, $C_{35}H_{56}O_{14}$	From *Digitalis purpurea*	Digitaligenin and digitalose
Elaterin, $C_{20}H_{28}O_5$	From *Elaterium*	
Fraxin, $C_{32}H_{30}O_{20}$	From *Fraxinus Ornus*	Fraxetin
Gentiopicrin, $C_{20}H_{30}O_{12}$	From *Gentiana lutea*	Gentiogenin
Globularin, $C_{20}H_{44}O_{14}$	From *Globularia Alypum*	Globularetin
Glycyrrhizin, $C_{44}H_{63}NO_{18}$	From *Glycyrrhiza glabra*	Glycyrrhetin
Gratiolin, $C_{20}H_{34}O_7$	From *Gratiola officinalis*	Gratioletin and gratiolaretin

Glucosides—*Continued*

Glucoside	Source	Derivatives
Gratiosolin, $C_{46}H_{84}O_{25}$	From *Gratiola officinalis*	Gratiosoletin
Helicin, $C_{13}H_{16}O_7$	From Salicin	Salicyl aldehyde
Jalapin, $C_{68}H_{112}O_{32}$	From *Exogonium purga*	Jalapinol
Ononin, $C_{30}H_{34}O_{13}$	From *Ononis spinosa*	Formonetin
Phillyrin, $C_{27}H_{34}O_{11}$	From *Phillyria latifolia*	Phillygenin
Phlorizin, $C_{21}H_{24}O_{10}$	From the bark of the pear, apple, cherry, and plum tree	Phloretin
Pinipicrin, $C_{22}H_{36}O_{11}$	From *Thuja occidentalis*	Ericinol
Populin, $C_{20}H_{22}O_8$	From different species of Populus	Benzoic acid, saliretin
Prophetin, $C_{23}H_{36}O_7$	From *Cucumis prophetarum*	Propheretin
Quercitrin, $C_{36}H_{38}O_{30}$	From *Quercus tinctoria*	Quercetin
Quinovin, $C_{38}H_{62}O_{11}$	From the bark of Cinchonas	Quinovic acid
Salicin, $C_{13}H_{18}O_7$	From different species of Salix and Populus	Saligenin
Santonin, $C_{15}H_{18}O_3$	From *Artemisia pauciflora*	Santoniretin
Saponin, $C_{32}H_{54}O_{18}$	From *Saponaria officinalis*	Saponetin
Thujin, $C_{20}H_{22}O_{12}$	From *Thuja occidentalis*	Thujigenin and thujetin
Xanthorhamnin, $C_{48}H_{66}O_{29}$	From *Rhamnus amygdalinus*	Rhamnetin

GENTIANA. U.S. Gentian

The dried rhizome and roots of *Gentiana lutea* Linné (Fam. *Gentianaceæ*).

In nearly cylindrical pieces or longitudinal slices, of variable length and from 5 to 35 Mm. thick; externally yellowish-brown, the rhizome annulate, the roots longitudinally wrinkled; fracture short but uneven, the bark rather thick, separated from the somewhat spongy, reddish-yellow or brownish inner portion by a dark brown cambium zone; odor strong, characteristic; taste slightly sweetish, strongly and persistently bitter.

The powder is free from starch grains and sclerenchymatic tissues.

Gentian contains the glucoside *gentiopicrin* $C_{20}H_{30}O_{12}$ (which splits, when heated with dilute acids, into gentiogenin and glucose), *gentisic acid*, $C_{14}H_{10}O_5$, pectin, sugar (*gentianose*), and a little fixed oil. A dark green coloration is produced when a ferric salt is added to a preparation of gentian; this is said to be due to the reaction with gentisic acid. If the preparation is treated with ferric hydroxide, and then filtered, the tendency to become discolored is lost.

Uses.—Gentian is a bitter tonic. Dose, fifteen grains (1 Gm.).

Official Preparations

Fluidextractum Gentianæ Fluidextract of Gentian	Made with a menstruum of diluted alcohol (see page 397). Dose, ten to thirty minims (0.6 to 2 Cc.)
Extractum Gentianæ Extract of Gentian	An aqueous extract made with cold water (see page 446). Dose, four to thirty grains (0.25 to 2 Gm.)
Tinctura Gentianæ Composita Compound Tincture of Gentian	Made by mixing 100 Gm. of gentian, 40 Gm. of bitter orange peel, and 10 Gm. of cardamom together, and percolating with a menstruum made by mixing 3 parts of alcohol with 2 parts of water to obtain 1000 Cc. (see page 352). Dose, one to two fluidrachms (4 to 8 Cc.).

CALUMBA. U.S. Calumba

[Columbo]

The dried root of *Jateorhiza palmata* (Lamarck) Miers (Fam. *Menispermaceæ*).

In transverse, circular or oval, biconcave sections, 2.5 to 5 Cm. in diameter and 2 to 12 Mm. thick; externally greenish-brown and roughly wrinkled; internally yellowish or grayish-yellow, with a few interrupted circles of fibro-vascular bundles, distinctly radiate in the outer portion, with a dark cambium; fracture short, mealy; odor slight; taste slightly aromatic, very bitter.

This African root owes its virtues to *columbin*, $C_{21}H_{22}O_7$, and *berberine*, both of which are very bitter; starch and colombic acid are present, with a mucilage which is often troublesome by interfering with percolating operations. Calumba must not be in very fine powder if it is to be percolated with diluted alcohol.

Uses.—It is a bitter tonic. Dose, thirty grains (2 Gm.).

Official Preparations

Fluidextractum Calumbæ Fluidextract of Calumba	Made with a menstruum of 7 parts of alcohol and 3 parts of water; the calumba in No. 20 powder (see page 386). Dose, fifteen to thirty minims (1 to 2 Cc.)
Tinctura Calumbæ Tincture of Calumba	Made by percolating 200 Gm. of calumba, in No. 20 powder, with sufficient menstruum, consisting of 3 parts of alcohol and 2 parts of water, to make 1000 Cc. (see page 346). Dose, one to two fluidrachms (4 to 8 Cc.)

QUASSIA. U. S. **Quassia**

[BITTER WOOD]

The wood of *Picrasma excelsa* (Swartz) Planchon (Fam. *Simarubaceæ*), known commercially as Jamaica Quassia, or *Quassia amara* Linné (Fam. *Simarubaceæ*), known commercially as Surinam Quassia.

Jamaica Quassia.—Occurring in various forms, usually in chips, raspings, or billets; yellowish-white or pale yellow, and of rather coarse texture; odor slight; taste intensely bitter; medullary rays containing tetragonal prisms or small, arrow-shaped crystals of calcium oxalate. Billets of Jamaica Quassia are usually 12.5 Cm. or more in diameter; in tangential section, the medullary rays are mostly 3 to 5 rows of cells in width.

Surinam Quassia.—Occurring usually in billets not exceeding 7.5 Cm. in diameter; the wood is heavier, harder, and more deeply colored than that of Jamaica Quassia, and the medullary rays in tangential section are mostly 1 or 2 rows of cells in width.

Quassia contains *quassin* (*picrasmin*), $C_{32}H_{44}O_{10}$, which is intensely bitter, and soluble in both alcohol and water; there are also present resin, mucilage, etc.

Uses.—It is a bitter tonic. Dose, eight grains (0.5 Gm.).

Official Preparations

Fluidextractum Quassiæ Fluidextract of Quassia	Made with a menstruum of 1 part of alcohol and 2 parts of water (see page 411). Dose, five to ten minims (0.3 to 0.6 Cc.)
Extractum Quassiæ Extract of Quassia	An aqueous extract, made with cold water (see page 452). Dose, one to two grains (0.065 to 0.125 Gm.)
Tinctura Quassiæ Tincture of Quassia	Made by percolating 200 Gm. of quassia with a menstruum of 35 parts of alcohol and 65 parts of water to obtain 1000 Cc. (see page 361). Dose, one-half to one fluidrachm (2 to 4 Cc.)

CHIRATA. U. S. **Chirata**

The dried plant of *Swertia Chirayita* (Roxburgh) Hamilton (Fam. *Gentianaceæ*). Smooth; root simple, about 7 Mm. thick near the crown; stem about 1 M. long, externally yellowish or purplish-brown, cylindrical near the base, quadrangular and lightly winged above, with numerous opposite, ascending branches; wood yellowish, thin, enclosing usually a large yellowish easily separable pith; leaves opposite, sessile, ovate-lanceolate, entire, five-nerved, about 6 Cm. long; flowers numerous, panicled, small, with a four-lobed calyx and corolla; capsule ovoid, acute, one-celled, many-seeded; odor slight; taste intensely bitter.

Chirata contains a bitter glucoside, *chiratin*, $C_{26}H_{48}O_{15}$, and a very bitter principle, *ophelic acid*, $C_{13}H_{20}O_{10}$.

Uses.—It is used as a tonic and febrifuge. Dose, fifteen grains (1 Gm.).

Official Preparation

Fluidextractum Chiratæ Fluidextract of Chirata	Made with a menstruum of diluted alcohol (see page 388). Dose, fifteen minims (1 Cc.)

SALICINUM. U. S. Salicin

$C_{13}H_{18}O_7 = 283.99$

A glucoside obtained from several species of *Salix* and *Populus* (Fam. *Salicaceæ*). Salicin should be kept in well-stoppered bottles.

Preparation.—A boiling concentrated decoction of the bark is treated with lead oxide or basic lead acetate until it becomes nearly colorless. Gum, tannin, and extractive matter, which would impede the crystallization of the salicin, are thus removed from the liquid; while a portion of the oxide is dissolved in combination probably with the salicin. To separate this portion of oxide, sulphuric acid is first added, and then barium sulphide, and the liquor is filtered and evaporated. Salicin is deposited, and may be purified by repeated solution and crystallization. It has been produced synthetically from helicin. It may also be prepared by boiling the bark with milk of lime to remove tannin, evaporating the filtrate to a soft extract, digesting this with alcohol, distilling off the alcohol, and obtaining the salicin in crystals from the residue. Salicin is a glucoside, splitting into saligenin and sugar under the influence of dilute acids and heat.

Official Description.—Colorless, silky, shining, crystalline needles, rhombic prisms, or a white crystalline powder.

Odor, Taste, and Reaction.—Odorless; very bitter taste; neutral reaction.

Solubility.—*Water.* In 21 parts at 25° C. (77° F); in 3.3 parts at 80° C. (176° F.).
Alcohol. In 71 parts at 25° C. (77° F.); in 22 parts at 60° C. (140° F.).
Other solvents. Insoluble in ether and chloroform.

Tests for Identity.—It melts at 201.4° C. (394.5° F.). Upon ignition, it is consumed, leaving no residue.

Its aqueous solution is lævogyrate.

On heating a small portion of Salicin in a test-tube until it turns brown, then adding a few Cc. of water, and afterwards a drop of ferric chloride T.S., a violet color will be produced.

Sulphuric acid produces a red color, which disappears upon the addition of water.

Upon gently heating 0.1 Gm. of Salicin with 0.2 Gm. of potassium dichromate and 2 Cc. of diluted sulphuric acid, the odor of salicylic aldehyde will be developed.

Sulphuric acid containing a trace of molybdic acid produces with Salicin a violet color, changing to a deep brownish-red. Sulphuric acid containing a trace of potassium iodate produces a dark red color, changing to deep purple. Sulphuric acid containing about one-fifth of its volume of solution of formaldehyde produces a deep purplish-red color.

If to a small quantity of Salicin a few drops of nitric acid be added, the liquid evaporated to dryness, and the resulting yellowish residue treated with ammonia water and heated upon a water-bath with a fragment of potassium cyanide, a blood-red color will be developed.

Impurities and Tests for Impurities.—*Absence of, and difference from, alkaloids.* The aqueous solution of Salicin is not precipitated by tannic or picric acid T.S., nor by mercuric potassium iodide T.S.

Uses.—Salicin is used as a febrifuge, in doses of fifteen to thirty grains (1 to 2 Gm.).

TARAXACUM. U.S. Taraxacum

[DANDELION]

The dried root of *Taraxacum officinale* Weber (Syn. *Taraxacum Taraxacum* (Linné) Karsten) (Fam. *Compositæ*), collected in autumn.

Cylindraceous and tapering very gradually, of variable length, and 1 to 2 Cm. thick above, crowned with several short, thickish heads, usually simple or somewhat branched, the branches closely parallel; externally blackish-brown, longitudinally wrinkled; fracture short, showing a yellowish, porous central axis, surrounded by a thick, whitish bark, containing numerous milk vessels arranged in concentric circles; inodorous; bitter.

Taraxacum owes its bitterness to *taraxacin*, an acrid crystalline principle, soluble in alcohol and water. It also contains pectin, sugar, resin, gum, etc.

Uses.—It is used as a cholagogue. Dose, two drachms (8 Gm.).

Official Preparations

Fluidextractum Taraxaci Fluidextract of Taraxacum	Made with a menstruum of diluted alcohol, adding 5 percent. of solution of sodium hydroxide to the percolate (see page 421). Dose, one to three fluidrachms (4 to 12 Cc.)
Extractum Taraxaci Extract of Taraxacum	Made by percolating taraxacum in No. 30 powder with a menstruum of 1 part of alcohol and 7 parts of water (see page 454). Dose, thirty to sixty grains (2 to 4 Gm.)

LAPPA. U.S. Lappa

[BURDOCK ROOT]

The dried root of *Arctium Lappa* Linné, or of other species of *Arctium* (Fam. *Compositæ*), collected from plants of the first year's growth.

Nearly simple, fusiform, of variable length, 5 to 20 Mm. in diameter near the crown; frequently split or in broken pieces; externally grayish-brown, longitudinally wrinkled, the crown somewhat annulate, sometimes surmounted by a woolly tuft of leaf remains; fracture somewhat horny; a dark cambium separating the thick brownish bark from the yellowish porous and radiate wood, centrally hollow or containing a white pith-like tissue; odor slight; taste mucilaginous, sweetish, and slightly bitter.

Lappa contains a bitter substance, inulin, sugar, mucilage, etc. Dose, thirty grains (2 Gm.).

Uses.—It is used as a diuretic and alterative.

Official Preparation

Fluidextractum Lappæ Fluidextract of Lappa	Made with a menstruum of diluted alcohol (see page 404). Dose, thirty to sixty minims (2 to 4 Cc.)

SCILLA. U.S. Squill

The bulb of *Urginea maritima* (Linné) Baker (Fam. *Liliaceæ*), deprived of its dry, membranaceous outer scales, cut into thin slices and carefully dried, the central portions being rejected.

In irregular, more or less curved, somewhat translucent, yellowish-white or reddish-white segments, 3 to 5 Cm. long, brittle and pulverizable when dry, tough and flexible when damp; odor slight; taste mucilaginous, bitter, and acrid.

Squill contains the bitter principle *scillipicrin*, also *scillin*, and *scillitoxin* (*scillain*), a poisonous glucoside. There are also present a large quantity of mucilage, calcium oxalate, sinistrin ($C_6H_{10}O_5$), etc. Water and alcohol extract its virtues.

Uses.—It is expectorant, emetic, and diuretic. Dose, two grains (0.125 Gm.).

Official Preparations

Acetum Scillæ Vinegar of Squill	Made by percolating 100 Gm. of ground squill previously macerated in 900 Cc. of diluted acetic acid with the latter until 1000 Cc. are obtained (see page 431). Dose, fifteen to thirty minims (1 to 2 Cc.)
Fluidextractum Scillæ Fluidextract of Squill	Made with a menstruum of about 10 percent. acetic acid (see page 416). Dose, one and a half minims (0.1 Cc.)
Syrupus Scillæ Syrup of Squill	Made by dissolving 800 Gm. of sugar in 450 Cc. of vinegar of squill and enough water to make 1000 Cc. (see page 297). Dose 30 minims (2 Cc.)
Syrupus Scillæ Compositus Compound Syrup of Squill (*Coxe's Hive Syrup*)	Made with 80 Cc. each of fluidextracts of squill and senega, 2 Gm. of antimony and potassium tartrate, 750 Gm. of sugar, 20 Gm. of purified talc to aid in clearing the filtrate, and enough water to make 1000 Cc. (see page 297). Dose, fifteen to thirty minims (1 to 2 Cc.)
Tinctura Scillæ Tincture of Squill	Made by percolating 100 Gm. of squill with sufficient menstruum, made by mixing 3 parts of alcohol and 1 part of water, to make 1000 Cc. (see page 363). Dose ten to twenty minims (0.6 to 1.2 Cc.)

DIGITALIS. U. S. Digitalis

[Foxglove]

The dried leaves of *Digitalis purpurea* Linné (Fam. *Scrophulariaceæ*), collected from plants of the second year's growth, at the commencement of flowering.

Usually in more or less crumpled and broken fragments; ovate to oval, from 10 to 30 Cm. long, 5 to 15 Cm. broad, abruptly contracted into a winged petiole from 5 to 10 Cm. long; thin, dull and rather pale green or grayish underneath; upper surface wrinkled, sparsely hairy; lower surface densely and finely hairy, the venation conspicuously reticulated; margin crenate or erose-dentate; the midrib and principal veins broad and flat, usually purplish, the lower veins continued into the wings of the petiole; odor slight, characteristic; taste strongly bitter.

In the powder, stone-cells, star-shaped hairs, and calcium oxalate crystals are absent.

Digitalis has been the subject of exhaustive investigation. The principle *digitalin* was at one time considered to be an alkaloid. It is, as usually seen, a mixture of *digitoxin* and other neutral principles. Digitoxin is converted into *toxiresin* by the action of diluted acids and heat.

Uses.—Digitalis is used as a sedative and cardiac stimulant. Dose, one grain (0.065 Gm.).

Official Preparations

Infusum Digitalis Infusion of Digitalis	Made by pouring 500 Cc. of boiling water on 15 Gm. of digitalis, and, after macerating and straining, adding 100 Cc. of alcohol, 150 Cc. of cinnamon water, and water enough to make 1000 Cc. (see page 330). Dose, one-half to two fluidounces (2 to 8 Cc.)
Fluidextractum Digitalis Fluidextract of Digitalis	Made with a menstruum of diluted alcohol (see page 394). Dose, one to two minims (0.05 to 0.12 Cc.)
Extractum Digitalis Extract of Digitalis	Made by evaporating the fluidextract of digitalis to a pilular consistence (see page 445). Dose, one-fifth grain (0.01 Gm.)
Tinctura Digitalis Tincture of Digitalis	Made by percolating 100 Gm. of digitalis with sufficient diluted alcohol to make 1000 Cc. (see page 351). Dose, ten to fifteen minims (0.6 to 1 Cc.)

CONVALLARIA. U. S. Convallaria

[Lily-of-the-Valley]

The dried rhizome and roots of *Convallaria majalis* Linné (Fam. *Liliaceæ*).

Rhizome of horizontal growth, somewhat branched, length variable, 1 to 3 Mm. thick, cylindrical, whitish or pale-brown, marked with few circular stem-scars and at each joint with a circle of root-scars or thin, tortuous and branched roots; fracture fibrous, but weak; internally whitish; odor distinct; taste sweetish, bitter, and slightly acrid.

This drug contains *convallarin*, a glucoside, which is split into *convallaretin* and glucose by the action of dilute acids; it also contains another glucoside, *convallamarin* ($C_{23}H_{44}O_{12}$), which is the active principle. The fluidextract is the best preparation.

Uses.—Convallaria is a valuable sedative and cardiac stimulant, and is often used in place of digitalis. Dose, eight grains (0.5 Gm.).

Official Preparation

Fluidextractum Convallariæ Fluidextract of Convallaria	Made with a menstruum of 65 parts of alcohol and 35 parts of water (see page 393). Dose, five to fifteen minims (0.3 to 1 Cc.)

STROPHANTHUS. U. S. Strophanthus

The ripe seed of *Strophanthus Kombé* Oliver (Fam. *Apocynaceæ*), deprived of its long awn.

Of a light fawn-brown color, with a distinct greenish tinge; about 15 Mm. long and 4 to 5 Mm. wide, 2 to 2.5 Mm. thick, lance-ovoid, obtuse at the base, gradually acuminate and somewhat acute at the summit, usually twisted, bearing on one side a ridge running from about the centre to the apex ; silky-lustrous from a dense coating of closely appressed hairs, which mostly lie in longitudinal grooves on the surface ; fracture short and somewhat soft, the fractured surface whitish and oily ; kernel consisting of a thin endosperm enclosing straight cotyledons. Odor slight, or heavy when the seeds are crushed and moistened ; taste very bitter.

The endosperm, and often parts of the cotyledons, quickly assume a green color when crushed or cut and treated with concentrated sulphuric acid. Under the microscope the hairs are seen to be of a light greenish-brown color, 1 Mm. or less in length and to consist of but one thin-walled cell.

A decoction prepared with 1 part of the seed and 10 parts of water has a brownish color, and is not changed in appearance on the addition of iodine T.S., ferric chloride T.S., or mercuric potassium iodide T.S.

Strophanthus contains a glucoside, *strophanthin*, kombic acid, fatty matter, resin, extractive, etc. Strophanthin is the active principle. Alcohol and water extract it. Ether and purified petroleum benzin are sometimes used to percolate the drug to deprive it of the fatty matter before exhaustion with alcohol.

Uses.—Strophanthus is used as a sedative and cardiac stimulant in the dose of one grain (0.065 Gm.).

Official Preparation

Tinctura Strophanthi Tincture of Strophanthus	Made by percolating 100 Gm. of powdered strophanthus with a menstruum of 65 parts of alcohol and 35 parts of water until 1000 Cc. are obtained (see page 364). Dose, eight minims (0.5 Cc.)

STROPHANTHINUM. U.S. Strophanthin

A glucoside, or mixture of glucosides, obtained from Strophanthus. It should be kept in well-stoppered, amber-colored vials.

Preparation.—This glucoside may be made by exhausting strophanthus with alcohol acidulated with hydrochloric acid, evaporating the liquid to a soft extract, treating this with water, and shaking the aqueous liquid with chloroform to remove the fatty matter; the aqueous liquid is evaporated to obtain the crystals of strophanthin.

Official Description.—A white or faintly yellowish crystalline powder, containing varying amounts of water of crystallization, which it does not lose entirely without decomposition. Permanent in the air.

Taste and Reaction.—Taste intensely bitter ; *great caution should be used in tasting it ;* neutral reaction.

Solubility.—*Water.* Very soluble.

Alcohol. Very soluble in diluted alcohol ; less soluble in absolute alcohol.

Other solvents. Nearly insoluble in ether, chloroform, and benzene.

Tests for Identity.—When heated, it begins to fuse at 170° C. (338° F.), and is not completely melted until the temperature of 190° C. (374° F.) is reached.

Its solutions are dextrogyrate, and neutral to litmus paper.

Sulphuric acid produces with Strophanthin an emerald-green color, changing to brown.

If to an aqueous solution of Strophanthin a trace of ferric chloride T.S. and a few Cc. of sulphuric acid be added, a red-brown precipitate will be produced, turning dark green after one or two hours.

Strophanthin should not reduce alkaline cupric tartrate V.S. ; if its solution be heated to 70° C. (158° F.) with a small amount of diluted hydrochloric acid (1 in 20), it will be decomposed into strophanthidin, which precipitates, and a sugar, which will remain in solution, and which will reduce alkaline cupric tartrate V.S.

Uses.—Strophanthin is used as a cardiac stimulant in the dose of one two-hundredth grain (0.0003 Gm.).

CUSSO. U.S. Kousso

[BRAYERA]

The dried panicles of the pistillate flowers of *Hagenia abyssinica* (Bruce) Gmelin (Fam. *Rosaceæ*).

In rolls or compressed bundles from 25 to 40 Cm. long, reddish-brown, each branch arising from the axil of a sheathing bract, and each flower furnished at its base with two rounded bracts; calyx-tube top-shaped, pubescent, and bearing a circle, resembling an outer calyx, of five rigid, spreading, obovate, purple-veined bracts, which are larger than the five usually shrivelled and incurved oval calyx-lobes; the five caducous petals usually absent in the drug; carpels two; styles exserted and stigmas broad and hairy; odor slight; taste bitter.

The large stems should be rejected.

Kousso contains a bitter resinous principle, *kosin*, $C_{31}H_{38}O_{10}$, about 24 per cent. of tannin, volatile oil, gum, sugar, etc. It is used as an anthelmintic. Dose, one-half ounce (16 Gm.).

SANTONICA. U.S. Santonica

[LEVANT WORMSEED]

The dried unexpanded flower-heads of *Artemisia pauciflora* (Ledebour) Weber (Fam. *Compositæ*).

Heads 2 to 4 Mm. long, oblong-ovoid, slightly flattened, obtuse, consisting of an involucre of about 12 to 18 closely imbricated, glandular scales with broad midribs, enclosing 4 or 5 rudimentary florets. Santonica has the appearance of a granular, yellowish-green or greenish-brown, somewhat glossy powder; odor strong, peculiar, somewhat camphoraceous; taste aromatic and bitter.

Santonica contains *santonin* (about 2 percent.), *artemisin*, resin, volatile oil, gum, etc. It is used as an anthelmintic. The dose is fifteen to fifty grains (1 to 3.2 Gm.).

SANTONINUM. U.S. Santonin

$C_{15}H_{18}O_3 = 244.29$

The inner anhydride or lactone of santonic acid, obtained from Santonica. It should be kept in dark amber-colored vials and in a dark place.

Preparation.—Santonin may be made by exhausting santonica mixed with lime with diluted alcohol, distilling off the alcohol, and adding acetic acid to the residue. The precipitated santonin is purified by dissolving it in alcohol, treating with animal charcoal, and crystallizing. Santonin forms soluble compounds with alkalies, and it may be precipitated from its solutions by acids. Soluble compounds of santonin are unsuited for medicinal uses, because the comparative insolubility of santonin is one of its great advantages for use as an anthelmintic.

Official Description.—Colorless, shining, flattened rhombic prisms; permanent in the air. Sublimes without decomposition. Santonin which has become yellow may be converted into white crystals by recrystallization from alcohol.

Odor, Taste, and Reaction.—Odorless; nearly tasteless when first put into the mouth, but afterwards developing a bitter taste; neutral reaction.

Solubility.—*Water.* In 5300 parts at 25° C. (77° F.); in 800 parts at 80° C. (176° F.).

Alcohol. In 34 parts at 25° C. (77° F.); in 5 parts at 60° C. (140° F.).

Other solvents. In 78 parts of ether and 2.5 parts of chloroform at 25° C. (77° F.); soluble in alkalies and in most fatty oils.

Tests for Identity.—It melts at 170.3° C. (338.5° F.). When ignited, it is consumed, leaving no residue.

Its solutions are lævogyrate.

If 0.5 Gm. of Santonin be heated with 5 Cc. of alcoholic potassium hydroxide T.S., a red color will be developed.

Upon shaking 0.01 Gm. of Santonin with a cold mixture of 1 Cc. each of sulphuric acid and water, heating to 100° C. (212° F.), and adding a minute trace of very dilute solution of ferric chloride, a violet color will result.

Impurities and Tests for Impurities.—*Sugar and other readily carbonizable organic impurities.* Sulphuric acid added to Santonin should not produce more than a faintly yellow color.

Alkaloids. If 2 Gm. of Santonin be boiled with 80 Cc. of water and 5 Cc. of diluted sulphuric acid, and the liquid, after frequent shaking, be allowed to become cold and then filtered, mercuric potassium iodide T.S., or iodine T.S., should produce no cloudiness in 10 Cc. of the filtrate, mixed with 10 Cc. of distilled water, even after standing for three hours.

Uses.—Santonin is used as an anthelmintic, in doses of one to two grains (0.065 to 0.125 Gm.).

Official Preparation

Trochisci Santonini Troches of Santonin	Each troche contains about half a grain of santonin

ERGOTA. U.S. Ergot

[Ergot of Rye Spurred Rye]

The sclerotium of *Claviceps purpurea* (Fries) Tulasne (Fam. *Hypocreaceæ*), replacing the grain of rye, *Secale cereale* Linné (Fam. *Gramineæ*). Ergot should be moderately dried, and not exposed to a damp atmosphere. After being kept more than one year, it is unfit for use.

Subcylindrical, obscurely three-angled, tapering toward both ends but obtuse, somewhat curved, 1.5 to 3 Cm. long and about 3 Mm. thick ; externally purplish-black, longitudinally furrowed on each side, more conspicuously on the concave side ; fracture short, pinkish or reddish-white ; odor peculiar, heavy, increased by trituration with potassium hydroxide T.S.; taste disagreeable.

Ergot owes its activity, according to Dragendorff, to *sclerotic acid*, *sclererythrin*, *scleromucin*, *scleroiodin*, and *picrosclerotin ;* there are also present *scleroxanthin* and *sclerocrystallin*, with 25 percent. of fixed oil, mycose, and protein compounds. Kobert believes that the activity of ergot is due to *cornutine*, *ergotic acid*, and *sphacelic acid.* Diluted alcohol is a good solvent for the active principles.

Uses.—It is used as a parturient and hæmostatic. Dose, thirty grains (2 Gm.). Sclerotic acid has been used in medicine in doses of one-half to three-fourths of a grain (0.03 to 0.04 Gm.).

Official Preparations

Fluidextractum Ergotæ Fluidextract of Ergot	Made with a menstruum of 98 parts of diluted alcohol and 2 parts of acetic acid (see page 394). Dose, one-half to four fluidrachms (2 to 16 Cc.)
Extractum Ergotæ Extract of Ergot	Made by exhausting 1000 parts of ergot with a menstruum consisting of 10 parts of alcohol and 4 parts of water, evaporating the percolate to 250 parts, adding 250 parts of water, filtering, adding 50 parts of diluted hydrochloric acid to the filtrate, setting it aside for twenty-four hours, filtering, adding gradually 8.5 parts of monohydrated sodium carbonate, then 12.5 parts of glycerin and finally evaporating until the extract weighs 125 parts (see page 445). Dose, four grains (0.25 Gm.)
Vinum Ergotæ Wine of Ergot	Made by adding 200 Cc. of fluidextract of ergot and 50 Cc. of alcohol to 750 Cc. of white wine (see page 369). Dose, two fluidrachms (8 Cc.)

GOSSYPII CORTEX. U.S. Cotton Root Bark

[Gossypii Radicis Cortex, Pharm. 1890]

The dried bark of the root of *Gossypium herbaceum* Linné, or of other cultivated species of *Gossypium* (Fam. *Malvaceæ*).

In thin, flexible bands or quilled pieces, the bark 0.2 to 1 Mm. thick ; outer surface yellowish-brown, longitudinally wrinkled, with small lenticels, the periderm frequently exfoliated and somewhat fuzzy from partly detached bast fibres; inner surface whitish, longitudinally striate; fracture tough, fibrous, the bast-layer separable into thin laminæ; odor faint; taste slightly astringent and acrid.

Cotton root bark contains a yellow resin, *chromogene*, which becomes red upon exposure to air, fixed oil, tannin, starch, sugar, etc. It is emmenagogue. Dose, thirty grains (2 Gm.).

SANTALUM RUBRUM. U.S. Red Saunders

The heart-wood of *Pterocarpus santalinus* Linné filius (Fam. *Leguminosæ*).

Usually in chips, or a coarse, brownish-red powder; in transverse section slightly radiate, with numerous concentric rings, the medullary rays being 1 cell in width; nearly inodorous and almost tasteless.

Red Saunders imparts a red color to alcohol, but not to water.

This wood contains *santalic acid* (*santalin*), a resinous substance, *pterocarpin*, and *santal*. It is used solely as a red coloring. (See Tinctura Lavandulæ Composita.)

Drugs containing Saponinoid Principles, with their Preparations

QUILLAJA. U.S. Quillaja

[Soap Bark]

The dried bark of *Quillaja Saponaria* Molina (Fam. *Rosaceæ*), deprived of the periderm.

In flat pieces of variable length, 3 to 8 Mm. thick, or in small chips; outer surface brownish-white, often with small patches of cork attached, otherwise nearly smooth; inner surface yellowish-white, nearly smooth, with occasional circular depressions, conical projections or transverse channels; fracture uneven and strongly fibrous, the laminæ oblique to each other; odor slight; taste acrid.

The powder is strongly sternutatory, and contains calcium oxalate in monoclinic pyramids and prisms from 0.035 to 0.0200 Mm. long.

This South American bark owes its activity to a peculiar principle, *saponin*, $C_{32}H_{54}O_{18}$, a glucoside, splitting upon heating with dilute acid into *sapogenin* and sugar. Saponin is a sternutatory white powder, soluble in alcohol and hot water; its aqueous solution froths when agitated, like soapsuds; it is found in several other drugs. Quillaja also contains calcium oxalate and calcium sulphate. It is used principally for cleansing silk; in pharmacy it is used as an emulsifying agent, but, as saponin is not an inert substance, it is unfitted for this purpose.

Uses.—It is sometimes used as a medicine, and is irritant, diuretic, and stimulating. Dose, three grains (0.2 Gm.).

Official Preparations

Fluidextractum Quillajæ Fluidextract of Quillaja	Made with a menstruum of diluted alcohol (see page 411). Dose, three minims (0.2 Cc.)
Tinctura Quillajæ Tincture of Quillaja	Made by boiling 200 Gm. of quillaja with 800 Cc. of water, and, after evaporation to 600 Cc., adding 350 Cc. of alcohol and enough water to make 1000 Cc. (see page 361)

SARSAPARILLA. U.S. Sarsaparilla

The dried root of *Smilax medica* Chamisso and Schlechtendal, *Smilax ornata* Hooker, *Smilax papyracea* Duhamel, or a dried root known commercially as Honduras Sarsaparilla, which is probably obtained from *Smilax officinalis* Kunth (Fam. *Liliaceæ*).

Usually more than 1 M. in length, and 4 to 6 Mm. thick, with few or many fine roots adhering; externally varying from light gray-brown and smooth, with few deep and sharp wrinkles, to dark or orange-brown and less smooth, and with more and smaller wrinkles; internally whitish, with a thick, mealy, or sometimes horny cortex, a circular wood-zone, and a thick pith; fracture tough; nearly inodorous; taste mucilaginous, somewhat sweetish and bitter, slightly acrid.

The thick, woody, knotty rhizome, if present, should be removed.

Sarsaparilla contains a glucoside analogous to, if not identical with, saponin, termed *parillin*. When boiled with dilute acids, it splits into *parigenin* and grape sugar. There are also present starch, resin, coloring matter, and extractive. Alcohol and water are good solvents.

Uses.—It is popularly believed to be an alterative. Dose, thirty grains (2 Gm.).

Official Preparations

Fluidextractum Sarsaparillæ Fluidextract of Sarsaparilla	Made with a menstruum composed of 1 part of alcohol and 2 parts of water (see page 415). Dose, thirty to sixty minims (2 to 4 Cc.)
Fluidextractum Sarsaparillæ Compositum Compound Fluidextract of Sarsaparilla	Made by mixing 750 Gm. of sarsaparilla, 120 Gm. of glycyrrhiza, 100 Gm. of sassafras, and 30 Gm. of mezereum together, and percolating with a menstruum of diluted alcohol and 10 percent. of glycerin (see page 416). Dose, thirty to sixty minims (2 to 4 Cc.)
Syrupus Sarsaparillæ Compositus Compound Syrup of Sarsaparilla	Made by mixing 200 Cc. of fluidextract of sarsaparilla, 15 Cc. each of the fluidextracts of glycyrrhiza and senna, 0.2 Cc. each of the oils of sassafras, anise, and gaultheria, dissolving in the mixtrue 650 Gm. of sugar, and adding enough water to make 1000 Cc. (see page 296). Dose, four fluidrachms (16 Cc.)

SENEGA. U.S. Senega

The dried root of *Polygala Senega* Linné (Fam. *Polygalaceæ*).

Somewhat cylindrical, tapering, more or less flexuous, 3 to 15 Cm. long and 2 to 8 Mm. thick, bearing several similar, horizontal branches and a few rootlets; crown knotty with numerous buds and short stem-remnants; externally yellowish-gray or brownish-yellow, longitudinally wrinkled, usually marked by a keel which is more prominent in perfectly dry roots near the crown; fracture short, wood light yellow, usually excentrically developed; odor slight, nauseating; taste sweetish, afterwards acrid.

Senega contains *senegin*, $C_{32}H_{54}O_{18}$, *polygalic acid*, fixed oil, pectose, etc. *Senegin* is analogous to, if not identical with, saponin. Alcohol and water are good menstrua for extracting its virtues. Liquid preparations of senega are very apt to gelatinize, owing to the presence of pectin; this is obviated by using solution of potassium hydroxide or other alkali to dissolve it. Its fluidextract is used in preparing the compound syrup of squill (see page 297).

Uses.—Senega is a valuable expectorant and stimulant. Dose, fifteen grains (1 Gm.).

Official Preparations

Fluidextractum Senegæ Fluidextract of Senega	Made with a menstruum of 2 parts of alcohol, 1 part of water, and 3 percent. solution of potassium hydroxide (see page 418). Dose, ten to thirty minims (0.6 to 2 Cc.)
Syrupus Senegæ Syrup of Senega	Made with 200 Cc. of fluidextract of senega and 800 Cc. of syrup (see page 298). Dose, one to two fluidrachms (4 to 8 Cc.)

Unofficial Drugs containing Glucosides or Bitter Principles

Adonis Vernalis Pheasant's Eye	A cardiac stimulant. Contains the glucoside *adonidin*, of which the dose is one-third of a grain (0.02 Gm.)
Azedarach Azedarach	The bark of the root of *Melia Azadirachta*. It contains a resinous principle, and is used as an emetic and anthelmintic, in doses of fifteen to thirty grains (1 to 2 Gm.)
Cassia Marilandica American Senna	Cathartic. Used in the form of infusion
Caulophyllum (Blue Cohosh). U. S. P. 1890	The rhizome and roots of *Caulophyllum thalictroides* (Linné) Michaux (Fam. Berberidaceæ). It contains *saponin*, resin, starch, gum, albumin, etc. Used as an antispasmodic and emmenagogue.
Chamælirium Starwort	The rhizome of *C. luteum* and other species. It contains about 8 percent. of the glucoside *chamælirin*.
Cocillana Bark Sycocarpus Rusbyi	Stimulant, expectorant. Dose of fluidextract, ten to twenty-five drops (0.5 to 1.25 Cc.)
Condurango	Contains *condurangin*, an amorphous powder, soluble in water, alcohol, and chloroform. It is poisonous
Cornus Dogwood	The bark of the root of *Cornus florida*. It contains a bitter principle, *cornin*
Coronilla Scorpioides	Cardiac stimulant, diuretic
Coto Bark	Contains cotoin, $C_{22}H_{18}O_6$. Used in diarrhœa. Dose, three grains (0.2 Gm.); dose of *cotoin*, one grain (0.065 Gm.)
Crocus Saffron. U. S. P. 1890	The stigmas of *Crocus sativus* Linné (Fam. Irideæ). It contains *polychroit*, $C_{48}H_{60}O_{18}$, a glucoside which splits into *crocin* and glucose, volatile oil, etc. Used chiefly as a coloring and flavor. Dose, twenty grains (1.2 Gm.)
Frasera American Columbo	The root of *F. Walteri*, indigenous to the United States. It contains *gentisic acid* and *gentiopicrin*
Gillenia Gillenia	The rhizome of *G. trifoliata* and others, indigenous to the United States. It contains the bitter principle *gillenin*, resin, tannin, etc.
Gratiola Hedge Hyssop	From *G. officinalis*, indigenous to Southern Europe. It contains a bitter glucoside, *gratiolin*, etc.
Hedera Helix Ivy	Contains a glucoside, and hederic and tannic acids. Dose, twenty grains (1.3 Gm.) or more, dried and powdered, given in the atrophy of children
Helleborus Black Hellebore	The rhizome of *H. niger*, grown in Europe. It contains a crystalline glucoside, *helleborin*, $C_{26}H_{44}O_{15}$
Ilex Holly	The leaves of different species of *Ilex*, indigenous to the United States. It contains *ilixanthin*, $C_{17}H_{22}O_{11}$, and *ilicic acid*
Ledum Marsh Tea	The leaves of *L. palustre*, grown in North America. It contains the glucoside *ericolin*, $C_{34}H_{56}O_{21}$; also about 1 percent. of volatile oil
Ligustrum Privet	The leaves of *L. vulgare*, indigenous to Southern Europe. It contains *ligustrin*, etc.
Liriodendron Tulip Tree Bark	The bark of *L. tulipifera*, found in the Northern United States. It contains *liriodendrin*, which occurs in white prisms
Lupinus Albus Lupin	Contains a glucoside, *lupinin*, $C_{29}H_{32}O_{16}$. The seeds are anthelmintic, diuretic, and emmenagogue
Megarrhiza Californica (Man Root)	It contains a resinous substance called megarrhizitin, and a glucoside called *megarrhin*, possessing mydriatic properties
Melilotus Melilot	The leaves and flowering branches of *M. officinalis*, indigenous to Europe. It contains *coumarin*, $C_9H_6O_2$, and *melilotic acid*, $C_9H_{10}O_3$
Panax Ginseng	The root of *P. quinquefolium*, found in North America. It contains *panaquilon*, $C_{12}H_{25}O_9$
Para Coto Bark	Contains *para-cotoin*, $C_{19}H_{12}O_6$
Picrotoxinum, $C_{30}H_{34}O_{13}$ Picrotoxin. U. S. P. 1890	A neutral principle obtained from the seed of *Anamirta paniculata* Colebrook (Fam. Menispermaceæ). Odorless, bitter, colorless crystals, or a micro-crystalline powder, used as a tonic and antispasmodic, in doses of one-sixtieth grain (0.001 Gm.). Very poisonous in large doses
Piscidia Erythrina Jamaica Dogwood	Narcotic, anodyne. Dose of fluidextract is a fluidrachm (4 Cc.), to be increased carefully
Prinos Black Alder	The bark of *Prinos verticillatus*. It contains a bitter principle. It is a tonic, astringent, and alterative
Rhamnus Catharticus Purging Buckthorn	From *R. catharticus*, found in Europe. It contains rhamnocathartin, which occurs as a yellowish mass, etc.
Rhus Toxicodendron Poison Ivy. U. S. P. 1890	The fresh leaves of *Rhus radicans* Linné. Fam. Anacardiaceæ. It contains *toxicodendric acid*, fixed oil, etc. It is toxic, irritant, and rubefacient. Dose, five grains (0.3 Gm.)
Ruta Rue	The leaves of *R. graveolens*, which grows in Southern Europe. It contains a volatile oil and *rutin*, $C_{25}H_{28}O_{15}$, which occurs in needle-shaped crystals. Emmenagogue. Dose, fifteen to thirty grains (1 to 2 Gm.), two or three times a day, preferably given in infusion

Unofficial Drugs containing Glucosides or Bitter Principles—*Continued*

Sabbatia American Centaury	A simple bitter. Dose, a drachm (4 Gm.), given in the form of fluid extract or decoction
Salix Willow	The bark of *Salix alba*, and of other species of Salix. It contains a glucoside, *salicin* ($C_{13}H_{18}O_7$)
Saponaria Officinalis Soapwort Bouncing Bet	Contains a glucoside, saponin
Simaruba Simaruba	The bark of the root of *S. officinalis*, grown in South America. It contains a bitter principle, a volatile oil, etc. Tonic. Dose, from twenty to sixty grains (1.3 to 4 Gm.), best given in infusion
Taxus Yew	From *Taxus baccata*, grown in Asia. It contains volatile oil, *taxina*, etc.
Ustilago Corn Smut	From *Zea Mays*. It contains a principle analogous to sclerotic acid. Used as a parturient. Dose, fifteen to thirty grains (1 to 2 Gm.)
Viola Tricolor Pansy	The flowering herb of *Viola tricolor*. It contains a bitter principle, salicylic acid, etc. It is expectorant and alterative, in doses of fifteen to forty grains (1 to 2.6 Gm.)

Drugs containing Cathartic Principles, and their Preparations

SENNA. U.S. Senna

The dried leaflets of *Cassia acutifolia* Delile (Alexandria Senna), or of *Cassia angustifolia* Vahl (India Senna) (Fam. *Leguminosæ*).

Alexandria Senna.—Leaflets about 25 Mm. long and 10 Mm. broad, having extremely short, stout petioles; inequilaterally lanceolate or lance-ovate, acutely cuspidate, entire, subcoriaceous, brittle, pale-green or grayish-green, sparsely and obscurely hairy, especially beneath, the hairs appressed, 1-celled, and thick-walled; odor characteristic; taste somewhat mucilaginous and bitterish.

India Senna.—Leaflets 25 to 50 Mm. long, 10 to 15 Mm. broad, inequilaterally lanceolate, entire, thin, more abruptly pointed than those of Alexandria Senna, yellowish-green, and smooth above, paler beneath; in odor and taste closely resembling Alexandria Senna.

Senna should be free from stalks, and from Argel leaves, which are sometimes present in Alexandria Senna, and which are equilateral, 1-veined, thick, wrinkled, glaucous, and possess 3-celled hairs.

Senna, according to Tschirch, contains *anthroglucosennin*, *emodin*, *chrysophanic acid*, isoemodin, glucosennin, sennanigrin, and senna-rhamnetin. Emodin and chrysophanic acids are oxymethylanthraquinones upon which the cathartic action is believed to depend. *Cathartic acid* was formerly believed to be the chief purgative principle. When senna leaves are macerated in strong alcohol, the principles which produce griping and give odor and taste are dissolved, while the purgative properties are unaffected. Water and diluted alcohol are good solvents for its virtues. It is an important ingredient in the compound powder of glycyrrhiza and in the following.

Uses.—Senna is purgative and cathartic. The dose is two to four drachms (8 to 16 Gm.), when given in infusion.

Official Preparations

Fluidextractum Sennæ Fluidextract of Senna	Made by first exhausting the senna with alcohol to remove the griping principle, drying the powder, and again exhausting with a menstruum of diluted alcohol (see page 418). Dose, one-half to two fluidrachms (2 to 8 Cc.)
Infusum Sennæ Compositum Compound Infusion of Senna	60 Gm. of Senna, 120 Gm. each of manna and magnesium sulphate, 20 Gm. of fennel, and 1000 Cc. of boiling water (see page 331). Dose, four fluidounces (120 Cc.)
Syrupus Sennæ Syrup of Senna	Made by adding 5 Cc. oil of coriander to 250 Cc. fluidextract of senna and then enough syrup to make 1000 Cc. (see page 298). Dose, one fluidrachm (4 Cc.)
Confectio Sennæ Confection of Senna	Made from 100 Gm. each of senna and tamarind, 160 Gm. of cassia fistula, 70 Gm. of prune, 120 Gm. of fig, 555 Gm. of sugar, 5 Gm. of oil of coriander, and water 500 Cc. to make 1000 Gm. (see Confectiones). Dose, one drachm (4 Gm.)

TAMARINDUS. U.S. Tamarind

The preserved pulp of the fruit of *Tamarindus indica* Linné (Fam. *Leguminosæ*)
A pulpy mass of a light reddish-brown color, darkening with age so as to become dark brown, containing some branching fibres and numerous reddish-brown, smooth, oblong or quadrangular, compressed seeds, each enclosed in a tough membrane ; odor distinct ; taste sweet and agreeably acid.

Tamarind belongs to the class of acid saccharine fruits (see page 797), and also to the cathartics. It contains tartaric, citric, and malic acids, and potassium bitartrate. It is laxative, and is used in confection of senna. Copper is sometimes present in the acid pulp, owing to its having been concentrated in copper kettles. Dose, four drachms (16 Gm.).

CASSIA FISTULA. U.S. Cassia Fistula

[PURGING CASSIA]

The dried fruit of *Cassia Fistula* Linné (Fam. *Leguminosæ*).
Cylindrical, 25 to 50 Cm. long, about 20 Mm. in diameter, chestnut-brown in color, on one side a longitudinal groove and on the other a smooth line or slight ridge, indicating the two sutures ; indehiscent, the cavity divided transversely into numerous compartments, each containing a reddish-brown, glossy, flattish-ovoid seed embedded in a blackish-brown pulp ; with an odor resembling that of prunes, and a mawkish sweet taste.

Cassia fistula yields about 25 percent. of pulp, which contains pectin, sugar, albuminous principles, salts, etc. The pulp is laxative, and is used in confection of senna. Dose, one drachm (4 Gm.).

FICUS. U.S. Fig

The partially dried fruit of *Ficus Carica* Linné (Fam. *Moraceæ*).
Usually compressed, of irregular shape, fleshy, brownish or yellowish, frequently with an efflorescence of sugar ; apex with a small scaly orifice ; base with a scar or short stalk ; internally hollow, with numerous small, brownish-yellow, glossy and hard akenes ; odor distinct, fruity ; taste sweet, pleasant.

Figs contain mucilaginous constituents, sugar, fat, gum, etc. They are nutritious, demulcent, and laxative, and the pulp is used in confection of senna.

PRUNUM. U.S. Prune

The partly dried ripe fruit of *Prunus domestica* Linné (Fam. *Rosaceæ*).
Oblong, ellipsoidal, more or less compressed, 3 to 4 Cm. long ; externally brownish-black, shrivelled ; the sarcocarp sweet and acidulous ; putamen hard, smooth or irregularly ridged ; the seed, shaped like that of the almond but smaller, and of a bitter-almond taste.

This fruit contains sugar, malic acid, pectin, salts, etc. The pulp is laxative, and is used in confection of senna.

RHEUM. U.S. Rhubarb

The dried rhizome of *Rheum officinale* Baillon, *Rheum palmatum* Linné, and the var. *tanguticum* Maximowicz (Fam. *Polygonaceæ*), or probably other species of *Rheum*, grown in China and Thibet, and deprived of most of the bark and carefully dried.
Subcylindrical, barrel-shaped, conical, plano-convex or irregularly formed pieces, frequently with a large perforation ; hard and moderately heavy ; 5 to 15 Cm. long, 4 to 8 Cm. in diameter ; externally mottled with alternating striæ of light brown parenchyma cells and dark brown medullary rays, occasionally with

reddish-brown cork patches and small, radiate scars of fibrovascular tissue, smooth and sometimes covered with a bright brownish-yellow powder; fracture somewhat granular, presenting a peculiar marbled appearance; odor characteristic; taste bitter, astringent; gritty when chewed.

Powder bright orange yellow, becoming red with alkalies, containing rosette-shaped crystals of calcium oxalate which are from 0.050 to 0.100 Mm. in diameter, and spherical starch grains from 0.005 to 0.020 Mm. in diameter, either single or 2- to 4-compound.

Rhubarb contains *chrysophanic acid*, or dioxymethylanthraquinone, $C_{15}H_6O_2(OH)_2$; *emodin*, or trioxymethylanthraquinone, $C_{15}H_7O_2(OH)_3$; *rhein*, or tetraoxymethylanthraquinone, $C_{15}H_{10}O_6$; *rhabarberon*, $C_{15}H_{10}O_5$; and the resins, *erythroretin*, *phæoretin*, and *aporetin*. The astringent properties of rhubarb are due to *rheotannic acid*, $C_{26}H_{26}O_{14}$; calcium oxalate is also present.

Uses.—The therapeutical properties of rhubarb depend upon the valuable natural combination of its cathartic and astringent constituents. It is given in doses of ten to twenty grains (0.6 to 1.3 Gm.).

Official Preparations

Extractum Rhei Extract of Rhubarb	Made by evaporating 100 Cc. of the fluidextract of rhubarb to a pilular consistence (see page 453). Dose, four to ten grains (0.25 to 0.6 Gm.)
Fluidextractum Rhei Fluidextract of Rhubarb	Made with a menstruum of 4 parts of alcohol and 1 part of water (see page 413). Dose, fifteen minims (1 Cc.)
Tinctura Rhei Tincture of Rhubarb	Made by percolating 200 Gm. of rhubarb and 40 Gm. of cardamom with a menstruum of 500 Cc. of alcohol, 400 Cc. of water, and 100 Cc. of glycerin, to make 1000 Cc. (see page 362). Dose, one-half to one fluidrachm (2 to 4 Cc.)
Tinctura Rhei Aromatica Aromatic Tincture of Rhubarb	Made by percolating 200 Gm. of rhubarb, 40 Gm. each of Saigon cinnamon and cloves, and 20 Gm. of nutmeg, with a menstruum of 500 Cc. of alcohol, 400 Cc. of water, and 100 Cc. of glycerin, to make 1000 Cc. (see page 362). Dose, one-half to one fluidrachm (2 to 4 Cc.)
Syrupus Rhei Syrup of Rhubarb	Made by mixing 100 Cc. of fluidextract of rhubarb with 4 Cc. of spirit of cinnamon, and 10 Gm. of potassium carbonate dissolved in 50 Cc. of water, then adding enough syrup to make 1000 Cc. (see page 295). Dose, one to four fluidrachms (4 to 16 Cc.)
Syrupus Rhei Aromaticus Aromatic Syrup of Rhubarb	Made by adding 150 Cc. of aromatic tincture of rhubarb, in which 1 Gm. of potassium carbonate has been dissolved, to 850 Cc. of syrup (see page 296). Dose, two fluidrachms (8 Cc.)
Mistura Rhei et Sodæ Mixture of Rhubarb and Soda	15 Cc. of fluidextract of rhubarb, 35 Gm. of sodium bicarbonate, 3 Cc. of fluidextract of ipecac, 350 Cc. of glycerin, 35 Cc. of spirit of peppermint, and water to make 1000 Cc. (see page 304). Dose, one to eight fluidrachms (4 to 30 Cc.)
Pulvis Rhei Compositus Compound Powder of Rhubarb	25 Gm. of powdered rhubarb, 65 Gm. of magnesium oxide, and 10 Gm. of ginger. (See Pulveres.) Dose, half a drachm to a drachm (2 to 4 Gm.)
Pilulæ Rhei Compositæ Compound Pills of Rhubarb	Each pill contains about 2 grains (0.125 Gm.) of rhubarb, 1½ grains (0.1 Gm.) of purified aloes, 1 grain (0.065 Gm.) of myrrh, and $\frac{1}{10}$ grain (0.005 Cc.) of oil of peppermint

CHRYSAROBINUM. U.S. Chrysarobin

$C_{30}H_{26}O_7 = 494.46$

A neutral principle extracted from Goa Powder, a substance found deposited in the wood of *Vouacapoua Araroba* (Aguiar) Druce (Fam. *Leguminosæ*). Chrysarobin should be preserved in amber-colored, glass-stoppered vials.

Official Description.—A pale orange-yellow, micro-crystalline powder, irritating to the mucous membrane.

Odor and Taste.—Odorless and tasteless.

Specific Gravity.—0.920 to 0.922.

Solubility.—*Water.* Soluble in 4812 parts at 25° C. (77° F.); in 2170 parts at 80° C. (176° F.).

Alcohol. In 308 parts at 25° C. (77° F.); in 275 parts at 60° C. (140° F.).

Other solvents. In 25 parts of benzene, 18 parts of chloroform, 114 parts of ether, 30 parts of amyl alcohol, and 230 parts of carbon disulphide at 25° C. (77° F.); soluble in dilute or concentrated solutions of potassium hydroxide, forming a red-colored liquid, with green fluorescence.

Tests for Identity.—Chrysarobin, when heated, contracts and forms a dark mass at 148° C. (298.4° F.), and melts at 157° C. (314.6° F.). When ignited it is partly sublimed and finally entirely consumed.

In sulphuric acid it dissolves, forming a deep red solution. On pouring this liquid into water, Chrysarobin is deposited unchanged.

On mixing 0.001 Gm. of Chrysarobin with 2 drops of fuming nitric acid, a red-colored mixture is produced, which turns violet on the addition of a few drops of ammonia water (distinction from *chrysophanic acid,* which produces a yellow-colored liquid).

On shaking Chrysarobin with lime water for a few minutes, the liquid acquires a violet color (distinction from *chrysophanic acid,* which produces a yellow-colored liquid).

On adding a crystal of potassium dichromate to a solution of Chrysarobin in sulphuric acid, the red color is changed at first to green, then to purple, and finally to brown.

Uses.—Chrysarobin has been largely used in certain skin diseases, notably psoriasis. It has fallen into disuse mainly on account of the almost indelible stain produced upon the skin and clothing when it is employed. Internally, chrysarobin is cathartic, in the dose of one-half grain (0.03 Gm.).

Official Preparation

Unguentum Chrysarobini Chrysarobin Ointment	Made by rubbing 6 Gm. of chrysarobin with 94 Gm. of benzoinated lard. (See Unguenta)

CAMBOGIA. U. S. **Gamboge**

A gum-resin obtained from *Garcinia Hanburii* Hooker filius (Fam. *Guttiferæ*).

In cylindrical pieces, usually hollow in the centre, of variable length, 2 to 5 Cm. in diameter, externally grayish orange-brown, longitudinally striate; fracture conchoidal, orange-red, waxy, and somewhat porous; inodorous; taste very acrid.

Powder bright yellow, sternutatory, containing few or no starch grains. Not more than 25 percent. should be insoluble in alcohol; ash not more than 3 percent.

Gamboge contains about 75 percent. of resin called *gambogic acid,* which is dissolved by alkaline solutions, producing a red color; 20 percent. of gum is present, and this enables gamboge to be emulsified like the other gum resins. It is a powerful hydragogue cathartic, and is generally used in combination with other substances, which modify its action. Dose, one-half to three grains (0.03 to 0.2 Gm.).

JALAPA. U. S. **Jalap**

The dried tuberous root of *Exogonium Purga* (Wenderoth) Bentham (Fam. *Convolvulaceæ*), yielding, when assayed by the process given below not less than 7 percent. of total resin, of which not more than 15 percent. should be soluble in ether.

Napiform, pyriform or oblong, 3 to 8 Cm. long and 1 to 5 Cm. in diameter, the large roots often incised, more or less wrinkled, dark brown, with lighter colored spots, and short transverse ridges; hard, compact, internally dark brown, with numerous concentric circles composed of small resin cells; fracture resinous, lustrous, not fibrous; odor slight, but peculiar, smoky and sweetish; taste sweetish and acrid.

Jalap contains from 8 to 16 percent. of resin, the greater part of which is *convolvulin,* or *jalapurgin,* $C_{62}H_{100}O_{32}$, a glucoside insoluble in ether; there are also present gum, sugar, starch, etc. The value of jalap depends exclusively upon the amount of convolvulin present, and the U. S. Pharmacopœia gives the following assay for the resins:

Assay

Jalap, in No. 60 powder . . . . **10 Gm.**
Ether,
Alcohol,
Chloroform,
Distilled Water, each, a sufficient quantity

Insert a pledget of purified cotton in the neck of a funnel or small glass percolator, introduce the powdered jalap and pour ether upon it, keeping the funnel or percolator well covered, until 50 Cc. of percolate have been obtained. Transfer the percolate to a tared beaker, evaporate the ether by means of a water-bath, and weigh the residue. The weight multiplied by ten will give the percentage of ether-soluble resin in the jalap. Continue the percolation of the powder (which has been exhausted by the ether) with alcohol, until 100 Cc. of percolate have been obtained. Measure 20 Cc. of this percolate into a separator, add 20 Cc. of chloroform, mix the liquids and then add 20 Cc. of distilled water, and shake the separator thoroughly for one minute. When the liquids have completely separated, draw off the chloroform into a tared beaker, wash the separator with 5 Cc. of chloroform, and add the washings to the tared beaker. Evaporate the chloroform with the aid of a water-bath, and then dry the residue to a constant weight. This weight multiplied by fifty will give the percentage of resin insoluble in ether in the jalap. Add to this the percentage of ether-soluble resin already determined, and the result will be the percentage of total resin contained in the jalap.

Uses.—Jalap is an esteemed cathartic, and is generally used in combination with substances having similar properties. Dose, ten to twenty grains (0.6 to 1.3 Gm.).

Official Preparations

Pulvis Jalapæ Compositus Compound Powder of Jalap (Pulvis Purgans)	Made by mixing 35 Gm. of powdered jalap with 65 Gm. of potassium bitartrate. Dose, thirty to sixty grains (2 to 4 Gm.)
Resina Jalapæ Resin of Jalap	Made by exhausting jalap with alcohol, evaporating the tincture, adding it to water, and collecting the precipitated resin (see page 457). Dose, two to five grains (0.125 to 0.32 Gm.)

SCAMMONIUM. U.S. Scammony

A gum-resin obtained by incising the living root of *Convolvulus Scammonia* Linné (Fam. *Convolvulaceæ*).

In circular cakes or irregular, angular pieces of various sizes, greenish-gray or brownish-black, often covered with a grayish-white powder; very brittle, breaking with an angular fracture, porous and of a resinous lustre; internally of a uniform brownish-black color, more or less translucent in thin fragments; odor peculiar, somewhat cheese-like; taste slightly acrid.

Scammony is easily reduced to an ash-gray powder, which when triturated with water yields a greenish emulsion that does not effervesce on the addition of diluted hydrochloric acid; a decoction of Scammony, when cold, does not become blue with iodine T.S.; an alcoholic solution is not colored blue on the addition of tincture of ferric chloride; not less than 75 percent. should be soluble in ether, and when the residue left on the evaporation of the ethereal solution is dissolved in a hot solution of potassium or sodium hydroxide, it is not reprecipitated on the addition of diluted sulphuric acid; ash not more than 3 percent.

Scammony contains from 80 to 90 percent. of a resin having cathartic properties, called *scammonin*, or *orizabin*, $C_{34}H_{56}O_{16}$; this is identical with the jalapin obtained from *Ipomœa orizabensis* (see U. S. Dispensatory, 18th edition, p. 759).

Uses.—Scammony is a hydragogue cathartic; it is usually combined with other purgatives. Dose, four to ten grains (0.25 to 0.6 Gm.).

Official Preparation

Resina Scammonii Resin of Scammony	Made by digesting scammony with boiling alcohol several times, mixing the tinctures, distilling off the alcohol, adding the residue to water, and collecting the precipitate (see page 459). Dose, three grains (0.2 Gm.).

PODOPHYLLUM. U.S. Podophyllum

[MANDRAKE MAY APPLE ROOT]

The dried rhizome of *Podophyllum peltatum* Linné (Fam. *Berberidaceæ*).

Of horizontal growth and variable length, subcylindrical, flattened above, sometimes branched, consisting of joints 5 to 10 Cm. long, the internodes 2 to 8 Mm. thick; externally pale yellowish-brown to dark brown, nearly smooth; nodes annulate, the upper surface being marked by large cup-shaped scars, the lower surface with numerous root-scars or remains of roots; fracture short, the fractured surface mealy or horny, whitish to pale brown, with a circle of small wood bundles, and a large pith; odor slight, more pronounced and characteristic in the powder; taste sweetish and disagreeably bitter and acrid.

Podophyllum contains *picropodophyllin*, *podophyllotoxin*, and *podophyllinic acid.* The resinous substances extracted from the powdered rhizome with alcohol contain the purgative principles.

Uses.—It is cholagogue and cathartic, in doses of eight to twenty grains (0.5 to 1.3 Gm.).

Official Preparations

Fluidextractum Podophylli Fluidextract of Podophyllum	Made with a menstruum of 4 parts of alcohol and 1 part of water (see page 410). Dose, five to fifteen minims (0.3 to 0.9 Cc.)
Resina Podophylli Resin of Podophyllum	Made by percolating podophyllum with alcohol, distilling the alcohol from the tincture, and pouring the residue into water, cooled to 10° C. (50° F.), containing 1 percent. of hydrochloric acid (see page 458). Dose, one-tenth to one-half grain (0.005 to 0.03 Gm.)

LEPTANDRA. U.S. Leptandra

[CULVER'S ROOT]

The dried rhizome and roots of *Veronica virginica* Linné (Fam. *Scrophulariaceæ*).

Rhizome of horizontal or oblique growth, somewhat bent and branched, from 4 to 15 Cm. long and 3 to 8 Mm. in diameter; externally gray-brown to blackish-brown, with cup-shaped scars on the upper side; annulate, the inferior and lateral surfaces with coarse roots and root-scars; fracture tough and woody, branches readily separable from the main rhizome; internally, bark dark brown, 0.3 to 1 Mm. thick, wood hard, yellowish, pith large, purplish-brown; roots slender, longitudinally wrinkled, fragile; odor slight; taste bitter, slightly acrid.

Leptandra contains a crystalline principle, *leptandrin*,[1] resin, tannin, saponin, gum, mannite, etc. Crystalline leptandrin is bitter, and soluble in water, alcohol, and ether.

Uses.—Leptandra is cholagogue, cathartic, and alterative, in doses of fifteen to forty grains (1 to 2.6 Gm.).

Official Preparation

Fluidextractum Leptandræ Fluidextract of Leptandra	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 404). Dose fifteen minims (1 Cc.)

RHAMNUS PURSHIANA. U.S. Cascara Sagrada

The dried bark of *Rhamnus Purshiana* De Candolle (Fam. *Rhamnaceæ*), collected at least one year before being used.

In quills or curved pieces, of variable length and 1 to 5 Mm. thick; outer surface reddish-brown, frequently more or less covered with grayish or whitish lichens, several of which are peculiar to this bark, and with small groups of their brownish fruit-heads; inner surface yellowish to light brownish, becoming dark brown with age and reddened by alkalies, longitudinally striate; fracture short, with projections of bast fibres in the inner bark, and the medullary rays forming converging groups; odor distinct; taste bitter and slightly acrid.

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[1] This must not be confounded with the eclectic leptandrin, which is simply a resin extracted by alcohol.

This bark contains a neutral, crystallizable principle, *purshianin* or *cascarin*, also *rhamnetin*, *emodin*, and *chrysophanic acid*, resins, and tannic, malic, and oxalic acids.

Uses.—It is a laxative. Dose, fifteen grains (1 Gm.).

Official Preparations

Fluidextractum Rhamni Purshianæ Fluidextract of Cascara Sagrada	Made with a menstruum of 2 parts of alcohol and 3 parts of water (see page 412). Dose, fifteen minims (1 Cc.)
Fluidextractum Rhamni Purshianæ Aromaticum Aromatic Fluidextract of Cascara Sagrada	Made by macerating 1000 Gm. of cascara sagrada, 100 Gm. of glycyrrhiza, and 125 Gm. of magnesium oxide with 2000 Cc. of water for 12 hours, drying at a gentle heat, and percolating with a menstruum of 2 parts of alcohol, 1 part of water, and 1 part of glycerin, adding 10 Cc. of compound spirit of orange and enough diluted alcohol to make 1000 Cc. (see page 412). Dose, fifteen minims (1 Cc.)
Extractum Rhamni Purshianæ Extract of Cascara Sagrada	Made with a menstruum of 1 part of alcohol and 7 parts of water, evaporating the percolate to dryness, powdering, and adding enough powdered glycyrrhiza to make 250 Gm. (see page 452). Dose, four grains (0.25 Gm.)

FRANGULA. U.S. Frangula

[BUCKTHORN]

The dried bark of *Rhamnus frangula* Linné (Fam. *Rhamnaceæ*), collected at least one year before being used.

In quills of variable length, frequently flattened or crushed; bark 0.3 to 1 Mm. thick, externally grayish-brown to purplish-black, with numerous lenticels and occasional patches of foliaceous lichens; inner surface smooth, minutely striated, brownish-yellow to deep brown; fracture short and of a purplish-tint in the outer layer, fibrous and pale yellow in the inner layer; odor distinct; taste somewhat aromatic, sweetish, and bitter; when chewed, imparting to the saliva a yellow color.

The powder should be free from stone cells, and the fragments are colored reddish by sodium hydroxide T.S.

This bark contains *frangulin*, $C_{20}H_{20}O_9$, emodin, frangulic acid, isoemodin, tannin, resin, and other constituents.

Uses.—When frangula is fresh, it is emetic; when old, it is purgative, tonic, and diuretic. The dose is fifteen grains (1 Gm.).

Official Preparation

Fluidextractum Frangulæ Fluidextract of Frangula	Made with a menstruum of 5 parts of alcohol and 8 parts of water (see page 397). Dose, fifteen minims (1 Cc.)

EUONYMUS. U.S. Euonymus

[WAHOO]

The dried bark of the root of *Euonymus atropurpureus* Jacquin (Fam. *Celastraceæ*).

In quilled or curved pieces, 3 to 7 Cm. long and 0.5 to 5 Mm. thick; outer surface ashy or pale brownish-gray, with small, dark, scaly patches of soft cork; inner surface whitish or light brown, smooth; fracture short, whitish, with projecting, silky, modified bast fibres; odor distinct; taste sweetish, bitter and somewhat acrid.

This bark contains resins, a bitter principle called *euonymin*, *euonic acid*, starch, asparagin, and pectin.

Uses.—Euonymus is cholagogue, cathartic, and tonic. The dose is five to thirty grains (0.3 to 2 Gm.).

Official Preparation

Fluidextractum Euonymi Fluidextract of Euonymus	Made with a menstruum of 4 parts of alcohol and 1 part of water (see page 396). Dose, eight minims (0.5 Cc.)

ALOE. U.S. Aloes

[ALOE BARBADENSIS ALOE SOCOTRINA, PHARM. 1890]

The inspissated juice of the leaves of *Aloe vera* (Linné) Webb, *Aloe Chinensis* Baker, *Aloe Perryi* Baker, or other species of *Aloe* (Fam. *Liliaceæ*).

Aloes contains *aloin*, *emodin*, a trace of volatile oil, and a substance which has been improperly called resin. The aloin present in Socotrine aloes is *socaloin*, $C_{15}H_{16}O_7$. This may be distinguished from nataloin and barbaloin by Histed's test, as follows: barbaloin and nataloin are colored bright red by nitric acid; socaloin is not colored red. If nataloin be added to a drop of sulphuric acid on a white porcelain plate and a rod dipped in nitric acid be passed over it, the color changes to blue; with the other aloins no blue color is produced. According to Tschirch, emodin is present in aloes and aloin. A similar principle is also found in other cathartic drugs, senna, rhubarb, rhamnus, etc. He explains the cathartic action by the fact that the alkaline secretions of the upper intestines decompose and set free the emodin (trioxymethylanthraquinone), which produces peristalsis and the cathartic action follows.

Official Description.—In yellowish-brown or orange-brown to blackish-brown opaque masses; translucent in thin fragments; fracture uneven, dull and waxy, somewhat resinous, or smooth and glassy, somewhat conchoidal; occasionally exhibiting microscopic crystals of aloin.

Odor and Taste.—Odor characteristic; taste nauseous, bitter.

Tests for Identity.—Aloes gives a reddish color with nitric acid or with solutions of the alkalies.

If Aloes be dried at 100° C. (212° F.) until it ceases to lose weight, the loss of moisture should not exceed 10 percent.

A solution of Aloes in hot water yields, with a concentrated solution of sodium borate, a mixture having a greenish fluorescence.

If to 5 Gm. of Aloes 60 Cc. of boiling water be added, a nearly clear solution should be obtained, from which not more than 2 Gm. should separate on cooling.

Impurities and Test for Impurities.—*Gum, dextrin, and inorganic impurities.* If to 1 Gm. of Aloes 5 Cc. of Alcohol be added, and the mixture gently heated, a nearly clear solution should be obtained after cooling the liquid.

Uses.—Aloes is cathartic and emmenagogue. Dose, four to twenty grains (0.25 to 1.3 Gm.).

Official Preparations

Extractum Aloes Extract of Aloes	Made by dissolving aloes in boiling water, cooling, decanting, straining, and evaporating (see page 441). Dose, two to ten grains (0.125 to 0.6 Gm.)
Aloe Purificata Purified Aloes	See next article

ALOE PURIFICATA. U.S. Purified Aloes

	Metric	Old form
* Aloes	1000 Gm.	16 oz. av.
Alcohol	200 Cc.	3 fl. oz.

Heat the Aloes, by means of a water-bath, until it is completely melted. Then add the Alcohol, and, having stirred the mixture thoroughly, strain it through a No. 60 sieve, which has just been dipped into boiling water. Evaporate the strained mixture by means of a water-bath, constantly stirring, until a thread of the mass becomes brittle on cooling. Lastly, break the product, when cold, into pieces of a convenient size, and keep it in well stoppered bottles.

Official Description.—Purified Aloes is in irregular, brittle pieces of a dull brown or reddish-brown color, and having the peculiar odor of Aloes. It is almost entirely soluble in alcohol.

Aloes, owing to its method of preparation, always contains mechanical impurities,—sand, earth, chips, etc. Alcohol reduces the consistency of the melted aloes so that it can be strained, and it is easily evaporated afterwards.

Uses.—Purified aloes is used as a purgative in doses of five to fifteen grains (0.3 to 1 Gm.), and as an ingredient in compound extract of colocynth, compound pills of rhubarb, and compound tincture of benzoin, and is also used in the following :

Official Preparations

Tinctura Aloes Tincture of Aloes	Made by macerating 100 Gm. of purified aloes and 200 Gm. of powdered glycyrrhiza in sufficient diluted alcohol to make 1000 Cc. (see page 343). Dose, thirty minims to four fluidrachms (2 to 16 Cc.)
Tinctura Aloes et Myrrhæ Tincture of Aloes and Myrrh	Made by macerating 100 Gm. each of purified aloes, myrrh, and glycyrrhiza in a menstruum of 3 parts of alcohol and 1 part of water (see page 343). Dose, thirty minims to two fluidrachms (2 to 8 Cc.)
Pilulæ Aloes Pills of Aloes	Each pill contains 2 grains each of purified aloes and soap
Pilulæ Aloes et Ferri Pills of Aloes and Iron	Each pill contains about 1 grain each of purified aloes, exsiccated ferrous sulphate, and aromatic powder, with sufficient confection of rose
Pilulæ Aloes et Mastiches Pills of Aloes and Mastic	Each pill contains about 2 grains of purified aloes, and ½ grain each of mastic and red rose
Pilulæ Aloes et Myrrhæ Pills of Aloes and Myrrh	Each pill contains about 2 grains of purified aloes, 1 grain of myrrh, and ½ grain of aromatic powder

ALOINUM. U.S. Aloin

A neutral principle obtained from Aloes, varying more or less in chemical composition and physical properties according to the source from which it is obtained. Chiefly prepared from Curaçao Aloes.

Aloin is usually made by dissolving 1 part of Curaçao or Barbadoes Aloes in 10 parts of boiling water acidulated with hydrochloric acid, and after cooling, the liquid is decanted from the resinous matter, evaporated to about 2 parts, and set aside two weeks for crystals to form. The crystals are washed with acetic ether and dried. Socaloin and nataloin are not often found in commerce as the aloes from which they would be prepared are both scarce and the products would be expensive (see page 908).

Official Description.—A micro-crystalline powder or minute acicular crystals, lemon-yellow to dark yellow in color. It is slightly hygroscopic, the air-dried powder yielding 1 molecule of water of crystallization at 100° C. (212° F.).

Odor, Taste, and Reaction.—Slight odor of aloes and an intensely bitter taste; neutral reaction.

Solubility of Aloin from Curaçao Aloes.—*Water.* Aloin from Curaçao Aloes is almost completely soluble in 120 parts of water.

Alcohol. Almost completely soluble in 15 parts.

Other solvents. Almost completely soluble in 55 parts of acetone.

Tests for Identity.—When ignited, it is consumed without leaving a residue.

Aloin dissolves in water, forming a yellow solution, turns brown on standing, and has an intensely bitter taste.

Ammonia water and alkali-solutions dissolve Aloin, forming a yellow solution, soon turning red and exhibiting a greenish-red fluorescence.

Nitric Acid dissolves Aloin from Curaçao Aloes, forming a cherry-red solution (distinction from *Nataloin*, *Socaloin*, and *Capaloin*).

Aloin, when added to alkaline solutions, is rapidly decomposed, but if mixed with acid solutions, decomposition is slower. Aloin added in minute quantity to concentrated sulphuric acid forms a yellowish-red solution which, upon the addition of a small crystal of potassium dichromate, changes to an olive-green, then to a dark green, and finally, on standing, to a blue. If a large amount of potassium dichromate be used, the yellowish-red solution first turns purple, then brown, and finally green. Bromine water added to the aqueous solution of Aloin produces a pink color. Gold chloride T.S., when added to an aqueous solution of Aloin, turns it carmine-red, changing later to violet. A drop of ferric chloride T.S. added to an alcoholic solution of Aloin produces a brownish-green color.

If to a dilute aqueous solution of Aloin obtained from Curaçao Aloes, 1 drop of copper sulphate T.S. be added, a bright yellow color will be produced; upon adding a few drops of a concentrated solution of sodium chloride, the liquid will acquire a red color, and upon the further addition of a little alcohol the color will be changed to violet (distinction from *Nataloin* and *Capaloin*).

Impurity and Test.—*Limit of emodin.* On shaking 1 Gm. of Aloin with 10 Cc. of benzene for one minute and filtering, the filtrate should not impart more than a faint pink color to an equal volume of ammonia water (5 percent.), when shaken with it.

Uses.—Aloin is used as a cathartic, in doses of two grains (0.125 Gm.). The laxative dose is one-quarter to one grain (0.015 to 0.065 Gm.).

COLOCYNTHIS. U.S. Colocynth

[BITTER APPLE]

The peeled dried fruit of *Citrullus Colocynthis* Schrader (Fam. *Cucurbitaceæ*).

Globular, from 5 to 10 Cm. in diameter, white or yellowish-white, light, spongy, separable longitudinally into three carpels, each containing near the outer surface numerous ovoid, compressed, whitish or light brown seeds; odor slight; taste intensely bitter. The seeds should be separated and rejected.

Colocynth contains *colocynthin*, $C_{56}H_{84}O_{23}$, *colocynthitin*, gum, resin, etc. Colocynthin is a very bitter glucoside, splitting under the action of diluted acids into colocynthein and grape sugar. The seeds should be rejected. Colocynth is a hydragogue cathartic. Dose, one to five grains (0.065 to 0.3 Gm.).

Official Preparations

Extractum Colocynthidis Extract of Colocynth	Made by percolating colocynth with diluted alcohol, distilling off the alcohol, evaporating the residue to dryness, and reducing the dry mass to powder (see page 444). Dose, one-half grain (0.03 Gm.)
Extractum Colocynthidis Compositum Compound Extract of Colocynth	160 Gm. of extract of colocynth; 500 Gm. of purified aloes; 60 Gm. of cardamom; 140 Gm. each of resin of scammony and soap; 100 Cc. of alcohol (see page 444). Dose, five grains (0.3 Gm.)

ELATERINUM. U. S. Elaterin

$C_{20}H_{28}O_5 = 345.60$

A neutral principle obtained from elaterium, a substance deposited by the juice of the fruit of *Ecballium Elaterium* (Linné) A. Richard (Fam. *Curcurbitaceæ*).

Preparation.—It may be made by evaporating an alcoholic tincture of elaterium to the consistence of thin oil, and throwing the residue while yet warm into a weak boiling solution of potassium hydroxide. The potassium hydroxide holds the green resin in solution, and the elaterin crystallizes as the liquor cools. Or it may be made by exhausting elaterium with chloroform, and adding ether to the solution, which precipitates the elaterin.

Elaterium.—When the fruit of the squirting cucumber is sliced and placed upon a sieve, a perfectly limpid and colorless juice flows out, which soon becomes turbid, and in the course of a few hours begins to deposit a sediment. This, when collected and carefully dried, is very light and pulverulent, of a yellowish white color, slightly tinged with green, and is called elaterium. The yield is small,—only six grains from forty cucumbers,—but the elaterium is very powerful, one-eighth of a grain purging violently. Commercial elaterium is not usually made in this way, but by expression or other processes, whereby the yield is increased. This elaterium is, of course, weaker.

Official Description.—Minute, white, hexagonal scales or prismatic crystals; permanent in the air, and containing no water of crystallization.

Odor, Taste, and Reaction.—Without odor; slightly acrid, bitter taste; neutral reaction.

Solubility.—*Water.* Insoluble.

Alcohol. In 262 parts at 25° C. (77° F.) and in 75 parts at 60° C. (140° F.).

Other solvents. In 318 parts of ether, 22 parts of chloroform, 272 parts of benzene, and 200 parts of amyl alcohol at 25° C. (77° F.).

Tests for Identity.—When heated to 190° C. (374° F.) it turns yellow, and at 216° C. (420.80 F.) it melts, forming a yellowish-brown liquid. On ignition, it is consumed without leaving any residue.

Sulphuric acid colors it yellow, the color changing gradually to scarlet.

Sulphuric acid containing a trace of ammonium vanadate produces a blue color, changing to green and then to brown.

Sulphuric acid containing a drop of formaldehyde gives a brown color.

Sulphuric acid containing a trace of potassium dichromate produces an olive-green color, gradually turning darker.

If a crystal of Elaterin be added to a little hydrochloric acid, and this evaporated to dryness, the residue washed with hot water, and afterwards treated with sulphuric acid, a brownish-red (amaranth) color will be produced.

Impurity and Test.—*Absence of, and difference from, alkaloids.* An alcoholic solution of Elaterin should not be precipitated by tannic acid T.S., mercuric chloride T.S., or platinic chloride T.S.

Uses.—Elaterin is the purgative principle of elaterium. The dose is one-tenth of a grain (0.005 Gm.).

Official Preparation

Trituratio Elaterini Trituration of Elaterin	10 Gm. of elaterin are rubbed with 90 Gm. of sugar of milk. Dose, one-half grain (0.03 Gm.)

Unofficial Drugs containing Cathartic Principles

Bryonia (Bryony). U.S. P. 1890	The root of *Bryonia alba*, and of *Bryonia dioica* Linné (Fam. *Cucurbitaceæ*). It contains a glucoside, *bryonin*, resin, starch, etc., and is used as a hydragogue cathartic in doses of twenty grains (1.3 Gm.)
Colutea Bladder Senna	The leaves of *Colutea arborescens* Linné (Fam. *Leguminosæ*). It is slightly purgative and is used chiefly in domestic treatment, in infusions (℥i to Oi)
Juglans (Butternut). U. S. P. 1890	The bark of the root of *Juglans cinerea* Linné (Fam. *Juglandaceæ*), collected in autumn. It contains *nucin*, fixed oil, volatile oil, tannin, etc., and is cathartic and tonic in sixty grain doses (4 Gm.)
Kamala (Rottlera). U. S. P. 1890	The glands and hairs from the capsules of *Mallotus philippinensis* (Lamarck) Mueller Arg. (Fam. *Euphorbiaceæ*). It contains *rottlerin*, resins, coloring matter, etc. Used as a tænifuge and purgative in doses of one to three drachms (4 to 12 Gm.) suspended in mucilage or syrup
Rumex (Yellow Dock). U. S. P. 1890	The root of *Rumex crispus* Linné, and of some other species of *Rumex* (Fam. *Polygonaceæ*). It contains chrysophanic acid (*rumicin*), mucilage, tannin, etc. Said to be tonic, alterative, and astringent. Dose, sixty grains (4 Gm.)

Drugs containing Astringent Principles, and their Preparations

GALLA. U.S. Nutgall

An excrescence on *Quercus infectoria* Olivier (Fam. *Cupuliferæ*), caused by the punctures and deposited ova of *Cynips tinctoria* Olivier.

Subglobular, 1 to 2 Cm. in diameter, externally blackish olive-green or blackish-gray, more or less tuberculated above, the basal portion nearly smooth and contracted into a short stalk, sometimes with a perforation on one side; heavy; fracture horny, yellowish or grayish; in the centre a cavity containing either the partly developed insect, or pulverulent remains left by it; nearly inodorous; taste strongly astringent.

Nutgall contains about 50 percent. of tannin, 2 percent. of gallic acid, sugar, gum, resin, and starch.

Uses.—It is astringent. Dose, eight to fifteen grains (0.5 to 1 Gm.).

Official Preparations

Tinctura Gallæ Tincture of Nutgall	Made by percolating 200 Gm. of powdered nutgall with a menstruum of 900 Cc. of alcohol and 100 Cc. of glycerin to obtain 1000 Cc. (see page 351). Dose, one fluidrachm (4 Cc.)
Unguentum Gallæ Nutgall Ointment	Made by rubbing 20 Gm. of finely powdered nutgall with 80 Gm. of ointment. (See Unguenta)

ACIDUM TANNICUM. U.S. Tannic Acid

$HC_{14}H_9O_9 = 319.66$

[GALLOTANNIC ACID TANNIN]

A monobasic organic acid [$C_{13}H_9O_7.COOH$], obtained from nutgall.

Preparation.—Tannic acid, or *Tannin*, may be made by the modification of Leconnet's method, which was formerly official, as follows:

Take of Nutgall, in fine powder, Ether, each, a sufficient quantity. Expose the Nutgall to a damp atmosphere for twenty-four hours, and then mix it with sufficient Ether, previously washed with water, to form a soft paste. Set this aside, covered closely, for six hours; then, having quickly enveloped it in a close canvas cloth, express it powerfully between tinned plates, so as to obtain the liquid portion. Reduce the resulting cake to powder, and mix it with sufficient Ether, shaken with one-sixteenth of its bulk of water, to form again a soft paste, and express as before. Mix the liquids, and allow the mixture to evaporate spontaneously until it assumes a syrupy consistence; then spread it on glass or tinned plates, and dry it quickly in a drying closet. Lastly, remove the dry residue from the plates with a spatula, and keep it in a well stoppered bottle.

The explanation of this process is that water and ether form a soluble compound with tannic acid, which may be separated from the nutgall residue by expression; then, by exposing the thick solution to heat, the ether and water are evaporated, leaving the tannic acid in soft, cellular, friable scales upon the plates.

Official Description.—A light yellowish, amorphous powder, gradually turning darker when exposed to air and light, usually cohering in the form of glistening scales or spongy masses.

Odor, Taste, and Reaction.—Odorless, or having a faint, characteristic odor; strongly astringent taste; acid reaction.

Solubility.—*Water.* Very soluble at 25° C. (77° F.); very soluble in boiling water.

Alcohol. Very soluble at 25° C. (77° F.); very soluble in boiling alcohol.

Other solvents. Very soluble in about 1 part of glycerin, with the application of a moderate heat; almost insoluble in absolute ether, chloroform, benzene, or petroleum benzin.

Tests for Identity.—When heated on platinum foil, the Acid is gradually consumed, leaving not more than 0.6 percent. of ash.

The addition of a small quantity of ferric chloride T.S. to an aqueous solution of the Acid produces a bluish-black color or precipitate.

On adding to an aqueous solution (1 in 100) of Tannic Acid a small quantity of calcium hydroxide T.S., a pale bluish-white, flocculent precipitate is produced which is not dissolved on shaking (difference from *gallic acid*), and which becomes more copious and of a deeper blue by the addition of a moderate excess of calcium hydroxide T.S., while a large excess of the latter imparts a pale pinkish tint to the solution.

The aqueous solution of the Acid produces precipitates with most alkaloids and glucosides, and with test solutions of gelatin, albumin, and starch (distinction from *gallic acid*).

Impurities and Tests for Impurities.—*Gum or dextrin.* If 2 Gm. of Tannic Acid be dissolved in 10 Cc. of boiling water, and the liquid allowed to cool, no turbidity should be produced on diluting 5 Cc. of the solution with 10 Cc. of alcohol.

Resinous substances. Or with 10 Cc. of water.

Uses.—Tannic acid is powerfully astringent, in doses of three to ten grains (0.2 to 0.6 Gm.). Its solution in glycerin is a valuable liquid form of administration. It is an ingredient in styptic collodion, and in the following:

Official Preparations

Glyceritum Acidi Tannici Glycerite of Tannic Acid	20 Gm. of tannic acid, 80 Gm. of glycerin. Dissolve (see page 307). Dose, ten to forty minims (0.6 to 2.6 Cc.)
Unguentum Acidi Tannici Ointment of Tannic Acid	Made by dissolving 20 Gm. of tannic acid in 20 Gm. of glycerin, and rubbing the solution with 60 Gm. of ointment. (See Unguenta)
Trochisci Acidi Tannici Troches of Tannic Acid	Each troche contains about one grain of tannic acid. (See Trochisci)

ACIDUM GALLICUM. U.S. Gallic Acid

$HC_7H_5O_5 + H_2O = 186.65$

An organic acid [$C_6H_2(OH)_3.COOH + H_2O$], usually prepared from tannic acid.

Preparation.—The former official process may be used for making gallic acid. Take of Nutgall, in the fine powder, 36 oz.; Purified Animal Charcoal, Distilled Water, each, a sufficient quantity. Mix the Nutgall with sufficient Distilled Water to form a thin paste, and expose the mixture to the air, in a shallow glass or porcelain vessel, in a warm place, for a month, occasionally stirring it with a glass rod, and adding from time to time sufficient Distilled Water to preserve the semifluid consistence. Then submit the paste to expression, and, rejecting the expressed liquor, boil the residue in 8 pints of Distilled Water for a few minutes, and filter while hot through Purified Animal Charcoal. Set the liquid aside that crystals may form, and dry them on bibulous paper. If the crystals be not sufficiently free from color, they may be purified by dissolving them in boiling Distilled Water, filtering through a fresh portion of Purified Animal Charcoal, and again crystallizing. Gallic acid may be prepared synthetically. It is closely related to tannic acid, and both are usually found together in the same plants.

Official Description.—White, or pale fawn-colored, silky, interlaced needles, or triclinic prisms; permanent in the air.

Odor, Taste, and Reaction.—Odorless; an astringent and slightly acidulous taste; acid reaction.

Solubility.—*Water.* In from 83 to 86 parts at 25° C. (77° F.); in 3 parts of boiling water.

Alcohol. In 4.14 parts at 25° C. (77° F.); in 1 part of boiling alcohol.

Other solvents. In 40 parts of ether and in 12 parts of glycerin; very slightly soluble in chloroform, benzene, or petroleum benzin.

Tests for Identity.—When heated at 100° C. (212° F.), the Acid loses its water of crystallization (nearly 9.58 percent.). At about 200° C. (392° F.) it begins to melt, and at a higher temperature it is gradually decomposed. At a low red heat it is consumed without leaving a residue.

If 5 Cc. of a cold saturated aqueous solution of the Acid be treated, in a watch-glass, with 6 drops of sodium hydroxide T.S., the liquid will gradually acquire a deep green color, which is changed to reddish or brownish-red by acids.

Gallic Acid neither colors nor precipitates pure ferrous salts, but forms a bluish-black precipitate with ferric salts.

On adding to a cold saturated aqueous solution of Gallic Acid some calcium hydroxide T.S., a bluish-white precipitate will form, where the test solution is temporarily in excess, and will disappear on shaking. When the test solution has been added in excess, the precipitate no longer dissolves, and the liquid acquires a tint which is blue by reflected and green by transmitted light, and becomes pink on the addition of a large excess of calcium hydroxide T.S. (distinction from *tannic acid*).

Impurity and Test.—*Difference from, and absence of, tannic acid.* An aqueous solution of the Acid should not precipitate alkaloids, gelatin T.S., albumin T.S., or starch T.S.

Uses.—Gallic acid is astringent. Dose, five to fifteen grains (0.3 to 1 Gm.).

PYROGALLOL. U.S. Pyrogallol

$C_6H_6O_3 = 125.10$

[PYROGALLIC ACID]

A triatomic phenol [$C_6H_3(OH)_3$ 1 : 2 : 3], obtained chiefly by carefully heating gallic acid. Pyrogallol should be kept in dark amber-colored bottles.

When gallic acid is sublimed, it is converted by the heat into pyrogallol and carbon dioxide.

$$\underset{\text{Gallic Acid}}{C_7H_6O_5} = \underset{\text{Pyrogallol}}{C_6H_6O_3} + \underset{\text{Carbon Dioxide}}{CO_2}$$

Official Description.—Light, white laminæ or fine needles, acquiring a grayish tint on exposure to air and light.

Odor, Taste, and Reaction.—Odorless; bitter taste. The freshly prepared aqueous solution is neutral to litmus paper and colorless, but gradually acquires by exposure to the air a brown color and an acid reaction, due to absorption of oxygen; the absorption of oxygen and change of color take place very rapidly if the solution contains an alkali hydroxide.

Solubility.—*Water.* In 1.6 parts at 25° C. (77° F.); very soluble in boiling water.
Alcohol. In 1 part at 25° C. (77° F.); very soluble in boiling alcohol.
Other solvents. In 1.1 parts of ether at 25° C. (77° F.).

Tests for Identity.—When heated to 132° C. (269.6° F.) Pyrogallol melts and sublimes unchanged. When ignited it is consumed, leaving no residue.

The aqueous solution of Pyrogallol (1 in 10) reduces solutions of the salts of silver, gold, and mercury even in the cold.

When freshly prepared, 1 Cc. of the aqueous solution (1 in 20) is colored brownish-red by a few drops of ferric chloride T.S. and this color is changed to deep bluish-black on the addition of one or two drops of ammonia water. A bluish-black color is also produced in the aqueous solution of Pyrogallol by freshly prepared ferrous sulphate T.S.

Uses.—Pyrogallol is used in the form of ointment in the treatment of psoriasis, although its use is not without danger; it is also employed in photography.

GAMBIR. U.S. Gambir

[To replace CATECHU, PHARM. 1890 PALE CATECHU]

An extract prepared from the leaves and twigs of *Ourouparia Gambir* (Hunter) Baillon (Fam. *Rubiaceæ*).

Irregular masses, or cubes about 25 Mm. in diameter; externally reddish-brown, pale brownish-gray, or light brown; fracture dull-earthy, friable, crystalline; inodorous, bitterish, very astringent, with a sweetish after-taste; free from starch.

Not less than 70 percent. should be soluble in alcohol; when incinerated, Gambir should not yield more than 5 percent. of ash.

Gambir was introduced into the U. S. P. (8th Rev.) to replace catechu, because the former can be obtained in commerce much more uniform in quality. It contains *catechutannic acid*, a peculiar form of tannin, which is insoluble in ether and turns greenish-black with ferric salts. *Catechin* and *catechol* are also present. Owing to the decomposition of the tannic acid, the liquid preparations often gelatinize.

Uses.—It is astringent and tonic. Dose, fifteen grains (1 Gm.).

Official Preparations

Tinctura Gambir Composita Compound Tincture of Gambir	Made by macerating 50 Gm. of gambir and 25 Gm. of Saigon cinnamon with 750 Cc. of diluted alcohol for 48 hours, filtering, and adding enough menstruum to make 1000 Cc. (see page 352). Dose, one to four fluidrachms (4 to 16 Cc.)
Trochisci Gambir Troches of Gambir	Each troche contains about 1 grain of gambir

KINO. U.S. Kino

The inspissated juice of *Pterocarpus Marsupium* Roxburgh (Fam. *Leguminosæ*).

Small, angular, dark red, shining pieces, brittle, in thin layers ruby-red and transparent; inodorous, very astringent, and sweetish, tingeing the saliva deep-red.

Soluble in alcohol, nearly insoluble in ether, and slowly soluble in cold water.

Kino contains *kinotannic acid*, pyrocatechin, kino red, kinoin, gum, etc. Owing to the decomposition of the kinotannic acid, the liquid preparations, if not protected, frequently gelatinize. Tincture of kino (U. S. P. 8th Rev.), is heated to destroy an enzyme which it is said induces gelatinization by aiding in the decomposition of the kinotannic acid.

Uses.—Kino is astringent and tonic. Dose, five to twenty grains (0.3 to 1.3 Gm.).

Official Preparation

Tinctura Kino Tincture of Kino	Made by triturating 50 Gm. of kino and 10 Gm. of purified talc with sufficient of a mixture of 150 Cc. of glycerin and 200 Cc. of water to produce a thin, smooth magma, heating, cooling, and restoring the original weight with water, adding 650 Cc. of alcohol, filtering, and adding sufficient alcohol to make 1000 Cc. of tincture (see page 355). Dose, one fluidrachm (4 Cc.)

HÆMATOXYLON. U.S. Hematoxylon

[Logwood]

The heart-wood of *Hæmatoxylon campechianum* Linné (Fam. *Leguminosæ*).

Usually in small chips, reddish-brown, the freshly cut surface dark yellowish-red; on transverse section the wood showing medullary rays which are four cells wide; odor faint, agreeable; taste sweetish, astringent.

Hematoxylon imparts to water containing a little acid a yellowish color, which is changed to purple or violet-red by alkalies.

When the surface has a greenish metallic lustre, the wood has undergone fermentation and should be rejected.

Logwood contains *hematoxylin*, $C_{16}H_{14}O_6$, a colorless, sweet principle, which is reddened upon exposure to light, and turned blackish purple upon contact with alkalies, yielding *hematëin*, $C_{16}H_{12}O_6.H_2O$. *Hematoxylin* is used officially as an indicator. (See Hematoxylin Test Solution, Tests and Reagents.) It also contains tannin, resin, etc. It is used largely in the arts for dyeing.

Uses.—Logwood is astringent. Dose, forty grains (2.6 Gm.).

Official Preparation

Extractum Hæmatoxyli Extract of Hematoxylon	An aqueous extract made by evaporating the decoction (see page 447). Dose, fifteen grains (1 Gm.)

KRAMERIA. U.S. Krameria

[Rhatany]

The dried root of *Krameria triandra* Ruiz and Pavon (Peruvian Krameria), *Krameria Ixina* Linné (Savanilla Krameria) or of *Krameria argentea* Martius (Para or Brazilian Krameria) (Fam. *Krameriaceæ*).

Peruvian Krameria.—Root-branches several or many, usually attached to a short, hard, and woody tap-root, which is 1.5 to 4 Cm. thick, roughly fissured, and supporting a knotty, several to many-headed crown; roots of variable length, rarely exceeding 50 Cm. and usually less than 1 Cm. thick, cylindrical, flexuous or wavy, very flexible; externally light red-brown, more or less marked with dark, scaly patches, especially upward, otherwise smoothish, devoid of transverse fissures; fracture tough and splintery, the pinkish-brown bark occupying less than one-third of the radius, the wood yellowish or pinkish-white, finely radiate; inodorous and of a very astringent taste.

Savanilla and Brazilian Kramerias.—Branches usually occurring detached from the tap-root and crown, less flexuous than those last described, externally of a purple-brown or chocolate brown, and with numerous transverse cracks or fissures; fracture less tough than that of Peruvian Krameria, the bark and wood both darker, the bark occupying two-fifths or more of the radius, the taste more astringent than that of Peruvian Krameria.

Krameria contains about 18 percent. of *kramerotannic acid*, starch, gum, rhatannic red, etc.

Uses.—It is a valuable astringent. Dose, fifteen grains (1 Gm.).

Official Preparations

Extractum Krameriæ Extract of Krameria	An aqueous extract made with cold water (see page 447). Dose, eight grains (0.5 Gm.). Used in making Trochisci Krameriæ. (See Trochisci)
Fluidextractum Krameriæ Fluidextract of Krameria	Made with diluted alcohol (see page 403). Dose, fifteen minims (1 Cc.). Used in making Syrupus Krameriæ (see page 294)
Tinctura Krameriæ Tincture of Krameria	Made by percolating 200 Gm. of krameria with sufficient diluted alcohol to make 1000 Cc. (see page 355). Dose, one fluidrachm (4 Cc.)

QUERCUS. U. S. White Oak

[Quercus Alba, Pharm. 1890)

The dried bark of *Quercus alba* Linné (Fam. *Cupuliferæ*), collected from trunks or branches ten to twenty-five years of age, and deprived of the periderm.

In nearly flat pieces, 2 to 10 Mm. thick; externally light brown, becoming darker with age, rough-fibrous; fracture uneven, coarsely fibrous; odor distinct; taste strongly astringent; not tingeing the saliva yellow when chewed.

White oak is largely used in tanning leather. It contains about 10 percent. of tannic acid, with quercin, pectin, resin, and brownish-red coloring matter (oak red).

Uses.—It is astringent. Dose, fifteen to thirty grains (1 to 2 Gm.).

Official Preparation

Fluidextractum Quercus Fluidextract of Quercus	Made with diluted alcohol, containing 10 percent. of glycerin (see page 411). Dose, fifteen minims (1 Cc.)

ROSA GALLICA. U. S. Red Rose

The dried petals of *Rosa gallica* Linné (Fam. *Rosaceæ*), collected before expanding.

Usually in small cones, consisting of numerous imbricated, roundish, retuse, deep purplish-red, yellow-clawed petals, having a characteristic odor and a bitterish, slightly acidulous, and distinctly astringent taste.

Red rose contains *quercitrin* and *quercitannic acid.* The pale red coloring matter is made bright red by the addition of sulphuric acid. Red rose is an ingredient in pills of aloes and mastic, and in the following.

Uses.—It is slightly astringent and tonic. The infusion of red rose is an elegant vehicle for many substances. (See Part V.)

Official Preparations

Fluidextractum Rosæ Fluidextract of Rose	Made with diluted alcohol containing 10 percent. of glycerin (see page 414). Dose, thirty minims (2 Cc.). Used to make syrup of rose (see page 296) and honey of rose (see page 300)
Mel Rosæ Honey of Rose	Made by mixing the fluidextract with clarified honey (see page 300). Used as a flavor
Confectio Rosæ Confection of Rose	Made by mixing 80 Gm. of red rose, 640 Gm. of sugar, 120 Gm. of clarified honey, and 160 Cc. of stronger rose water. Used as an excipient
Syrupus Rosæ Syrup of Rose	Made by mixing 125 Cc. fluidextract of rose with 300 Cc. of water, adding 10 Cc. of diluted sulphuric acid, filtering, dissolving 750 Gm. of sugar in filtrate, and adding water to make 1000 Cc. (see page 296). Used as a flavor

OLEUM ROSÆ. U.S. Oil of Rose

A volatile oil distilled from the fresh flowers of *Rosa damascena* Mueller (Fam. *Rosaceæ*), having, when assayed by the process given below, a saponification value of not less than 10 nor more than 17. It should be kept in well-stoppered, amber-colored vials, in a cool place, protected from light. When dispensed, it should be completely liquefied by warming, if necessary, and well mixed by agitation.

Oil of rose is made in Turkey by distillation. It is used solely as a perfume or flavor.

Official Description.—A pale yellowish, transparent liquid.
Odor and Taste.—Strong, fragrant odor of rose; mild, slightly sweetish taste.
Specific Gravity.—0.855 to 0.865 at 25° C. (77° F.).
Solubility.—*Alcohol.* The addition of 70 percent. alcohol precipitates the paraffin hydrocarbons of the Oil, but forms a clear solution with its other constituents, the solution being slightly acid to litmus T.S.
Tests for Identity.—The congealing point, when determined according to the following method, should be between 18° and 22° C. (64.4° and 71.6° F.).

Introduce about 10 Cc. of Oil into a test-tube of about 15 Mm. diameter; insert a thermometer in such a manner that it touches neither the bottom nor the sides of the tube. Raise the temperature of the Oil in the tube from 4° to 5° above the saturation point by grasping it in the hand, and shake the tube gently. Allow the oil to cool, and when the first crystals appear, note the temperature. This is regarded as the congealing point; a second test should be made for confirmation.

Assay.—Place in a weighing bottle about 2 Cc. of the Oil of Rose, and weight it accurately. Transfer it, with the aid of a little alcohol, to a 100 Cc. flask, and add 20 Cc. of half-normal alcoholic potassium hydroxide V.S. Connect the flask with a reflux condenser, and boil the mixture during thirty minutes on a water-bath. When cool, add 50 Cc. of distilled water and a few drops of phenolphthalein T.S., and titrate with half-normal sulphuric acid V.S. Subtract the number of Cc. of half-normal sulphuric acid V.S. required, from 20 (the 20 Cc. of half-normal alcoholic potassium hydroxide V.S. taken), multiply the difference by 27.87, and divide by the weight of the Oil to obtain the saponification value.

RHUS GLABRA. U.S. Rhus Glabra

The dried fruit of *Rhus glabra* Linné (Fam. *Anacardiaceæ*).

Flattened-ovoid, 3 to 4 Mm. in diameter, externally deep crimson, glandular-tomentose; endocarp light yellow, smooth, shiny, enclosing a single seed; inodorous; taste acidulous and astringent.

See page 797.

RUBUS. U.S. Rubus

[Blackberry]

The dried bark of the rhizome of *Rubus villosus* Aiton, *Rubus nigrobaccus* Bailey, or of *Rubus cuneifolius* Pursh (Fam. *Rosaceæ*).

In elongated, tough, flexible quills, from 3 to 6 Mm. in diameter, or in similar bands, the bark 1 to 2 Mm. thick; outer surface deep red-brown or dark gray-brown, occasionally blackish-brown, smoothish or somewhat scaly; inner surface yellow or pale brownish, strongly and coarsely long straight-striate; fracture tough-fibrous; readily splitting; inodorous; taste strongly astringent and bitterish.

Rubus owes its astringent properties to tannic acid. There are also present gum, coloring matter, etc.

Uses.—Rubus is used as an astringent. The dose is fifteen grains (1 Gm.).

Official Preparations

Fluidextractum Rubi Fluidextract of Rubus	Made with a menstruum of diluted alcohol (see page 414). Dose, a fluidrachm (4 Cc.). Used in making Syrupus Rubi (see page 296)
Syrupus Rubi Syrup of Rubus	Made by mixing 250 Cc. of fluidextract of rubus with syrup to make 1000 Cc. (see page 296). Dose, one fluidrachm (4 Cc.)

GERANIUM. U.S. Geranium

[CRANESBILL]

The dried rhizome of *Geranium maculatum* Linné (Fam. *Geraniaceæ*).

Of horizontal growth, cylindraceous, somewhat flattened and rather sharply tuberculated, 2.5 to 10 Cm. long and 3 to 15 Mm. in diameter; longitudinally wrinkled, dark brown; fracture short, light reddish-brown or purplish; bark thin; wood indistinct; central pith large; odor slight; taste strongly astringent.

Geranium contains about 15 percent. of tannic acid, with brownish-red coloring matter, starch, sugar, pectin, etc.

Uses.—It is astringent and tonic. Dose, fifteen grains (1 Gm.).

Official Preparation

Fluidextractum Geranii Fluidextract of Geranium	Made with a menstruum of 2 parts of alcohol, 1 part of water, and 10 percent. of glycerin (see page 398). Dose, a fluidrachm (4 Cc.)

HAMAMELIDIS CORTEX. U.S. Hamamelis Bark

[WITCHHAZEL BARK]

The bark and twigs of *Hamamelis virginiana* Linné (Fam. *Hamamelidaceæ*).

In irregularly quilled or bent pieces, 1 to 2 Mm. thick; outer surface grayish-brown, with numerous lenticels, or reddish-brown, with short transverse ridges or scars, or somewhat scaly in older bark; the thin, corky layer easily removed from the pale cinnamon-colored middle bark; inner surface pale cinnamon-colored, or sometimes yellowish, smooth, or finely striate; fracture of young bark short, of old bark tough in the bast layer; odor faint; taste astringent, somewhat bitter and pungent. Twigs flexible and tough, of irregular length, not more than 6 Mm. in diameter, branching, or bearing nodes at intervals of 2 to 5 Cm.; externally varying from yellowish brown to deep purplish-brown, lightly longitudinally wrinkled, and having scattered small circular whitish or pale lenticels; bark occupying about one-fifth of the radius; wood greenish-white, lightly radiate, and exhibiting one to three annual rings; pith centric, small.

Hamamelis bark contains tannic acid, chlorophyll, bitter principle, mucilage, etc.

Uses.—It is astringent, slightly hæmostatic, and sedative. Dose, thirty grains (2 Gm.).

Official Preparation

Aqua Hamamelidis Hamamelis Water	Made by macerating hamamelis bark in water, distilling and adding alcohol as a preservative (see page 277). Dose, two fluidrachms (8 Cc.)

HAMAMELIDIS FOLIA. U.S. Hamamelis Leaves

[HAMAMELIS, PHARM. 1890 WITCHHAZEL LEAVES]

The dried leaves of *Hamamelis virginiana* Linné (Fam. *Hamamelidaceæ*), collected in autumn.

Short-petiolate; blade inequilaterally obovate or oval, about 10 Cm. long; base slightly heart-shaped and oblique, margin coarsely sinuate; upper surface pale or brownish-green; under surface light green, with a satiny lustre, the midrib and veins prominent, the few hairs having much thickened walls and a very small lumen; petiole short, stout; odor slight; taste astringent, slightly aromatic and bitter.

Uses.—It is astringent. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Hamamelidis Foliorum Fluidextract of Hamamelis Leaves	Made with 1 part of alcohol, 2 parts of water, and 10 percent. of glycerin (see page 400). Dose, thirty minims (2 Cc.)

CHIMAPHILA. U.S. Chimaphila

[PIPSISSEWA]

The dried leaves of *Chimaphila umbellata* (Linné) Nuttall (Fam. *Ericaceæ*). Oblanceolate, 2.5 to 5 Cm. long, 8 to 18 Mm. broad, the upper portion coarsely and sharply serrate, acute or somewhat obtuse, the lower wedge-shaped and nearly entire; coriaceous, smooth, and uniformly dark green on the upper surface, paler beneath, the veins being very prominent; odor slight; taste astringent and bitter.

Chimaphila contains about 5 percent. of tannic acid, with *chimaphilin*, *ericolin*, *arbutin*, *urson*, sugar, gum, etc.

Uses.—It is used as an astringent, diuretic, and tonic, in doses of thirty grains (2 Cc.).

Official Preparation

Fluidextractum Chimaphilæ Fluidextract of Chimaphila	Made with diluted alcohol (see page 387). Dose, thirty minims (2 Cc.)

UVA URSI. U.S. Uva Ursi

[BEARBERRY]

The dried leaves of *Arctostaphylos Uva-ursi* (Linné) Sprengel (Fam. *Ericaceæ*). Obovate or oblong-spatulate, 15 to 30 Mm. long, obtuse, slightly revolute on the margin, tapering into a very short and stout petiole, coriaceous; upper surface dark green, finely reticulate; lower surface slightly pubescent; odor slight; taste strongly astringent and somewhat bitter.

Uva ursi contains about 6 percent. of tannic acid, with gallic acid, *urson*, *arbutin*, *ericolin*, gum, resin, coloring matter, etc.

Uses.—It is used as a diuretic, astringent, and tonic. Dose, thirty grains (2 Gm.).

Official Preparations

Fluidextractum Uvæ Ursi Fluidextract of Uva Ursi	Made with a menstruum of 2 parts of alcohol, 5 parts of water, and 30 percent. of glycerin (see page 422). Dose, thirty minims (2 Cc.)

SALVIA. U.S. Salvia

[SAGE]

The leaves of *Salvia officinalis* Linné (Fam. *Labiatæ*). (See page 812.)

Unofficial Astringent Substances

Agrimonia Agrimony	From *A. Eupatoria*, grown in North America. It contains tannin and bitter principle
Areca Nut Semen Arecæ (Betel Nut)	Vermifuge. Dose, one to two drachms (4 to 8 Gm.)
Bistorta Bistort	The rhizome of *Polygonum B.*, grown in Canada and the United States. It contains about 20 percent. of tannin, etc.
Castanea Chestnut. U. S. P. 1890	The leaves of *Castanea dentata* (Marshall) Sudworth (Fam. *Cupuliferæ*), collected in September or October, while still green. It contains tannin, mucilage, etc., and is astringent and tonic. Dose, thirty grains (2 Gm.)
Catechu Catechu U. S. P. 1890	From *Uncaria Gambir*, grown in the East India Islands. It contains catechin, catechutannin, etc., (see Gambir p. 914).
Comptonia Sweet Fern	The leaves of *C. asplenifolia*, found in North America. It contains volatile oil, tannin, etc.
Diospyros Persimmon	The bark of *D. virginiana*, grown in the United States. It contains tannin and malic acid
Epigæa Trailing Arbutus	From *E. repens*, found in North America. It contains tannin, and the principles common to the Ericaceæ
Epilobium Willow Herb	From *E. angustifolium*, found in the Northern Hemisphere. It contains tannin, mucilage, etc.
Epiphegus Beech-drop	From *E. virginiana*, a parasitic plant found in North America. It contains tannin, bitter principle, etc.

Unofficial Astringent Substances—*Continued*

Eugallol (Pyrogallol-mono-acetate)	A brownish yellow, syrupy liquid, soluble in water. Used like pyrogallol in skin diseases. Applied externally
Gallanol (Gallic Acid Anilide, Gallinol, Gallanilide), $C_6H_5NH.CO.C_6H_2(OH)_3$	Prepared by boiling tannic acid with aniline. In grayish scales or powder, having a bitter taste, soluble in water, alcohol, and ether; very astringent. Used in skin diseases, in 3 to 20 percent. ointments, and as a dusting powder when mixed with talc
Hepatica Liverwort	The leaves of *H. triloba*, found in North America. It contains tannin, mucilage, etc.
Heuchera Alum root	The root of *H. americana*, found in the United States. It contains about 20 percent. of tannin
Hieraceum Hawkweed	From different species of *Hieraceum*, found in North America. It contains tannin
Hippocastanum Horsechestnut Bark	The bark of *Æsculus Hippocastanum*, grown in North America. It contains tannin and various other principles
Ilex Paraguayensis Maté, Paraguay Tea	The leaves of *I. paraguayensis*, grown in Brazil. It contains tannin and 10 to 15 percent. of caffeine, etc.
Monesia Monesia	From *Chrysophyllum glycyphlœum*, found in Brazil. A vegetable extract, alterative, and astringent. Dose, from two to ten grains (0.125 to 0.6 Gm.) every hour or two
Myrobalanus Myrobalans	From different species of *Terminalia*, grown in Southern Asia. It contains about 45 percent. of gallo-tannic acid
Nymphæa Water Lily	The rhizome of *N. odorata*, found in the United States. It contains tannin and mucilage
Potentilla Cinquefoil	From *P. canadensis*, found in North America. It contains tannin
Pulmonaria Lungwort	From *P. officinalis*, grown in Europe. It contains tannin
Quercus Tinctoria Black Oak Bark	From *Q. coccinea*, var. *tinctoria*, grown in the United States. It contains tannin, etc.
Rhus Aromatica Sweet Sumach	From *R. aromatica*. It contains tannin, coloring matter, gum resin, etc.
Rosa Centifolia Pale Rose. U. S. P. 1890	The petals of *Rosa centifolia* Linné (Fam. *Rosaceæ*). It contains tannin, volatile oil, sugar, etc. Used as a flavor
Saligallol (Pyrogallol Disalicylate)	A resinous solid, sold in the form of a 33 percent. solution in acetone. Used in skin diseases, and as a vehicle for other dermic preparations. It is applied externally in the form of a 2 to 15 percent. solution
Spiræa Hardhack	From *S. tomentosa*, found in North America. It contains tannin and bitter principle
Statice Marsh Rosemary	The root of *S. Limonium*, grown in Europe. It contains tannin and volatile oil
Tannalbin (Exsiccated Tannin Albuminate)	A compound of tannin and albumin in the form of a red-brown powder; tasteless and odorless. It contains about 50 percent. of tannic acid. Used as an intestinal astringent, in doses of three to ten grains (0.2 to 0.6 Gm.)
Tannigen (Diacetyl Tannin), $C_{14}H_8(COCH_3)_2O_9$	An acetic ester of tannic acid. A yellowish, odorless, and tasteless hygroscopic powder; insoluble in water, very soluble in alcohol. An intestinal astringent in chronic diarrhœa, in doses of five to fifteen grains (0.3 to 1 Gm.)
Tannoform (Methylene-ditannin, Tannin-formaldehyde), $CH_2(C_{14}H_9O_9)_2$	Obtained by adding formaldehyde to an aqueous solution of tannic acid and precipitating with hydrochloric acid. A reddish-brown powder insoluble in water. Used as a dusting powder, as a drying antiseptic, and in intestinal disorders. Dose, four to eight grains (0.25 to 0.5 Gm.)
Tormentilla Tormentil	From *T. erecta*, grown in Europe. It contains about 20 percent. of tannin

CHAPTER LX

ALKALOIDS

THE alkaloids are unquestionably the most important of all the organic compounds which are of interest to the pharmacist, the most active and potent remedies that he dispenses belonging to this class of principles.

Chemically, many of the vegetable alkaloids are closely related to pyridine, and this fact, established by Königs,—and the successful synthesis of some of the alkaloids starting from a pyridine base,—has led chemists to endeavor to base a classification upon it. Alkaloids possess many properties which show their similarity to ammonia. They are mostly composed of carbon, hydrogen, nitrogen, and oxygen; in some oxygen is wanting. Alkaloids are obtained from both the vegetable and the animal kingdom. They are found in nearly all the organs of plants, in roots, barks, stems, leaves, petals, seeds, etc. The distinctive features of alkaloids are as follows:

1. They all contain nitrogen. The non-volatile alkaloids are mostly solids, the volatile alkaloids are chiefly liquids.
2. Alkaloids restore the color of reddened litmus. They unite with acids to form salts, like the derived ammonias, and they are precipitated from their saline solutions upon the addition of alkalies.
3. They are generally the active principles of the plants in which they reside, and are mostly very poisonous or energetic remedies, having a bitter, acrid, or pungent taste.
4. They are mostly crystallizable and colorless, although some are amorphous, a few liquid, and several are distinctly colored; they are insoluble in water, but are soluble in alcohol, chloroform, petroleum benzin, benzene, and some in ether. Their salts, on the other hand, are mostly soluble in water, less so in alcohol, but insoluble in chloroform, ether, petroleum benzin, and benzene.
5. Alkaloids are mostly precipitated by one or more of the following reagents, usually forming definite chemical compounds: mercuric-potassium iodide, gold chloride, tannic acid, phosphomolybdic acid, and picric acid.

The official nomenclature adopted for alkaloids requires that the last syllable shall terminate in *ine:* thus, quinine, morphine, strychnine. The Latin termination is *ina:* as, quinina, morphina, etc. The names of neutral principles and glucosides end in *in:* as salicin, santonin, gelatin.

OPIUM. U.S. Opium

The concrete, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné (Fam. *Papaveraceæ*), and yielding, in its normal, moist condition, not less than 9 percent. of crystallized morphine when assayed by the process given below.

In irregular, flattened, more or less rounded masses of variable size, externally grayish-brown, covered with remnants of poppy leaves and with occasional fruits of a species of *Rumex;* more or less plastic when fresh, but becoming hard on keeping; internally dark brown, somewhat lustrous; odor strong; narcotic; taste bitter and characteristic.

OPII PULVIS. U.S. Powdered Opium

Opium dried at a temperature not exceeding 85° C. (185° F.) and reduced to a very fine powder.

Powdered Opium, for pharmaceutical and medicinal purposes, when assayed by the process given below, should yield not less than 12 percent. nor more than 12.5 percent. of crystallized morphine.

Powdered Opium of a higher percentage may be brought within these limits by admixture with Powdered Opium of a lower percentage or powdered sugar of milk in proper proportions.

OPIUM GRANULATUM. U.S. Granulated Opium

Opium dried at a temperature not exceeding 85° C. (185° F.) and reduced to a coarse (No. 20) powder.

Granulated Opium, when assayed by the process given below, should yield not less than 12 percent. nor more than 12.5 percent. of crystallized morphine. Granulated Opium of a higher percentage may be brought within these limits by admixture with Granulated Opium of a lower percentage, powdered sugar of milk or acacia, in proper proportions.

Morphiometric Assay.—The proportion of morphine which any particular specimen of opium will furnish may be considered as the best test of its value, except that of an actual trial upon the system. The following is the official process for assaying it:

Assay

Opium, in any condition to be valued	**10.0 Gm.**
Ammonia Water	**3.5 Cc.**
Alcohol,	
Ether,	
Distilled Water,	
Lime Water, each, a sufficient quantity	

Introduce the Opium (which, if fresh, should be in very small pieces, and if dry, in very fine powder) into an Erlenmeyer flask having a capacity of about 300 Cc., add 100 Cc. of distilled water, stopper the flask, and agitate it every ten minutes (or continuously in a mechanical shaker) during three hours. Then pour the contents as evenly as possible upon a wetted filter having a diameter of 12 Cm., and, when the liquid has drained off, wash the residue with distilled water, carefully dropped upon the edges of the filter and its contents, until 150 Cc. of filtrate have been obtained. Then carefully transfer the moist Opium back to the flask by means of a spatula, add 50 Cc. of distilled water, agitate it thoroughly and repeatedly during fifteen minutes, and return the whole to the filter. When the liquid has drained off, wash the residue, as before, until the second filtrate measures 150 Cc., and finally collect about 20 Cc. more of a third filtrate. Evaporate carefully in a tared dish, first, the second filtrate to a small volume, then add the first filtrate, rinsing the vessels with the third filtrate, and continue the evaporation until the residue weighs 14 Gm. Rotate the concentrated solution about in the dish until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 Cc., and rinse the dish with a few drops of water at a time until the entire solution, after the rinsings have been added to the flask, weighs 20 Gm. Then add 10 Gm. (or 12.2 Cc.) of alcohol, shake the flask well, add 25 Cc. of ether, and repeat the shaking. Now add the ammonia water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least sixteen hours.

Remove the stopper carefully, and should any crystals adhere to it, brush them into the flask. Place in a small funnel two rapidly acting filters, of a diameter of 7 Cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with ether, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 10 Cc. of ether. Then pour the liquid in the flask into the filter, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when the liquid has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than 15 Cc. in all. Use a feather or rubber-tipped glass rod to remove the crystals that adhere to the flask. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-liquor, and afterwards wash them, drop by drop, from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc. or more, if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.) until its weight remains constant, then carefully transfer the crystals to a tared watch-glass and weigh them.

Place the crystals (which are not quite pure) in an Erlenmeyer flask, add lime water (10 Cc. for each 0.1 Gm. of morphine) and shake the flask at intervals during half an hour. Pass the liquid through two counterpoised, rapidly acting, plainly folded filters, one within the other (the triple fold of the inner filter being laid against the single fold of the outer filter), rinse the flask with more lime water and pass the washings through the filter until the filtrate, after acidulating, no longer yields a precipitate with mercuric potassium iodide T.S. Press the filters until nearly dry between bibulous paper and dry them to a constant weight, then weigh the contents, using the outer filter as a counterpoise. Deduct the weight of the insoluble matter on the filter from the weight of the impure morphine previously found. The difference, multiplied by 10, represents the percentage of crystallized morphine contained in the Opium.

OPIUM DEODORATUM. U. S. Deodorized Opium

	Metric	Old form
***Powdered Opium**	**500 Gm.**	8 oz. av.
Purified Petroleum Benzin, a sufficient quantity		

Macerate the Powdered Opium for twenty-four hours in a wide-mouthed, well-closed bottle, with sufficient Purified Petroleum Benzin to completely cover it, shaking occasionally. Decant the liquid as closely as possible and repeat the treatment with Purified Petroleum Benzin. Again decant the liquid and pour the contents of the bottle into a plain filter contained in a glass funnel which should be well covered, drain, and then slowly percolate the residue with Purified Petroleum Benzin until the latter passes without color. Remove the filter containing the Opium from the funnel and expose the powder to the open air, so that it may dry thoroughly.

Deodorized Opium should be kept in well-stoppered bottles, and, when assayed by the process given under *Opium* (see page 922), should be found to yield not less than 12 percent. nor more than 12.5 percent. of crystallized morphine.

Opium in coarser powder may be deodorized in the same manner as directed above.

Opium owes its value to the narcotic alkaloids present in it. Twenty-one alkaloids have been proved to exist in various kinds of opium, and several more have been announced, but their existence has not been certainly confirmed. Two acids are found in opium combined with the alkaloids,—*i.e.*, meconic and lactic acids; there are also present *meconin*, $C_{10}H_{10}O_4$, *meconoiosin*, $C_8H_{10}O_2$, both neutral principles, pectin, glucose, mucilage, caoutchouc, wax, and odorous, fatty, and coloring matters. *Meconic acid* is colored red by ferric salts, the color not being discharged by solution of mercuric chloride. A solution of potassium sulphocyanate is colored in a similar manner, but it is rendered colorless by solution of mercuric chloride. The alkaloids are as follows:

Morphine, $C_{17}H_{19}NO_3.H_2O$. The chief principle, and the first alkaloid discovered (see separate article, page 926).

Codeine, $C_{18}H_{21}NO_3.H_2O$. An important narcotic alkaloid (see page 929).

Narcotine, $C_{22}H_{23}NO_7$. Derosne, in 1803, obtained from opium a substance, "opium salt," which was a mixture of narcotine and morphine. He erroneously supposed it to be the narcotic principle, and did not recognize its alkaloidal character. Narcotine was isolated by Robiquet in 1817. It is white, tasteless, and inodorous, and crystallizes in silky flexible needles, usually larger than the crystals of morphine, fusible at 115.5° C. (240° F.), and volatilizable at 154.4° C. (310° F.), insoluble in cold water, soluble in 400 parts of boiling water, in 100 parts of cold alcohol, and in 24 parts of boiling alcohol, which deposits it upon cooling, and very soluble in ether. It is colored red by a mixture of sulphuric and nitric acids. It is *not narcotic*, but is said to be antiperiodic.

Thebaine (Paramorphine), $C_{19}H_{21}NO_3$, is white, crystallizable, of an acrid and styptic rather than bitter taste, fusible at about 193° C. (379.4° F.), scarcely soluble in water, very soluble in alcohol and ether when cold, and still more so when heated. Alkalies precipitate it from its acid solutions, and, unless in very concentrated solution, do not dissolve it when added in excess. Unlike morphine, it is not reddened by nitric acid, nor does it become blue with solutions of ferric salts. It is colored red by a mixture of sulphuric and nitric acids. It is not narcotic, but in its effects on the system is closely analogous to strychnine, producing tetanic spasms in the dose of a grain (0.065 Gm.).

Papaverine, $C_{20}H_{21}NO_4$, is crystallizable in needles, fusible at 147° C. (296.6° F.) and volatilizable at 154.4° C. (310° F.). It is insoluble in water, very sparingly soluble in cold alcohol or ether, more soluble in these liquids boiling hot, and deposited by them on cooling, soluble in benzene and chloroform. It is colored dark blue by sulphuric acid, changing to green if a crystal of potassium nitrate be added to it. It is narcotic.

Narceine, $C_{23}H_{27}NO_8.3H_2O$, is in white, silky crystals, inodorous, of a bitter taste, fusible at 170° C. (338° F.), and volatilizable at 215.5° C. (420° F.), soluble in 375 parts of cold and 220 of boiling water, soluble also in alcohol, and insoluble in ether. It forms a bluish compound with a little iodine, the color of which is destroyed by heat and the alkalies. It is rendered blue by the action of mineral acids so far diluted as not to decompose it; but, unlike morphine, it does not become blue by the action of ferric salts, nor red by that of nitric acid. Narceine is narcotic, and may be given in doses of one-third to one-half of a grain (0.02 to 0.03 Gm.).

Hydrocotarnine, $C_{12}H_{15}NO_3$, is soluble in alcohol, acetone, chloroform, petroleum benzin, and ether. It melts at 55° C. (131° F.), and loses at a somewhat greater heat the molecule of water with which it crystallizes. Sulphuric acid dissolves it, coloring it yellow in the cold, and crimson red if heated. Nitric acid colors it yellow; ferric chloride does not affect its color.

Pseudomorphine, $(C_{17}H_{18}NO_3)_2$, possesses two properties of morphine. It dissolves in concentrated nitric acid with an intense orange-red color, and in solution of ferric chloride with a blue color.

Cryptopine, $C_{21}H_{23}NO_5$, produces a blue color with sulphuric acid; it is but slightly soluble in water or alcohol. It is narcotic.

Protopine, $C_{20}H_{19}NO_5$, is insoluble in water, soluble in alcohol and chloroform.

Laudanine, $C_{20}H_{25}NO_4$. Colored red by sulphuric acid, a reddish violet when heated. A strong tetanic poison.

Codamine, $C_{20}H_{25}NO_4$. Isomeric with laudanine; colored green with nitric acid and ferric chloride.

Rhœadine, $C_{21}H_{21}NO_6$. Nearly insoluble in water, alcohol, ether, petroleum benzin, and chloroform; with sulphuric acid it turns a purple color.

Meconidine, $C_{21}H_{23}NO_4$. Amorphous; easily soluble in alcohol, ether, benzene, and chloroform; colored olive-green by sulphuric acid, orange-red by nitric acid.

Laudanosine, $C_{21}H_{27}NO_4$. Produces rose color with sulphuric acid, violet when heated; soluble in ether.

Lanthopine, $C_{23}H_{25}NO_4$. Easily soluble in chloroform, sparingly in alcohol, ether, or benzene.

Gnoscopine, $C_{22}H_{23}NO_7$. Crystallizable; soluble in chloroform, carbon disulphide, and benzene, but not in ether.

Deuteropine, $C_{20}H_{21}NO_5$. Similar to cryptopine.

Oxynarcotine, $C_{22}H_{23}NO_8$. Nearly insoluble in water, alcohol, chloroform, and benzene, but soluble in alkaline solutions.

Uses.—Opium is narcotic, sedative, and antispasmodic. The dose of powdered opium is one grain (0.065 Gm.).

Official Preparations of Opium

Opii Pulvis Powdered Opium	In No. 80 powder, 9 grains represent about 12 grains of opium
Opium Granulatum Granulated Opium	In No. 20 powder, 9 grains represent about 12 grains of opium

Official Preparations of Granulated Opium

Tinctura Opii Tincture of Opium	Made by adding 400 Cc. of hot water to 100 Gm. of granulated opium, macerating for twelve hours, adding 400 Cc. of alcohol, again macerating for forty-eight hours, occasionally shaking, and then transferring the mixture to a percolator; allowing the percolation to proceed slowly, and finally adding diluted alcohol to make 1000 Cc. (see page 358). Dose, eight minims (0.5 Cc.)
Tinctura Opii Deodorati Tincture of Deodorized Opium	Made by adding 400 Cc. of hot water to 100 Gm. of granulated opium, macerating for twenty-four hours, then transferring the mixture to a percolator, and completely exhausting with water. Then evaporating the percolate to 150 Cc. on a water bath, cooling, treating with purified petroleum benzin, separating the benzin, adding 600 Cc. of water to the deodorized residue, filtering, adding 200 Cc. of alcohol, and enough water to make 1000 Cc. (see page 360). Dose, eight minims (0.5 Cc.)
Vinum Opii Wine of Opium	Made by macerating and percolating 100 Gm. of granulated opium, 10 Gm. of Saigon cinnamon, and 10 Gm. of cloves with 150 Cc. of alcohol, and 850 Cc. of white wine, and adding enough menstruum to make 1000 Cc. (see page 370). Dose, eight minims (0.5 Cc.)

Official Preparations of Powdered Opium

Opium Deodoratum Deodorized Opium	See page 923
Acetum Opii Vinegar of Opium	Made by macerating and percolating 100 Gm. of powdered opium, 30 Gm. of myristica, and 200 Gm. of sugar, with sufficient diluted acetic acid to make 1000 Cc. (see page 431). Dose, eight minims (0.5 Cc.)
Extractum Opii Extract of Opium	An aqueous extract. 1 grain represents about 2 grains of opium. Dose, one-half grain (0.03 Gm.) (see page 449)

Official Preparation of Powdered Opium—*Continued*

Tinctura Opii Camphorata Camphorated Tincture of Opium	Made by macerating and percolating 4 Gm. each of powdered opium, benzoic acid, camphor, and 4 Cc. of oil of anise, with 40 Cc. of glycerin, and sufficient diluted alcohol to make 1000 Cc. (see page 359). Dose, one to four fluidrachms (4 to 16 Cc.)
Pilulæ Opii Pills of Opium	Each pill contains about 1 grain of powdered opium and $\frac{1}{3}$ grain of soap. (See Pilulæ)
Pulvis Ipecacuanhæ et Opii Powder of Ipecac and Opium	10 Gm. each of powdered opium and ipecac, and 80 Gm. of sugar of milk. (See Pulveres). Dose, eight grains (0.5 Gm.)
Trochisci Glycyrrhizæ et Opii Troches of Glycyrrhiza and Opium	Each troche contains about $\frac{1}{12}$ grain of powdered opium and $2\frac{1}{2}$ grains of extract of glycyrrhiza. (See Trochisci.)

Official Preparation of Tincture of Deodorized Opium

Tinctura Ipecacuanhæ et Opii Tincture of Ipecac and Opium	Made by evaporating 1000 Cc. of tincture of deodorized opium to 800 Gm., adding 100 Cc. of fluidextract of ipecac, filtering, and passing enough diluted alcohol through the filter to make 1000 Cc. (see page 355). Dose, eight minims (0.5 Cc.)

Official Preparation of Extract of Opium

Emplastrum Opii Opium Plaster	6 Gm. of extract of opium, 90 Gm. of adhesive plaster, and 8 Cc. of water, to make 100 Gm. (See Emplastra)

MORPHINA. U.S. Morphine

$C_{17}H_{19}NO_3 + H_2O = 300.92$

An alkaloid obtained from Opium.

Morphine was the first alkaloid to be discovered. The credit of its isolation belongs to Sertürner, an apothecary of Eimbeck, Germany, who discovered, in 1806, a crystalline principle in opium, and announced its basic character and that it existed in combination with a special acid. He published the results of his further investigations in 1817, when he stated that it was a vegetable alkali, and showed its similarity to ammonia; he named it *morphium.*

Preparation.—Morphine may be prepared by the former official process, as follows:

Take of Opium, sliced, 12 oz. troy; Water of Ammonia, 6 fl. oz.; Animal Charcoal, in fine powder, Alcohol, Distilled Water, each, a sufficient quantity. Macerate the Opium with 4 pints of Distilled Water for twenty-four hours, and, having worked it with the hand, again macerate for twenty-four hours, and strain. In like manner, macerate the residue twice successively with the same quantity of Distilled Water, and strain. Mix the infusions, evaporate to 6 pints, and filter; then add 5 pints of Alcohol, and afterwards 3 fl. oz. of the Water of Ammonia, previously mixed with 8 fl. oz. of Alcohol. After twenty-four hours, pour in the remainder of the Water of Ammonia, mixed, as before, with 8 fl. oz. of Alcohol; and set the liquid aside for twenty-four hours that crystals may form. To purify these, boil them with 2 pints of Alcohol until they are dissolved, filter the solution, while hot, through Animal Charcoal, and set it aside to crystallize.

In this process the infusions containing the morphine, in combination with meconic and lactic acids, are treated with alcohol and ammonia water. The former retains the coloring matter, caoutchouc, resins, etc., in solution, while the ammonia combines with the natural acids, the morphine being precipitated as an insoluble precipitate.

Official Description.—Colorless, or white, shining, rhombic prisms, or fine needles, or a crystalline powder; permanent in the air. It loses all of its water of crystallization at 100° C. (212° F.).

Odor, Taste, and Reaction.—Odorless; bitter taste; alkaline reaction.

Solubility.—*Water.* In 3330 parts at 25° C. (77° F.); in 1040 parts at 80° C. (176° F.).

Alcohol. In 168 parts at 25° C. (77° F.); in 76 parts at 60° C. (140° F.).

Other solvents. In 100 parts of lime water, 4464 parts of ether, 1800 parts of chloroform, 113.5 parts of amyl alcohol, and in 525 parts of acetic ether at 25° C. (77° F.); insoluble in benzene.

Tests for Identity.—When heated slowly to about 200° C. (392° F.), it assumes a brown color, and when heated rapidly it melts at 254° C. (489.2° F.). Upon ignition, it is slowly consumed without leaving a residue.

Sulphuric acid (free from nitrous compounds) added to Morphine produces no color or only a slight yellowish tint, but on heating, a brown color is developed.

Sulphuric acid containing a crystal of potassium iodate gives with Morphine a dark brown color. (*Codeine* yields a moss-green color, changing to brown, and *narcotine* a cherry-red color.)

Sulphuric acid containing a trace of selenous acid gives with Morphine a blue color, changing to green and then to brown. (*Codeine* yields a green color, changing to blue, and afterwards to grass-green; *narcotine* gives a green color, changing to brown, and then to cherry-red.)

Nitric acid produces with Morphine an orange-red color fading to yellow (difference from *quinine*). Sulphuric acid containing a trace of molybdic acid gives a purple color, changing to blue. Sulphuric acid containing in each Cc. one drop of solution of formaldehyde yields an intense purple color.

Mercuric potassium iodide T.S. produces in a solution of Morphine a white gelatinous precipitate.

A solution of sodium phosphomolybdate (1 in 20) produces in solutions of Morphine a yellow precipitate soluble in ammonia water.

If to a neutral solution of Morphine (1 in 100), made by the careful addition of diluted sulphuric acid, a few drops of ferric chloride T.S. be added, a blue color will be produced, which is destroyed by acids, alcohol, or by heating.

Morphine solutions, when heated with an aqueous solution of potassium ferricyanide containing a drop of neutral ferric chloride solution, give a deep blue solution, from which, after standing, a blue precipitate separates (difference from *codeine*).

Impurities and Tests for Impurities.—*Absence of strychnine, which yields a purple color, or of acetanilide, which gives a crimson color, changing to green.* Sulphuric acid containing a crystal of potassium dichromate gives no color at first, but after a time a green color.

Meconic acid or meconates. If 0.1 Gm. of Morphine be dissolved in 10 Cc. of diluted hydrochloric acid, no red coloration should be produced by the addition of a few drops of ferric chloride T.S.

Absence of, and difference from, various other alkaloids. On adding 4 Cc. of potassium hydroxide T.S. to 0.2 Gm. of Morphine, a clear solution, free from any undissolved residue, should result.

Ammonium salts. No odor of ammonia should be noticeable.

Uses.—Morphine is rarely used medicinally, its salts—the sulphate, acetate, hydrochloride, etc.—being preferred because of their solubility in water.

MORPHINÆ ACETAS. U.S. Morphine Acetate

$$C_{17}H_{19}NO_3.C_2H_4O_2 + 3H_2O = 396.26$$

The acetate [$CH_3COOH.C_{17}H_{19}NO_3 + 3H_2O$] of the alkaloid morphine should be kept in well-stoppered, dark amber-colored vials; a minute quantity of free acetic acid should be present to prevent decomposition.

Preparation.—This salt may be made by the former official process, as follows:

Take of Morphine, in fine powder, 1 oz. troy; Distilled Water, 8 fl. oz.; Acetic Acid, a sufficient quantity. Mix the Morphine with the Distilled Water; then carefully drop Acetic Acid into the mixture, stirring it constantly until the Morphine is neutralized and dissolved. Evaporate the solution, by means of a water-bath, to the consistence of syrup, and set aside until it concretes. Lastly, dry the salt with a gentle heat, and rub it into powder.

Care is required not to employ too much heat in the evaporation, as the acetate is easily decomposed, a portion of the acetic acid escaping and leaving an equivalent portion of uncombined morphine. The salt itself is subject to loss of acetic acid, and this may be discovered upon attempting to make a solution. When turbidity results, due to the inability of the water to dissolve the alkaloid, a few drops of acetic acid are needed to make the solution perfect.

Official Description.—A white, or yellowish-white, crystalline or amorphous powder. It gradually loses acetic acid when exposed to air, and becomes less soluble in water.
Odor and Taste.—Faintly acetous odor; bitter taste.
Solubility.—*Water.* In 2.25 parts at 25° C. (77° F.); in 2 parts at 80° C. (176° F.).
Alcohol. In 21.6 parts at 25° C. (77° F.); in 2.5 parts at 60° C. (140° F.).
Other solvents. In 480 parts of chloroform and in 5.2 parts of glycerin at 25° C. (77° F.); insoluble in ether.
Tests for Identity.—When heated, the salt loses water and acetic acid, and melts at about 200° C. (392° F.). When ignited, it is consumed completely, leaving no residue.
The addition of diluted ammonia water in slight excess to an aqueous solution of Morphine Acetate causes a white precipitate, which, when collected and washed, should conform to the reactions and tests given under *Morphina.*
On adding sulphuric acid to the salt, vapors of acetic acid are evolved.
Ferric chloride T.S. produces, in neutral aqueous solutions of the salt, a blue color, destroyed by acids, alcohol, or by heating.
The color tests for the identification of Morphine Acetate and those showing the absence of impurities are identical with those described under *Morphina.*

Uses.—Morphine acetate is narcotic and sedative. Dose, one-eighth to one-fourth of a grain (0.008 to 0.015 Gm.).

MORPHINÆ HYDROCHLORIDUM. U.S. Morphine Hydrochloride

$C_{17}H_{19}NO_3.HCl + 3H_2O = 372.86$

[MORPHINÆ HYDROCHLORAS, PHARM. 1890 MORPHINE HYDROCHLORATE]

The hydrochloride [$HCl.C_{17}H_{19}NO_3 + 3H_2O$] of the alkaloid morphine should be kept in well-stoppered, amber-colored vials.

Preparation.—This salt may be prepared by a process similar to that used for making morphine acetate (see preceding article), by substituting hydrochloric acid for acetic acid. It is a more stable salt than the acetate.

Official Description.—White, silky, glistening needles or microcrystalline cubes, or a white, crystalline powder; permanent in the air. It loses its water of crystallization at 100° C. (212° F.).
Odor, Taste, and Reaction.—Odorless; bitter taste; neutral reaction.
Solubility.—*Water.* In 17.2 parts at 25° C. (77° F.); in 0.5 part at 80° C. (176° F.).
Alcohol. In 42 parts at 25° C. (77° F.); in 35.5 parts at 60° C. (140° F.).
Other solvents.—Insoluble in ether and in chloroform.
Tests for Identity.—When heated to 250° C. (482° F.), it assumes a brown color, and on higher heating, chars without melting. On ignition, it is slowly consumed, leaving no residue.
On shaking an aqueous solution of the salt with diluted ammonia water in slight excess, a crystalline precipitate is formed, which, when collected and washed, should respond to all tests and reactions given under *Morphina.*
Silver nitrate T.S. produces a white precipitate, insoluble in nitric acid.
Ferric chloride T.S. produces, in neutral aqueous solutions of the salt, a blue color, which is destroyed by acids, alcohol, or by heating.
Impurities and Tests for Impurities.—*Apomorphine.* On adding potassium carbonate T.S. to a solution of the salt (1 in 30), a white precipitate should be formed, which should dissolve in chloroform without color.
The color tests for the identification of Morphine Hydrochloride and those showing the absence of impurities are identical with those described under *Morphina.*

Uses.—Morphine hydrochloride is used very largely in Great Britain as a narcotic and sedative. The dose is one-eighth to one-fourth of a grain (0.008 to 0.015 Gm.).

MORPHINÆ SULPHAS. U.S. Morphine Sulphate

$(C_{17}H_{19}NO_3)_2.H_2SO_4 + 5H_2O = 752.83$

The sulphate $[SO_2(OH)_2.(C_{17}H_{19}NO_3)_2 + 5H_2O]$ of the alkaloid morphine should be kept in well-stoppered, amber-colored vials.

Preparation.—This useful salt may be made by the former official process, as follows :

Take of Morphine, in fine powder, 1 oz. troy ; Distilled Water 8 fl. oz. ; Diluted Sulphuric Acid a sufficient quantity. Mix the Morphine with the Distilled Water, then carefully drop in Diluted Sulphuric Acid, constantly stirring until the Morphine is neutralized and dissolved. Evaporate the solution, by means of a water-bath, so that on cooling it may crystallize. Lastly, drain the crystals, and dry them on bibulous paper.

Official Description.—White, feathery, acicular, silky crystals, or in cubical masses ; permanent in the air. It loses three molecules of water of crystallization at 100° C. (212° F.).

Odor, Taste, and Reaction.—Odorless ; bitter taste ; neutral reaction.

Solubility.—*Water.* In 15.3 parts at 25° C. (77° F.) ; in 0.6 part at 80° C. (176° F.).
Alcohol. In 465 parts at 25° C. (77° F.) ; in 187 parts at 60° C. (140° F.).
Other solvents. Insoluble in ether and chloroform.

Tests for Identity.—When heated to about 250° C. (482° F.), the salt assumes a brown color, and then chars without melting. When ignited, it is very slowly consumed, leaving no residue.

On adding a dilute solution of ammonia water in slight excess to its aqueous solution, and vigorously shaking the liquid, a precipitate is formed which, when collected and washed, should respond to all the tests and reactions given under *Morphina.*

Barium chloride T.S. produces a white precipitate, insoluble in hydrochloric acid.

Ferric chloride T.S., when added to neutral aqueous solutions of the salt, produces, a blue color, which is destroyed by acids, alcohol, or by heating.

The color tests for the identification of Morphine Sulphate, and those showing the absence of impurities, are identical with those described under *Morphina.*

Uses.—Morphine sulphate is much more largely employed in the United States than any other salt of morphine. The dose is one-eighth to one-fourth of a grain (0.008 to 0.015 Gm.). The *solution of sulphate of morphine* formerly official was made by dissolving one grain of morphine sulphate in one fluidounce of distilled water. Although the solution is more stable than that of any other of the morphine salts in use, it will in time deteriorate, either through the presence of microscopic plants or from other causes, and hence it is not desirable to keep it on hand. This solution must not be confounded with *Magendie's solution,* which is *sixteen times as strong,*—*i.e.,* sixteen grains in a fluidounce. This solution is often used hypodermically.

Official Preparation

Pulvis Morphinæ Compositus Compound Powder of Morphine	Made by mixing 1.5 Gm. of morphine sulphate with 32 Gm. of powdered camphor, 33 Gm. of glycyrrhiza, and 33.5 Gm. of precipitated calcium carbonate. (See Pulveres.) Dose, eight grains (0.5 Gm.)

CODEINA. U.S. Codeine

$C_{18}H_{21}NO_3 + H_2O = 314.83$

An alkaloid $[C_{17}H_{18}(CH_3)NO_3 + H_2O]$ obtained from Opium, or prepared from morphine by methylation. It should be kept in well-stoppered, amber-colored vials.

When a solution of mixed morphine and codeine hydrochlorides is treated with ammonia, the former alkaloid is precipitated, and the codeine, remaining in solution, may be obtained by evaporation and crystallization. It may be purified by treating the crystals with hot ether, which dissolves them, and yields the codeine in colorless crystals on spontaneous evaporation.

Codeine is a substituted morphine, in which one of the hydroxyl atoms is replaced by methoxyl, OCH_3. It has been obtained synthetically by heating morphine with methyl iodide.

Codeine is remarkable for being, with the exception of colchicine, the most soluble alkaloid in use, there being no necessity for salifying it. Its salts are frequently used and are even more soluble. It is usually seen in larger crystals than any other alkaloid.

Official Description.—White, or nearly translucent, orthorhombic prisms, octahedral crystals, or a crystalline powder; slightly efflorescent in warm air.

Odor, Taste, and Reaction.—Odorless; faintly bitter taste. Its aqueous solution is alkaline to litmus paper, and is lævogyrate.

Solubility.—*Water.* In 120 parts at 25° C. (77° F.); in 59 parts at 80° C. (176° F.).

Alcohol. In 1.6 parts at 25° C. (77° F.); in 0.92 part at 60° C. (140° F.).

Other solvents. In 12.5 parts of ether and 0.66 part of chloroform at 25° C. (77° F.)

Tests for Identity.—At 100° C. (212° F.) it loses its water of crystallization, and melts at 154.9° C. (310.8° F.) When heated in an insufficient amount of water for complete solution, it melts to oily drops, which crystallize on cooling. It leaves no residue on incineration.

Its aqueous solution is alkaline to litmus paper, and is lævogyrate.

Sulphuric acid (free from nitrous compounds) produces either no color or a slight pinkish tint, which disappears within two minutes, but on heating, a violet color is developed. (The presence of nitrous compounds causes a pink color in the cold.)

Sulphuric acid containing a trace of ferric chloride produces with Codeine a violet-blue color; sulphuric acid heated, with a drop of nitric acid added, gives a blood-red color; sulphuric acid containing a trace of selenous acid produces a green color, changing rapidly to blue, and then slowly back to grass-green (with morphine it gives a blue color, changing to green, and then to brown); sulphuric acid and Codeine develop no color, but on adding a drop of solution of formaldehyde a violet-blue color is produced (morphine giving an intense purple color).

If 1 drop of a diluted nitric acid solution (1 drop in 200 Cc. of water) be added to a solution of 0.03 Gm. of Codeine in 2 Cc. of sulphuric acid, a bluish-red tint, gradually changing to blue, will be developed.

Impurities and Tests for Impurities.—*Difference from, and absence of, morphine.* On sprinkling 0.05 Gm. of Codeine upon 2 Cc. of nitric acid (sp. gr. 1.200) the crystals will turn red, but the acid will acquire only a yellow color.

Morphine. On dissolving a small crystal of potassium ferricyanide in 10 Cc. of water, adding one drop of ferric chloride T.S., and then 1 Cc. of Codeine solution (1 in 100), no blue color should be produced at once.

Uses.—Codeine is sedative, in doses of one-fourth to one grain (0.015 to 0.065 Gm.).

CODEINÆ PHOSPHAS. U.S. Codeine Phosphate

$C_{18}H_{21}NO_3.H_3PO_4 + 2H_2O = 430.0$

The phosphate $[PO(OH)_3.(C_{17}H_{18}(CH_3)NO_3) + 2H_2O]$ of an alkaloid obtained from Opium, or prepared from morphine by methylation. It should be kept in well-stoppered, amber-colored vials.

Preparation.—Codeine phosphate may be made by evaporating and crystallizing a solution of codeine in phosphoric acid.

Official Description.—Fine, white, needle-shaped crystals, or a crystalline powder. It frequently crystallizes with one and a half molecules of water of crystallization.

Odor, Taste, and Reaction.—Without odor, and having a bitter taste; alkaline reaction.

Solubility.—*Water.* In 2.25 parts at 25° C. (77° F.); in 0.46 part at 80° C. (176° F.).

Alcohol. In 261 parts at 25° C. (77° F.); in 97 parts at 60° C. (140° F.).

Other solvents. In 1340 parts of ether and 6620 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—At 100° C. (212° F.) it loses all of its water of crystallization; above 200° C. (392° F.) it becomes darker in color, and at 235° C. (455° F.) melts to a brown liquid, which rapidly volatilizes.

Its aqueous solution reddens blue litmus paper.

If silver nitrate T.S. be added to its aqueous solution, a yellow precipitate is produced, which is soluble in diluted nitric acid and in ammonia water.

Sulphuric acid (free from nitrous compounds) produces either no color or a slight pinkish tint, which disappears within two minutes; sulphuric acid containing a trace of ferric chloride produces a violet blue color; sulphuric acid containing a trace of selenous acid gives a green color, changing rapidly to blue, and then slowly back to grass-green (with morphine it gives a blue color, changing to green, and then to brown). Sulphuric acid and a drop of solution of formaldehyde produce a violet-blue color (morphine an intense purple).

Impurity and Test.—*Morphine.* On dissolving a small crystal of potassium ferricyanide in 10 Cc. of water, adding 1 drop of ferric chloride T.S., and then 1 Cc. of Codeine Phosphate solution (1 in 100), no blue color should be produced at once.

Quantitative Test.—If 0.2 Gm. of Codeine Phosphate be dissolved in 5 Cc. of water and 3 Cc. of potassium hydroxide T.S., and the solution shaken out successively with three portions of chloroform (5 Cc. each), the combined chloroformic solutions, evaporated to dryness in a tared dish, should yield not less than 0.13 Gm. of codeine.

Uses.—Codeine phosphate is a valuable sedative, and is often preferred to any of the morphine salts. Dose, one-half grain (0.03 Gm.).

CODEINÆ SULPHAS. U.S. Codeine Sulphate

$(C_{18}H_{21}NO_3)_2.H_2SO_4 + 5H_2O = 780.65$

The sulphate $[SO_2(OH)_2.(C_{17}H_{18}(CH_3)NO_3)_2 + 5H_2O]$ of an alkaloid obtained from Opium, or prepared from morphine by methylation. It should be kept in well-stoppered, amber-colored vials.

Preparation.—Codeine sulphate is made by evaporating a solution of codeine in diluted sulphuric acid.

Official Description.—Long, glistening, white, needle-shaped crystals, rhombic prisms, or a crystalline powder, efflorescing in the air.

Odor, Taste, and Reaction.—Odorless; bitter taste; neutral reaction.

Solubility.—*Water.* In about 30 parts at 25° C. (77° F.), and in 6.25 parts at 80° C. (176° F.).

Alcohol. In 1035 parts at 25° C. (77° F.), and in 340 parts at 60° C. (140° F.).

Other solvents. Insoluble in chloroform and ether.

Tests for Identity.—The salt loses its water of crystallization at 100° C. (212° F.); chars, decomposes, and partially volatilizes above 200° C. (392° F.), without melting; the residue melts at about 278° C. (532.4° F.).

Its aqueous solution (1 in 20) is neutral or faintly acid to litmus paper.

If barium chloride T.S. be added to an aqueous solution of the salt, a white precipitate is produced, which is insoluble in hydrochloric acid.

Sulphuric acid (free from nitrous compounds) produces either no color or a slight pinkish tint, which disappears within two minutes, when added to Codeine Sulphate, but on heating, a violet color is produced; sulphuric acid heated, with a drop of nitric acid added, gives a blood-red color; sulphuric acid containing a trace of selenous acid produces a green color, changing rapidly to blue, and then slowly back to grass-green (with morphine sulphate it gives a blue color, changing to green, and then to brown); sulphuric acid and Codeine Sulphate give no color, but on adding a drop of solution of formaldehyde, a violet blue color is produced (morphine sulphate yielding an intense purple color).

If 1 drop of a diluted nitric acid solution (1 drop in 200 Cc. of water) be added to 2 Cc. of a solution of 0.1 Gm. of Codeine sulphate in 6 Cc. of sulphuric acid, a bluish-red tint, gradually changing to blue, will be developed.

Impurities and Tests for Impurities.—*Morphine.* On dissolving a small crystal of potassium ferricyanide in 10 Cc. of water, adding 1 drop of ferric chloride T.S., and then 1 Cc. of Codeine Sulphate solution (1 in 100), no blue color should be produced at once.

Uses.—Codeine sulphate is preferred by many practitioners to morphine sulphate. It is used as a sedative and narcotic. Dose, one-half grain (0.03 Gm.).

APOMORPHINÆ HYDROCHLORIDUM. U.S. Apomorphine Hydrochloride

$C_{17}H_{17}NO_2.HCl = 301.34$

[Apomorphinæ Hydrochloras, Pharm. 1890 Apomorphine Hydrochlorate]

The hydrochloride $[HCl.C_{17}H_{17}NO_2]$ of an alkaloid prepared from morphine by the abstraction of one molecule of water. It should be kept in small, dark amber-colored vials, which have been previously rinsed with diluted hydrochloric acid and dried.

Preparation.—It may be made by heating morphine in a closed tube with a great excess of hydrochloric acid for two or three hours to the temperature of 140° to 150° C. (284° to 302° F.). The contents of the tube are then dissolved in water, an excess of sodium bicarbonate added, and the precipitate exhausted with ether or chloroform. On the addition to the solution of a very small quantity of hydrochloric acid, crystals of apomorphine hydrochloride form. The process is one of dehydration,—the morphine parting with one molecule of water, thus:

$$\underset{\text{Morphine}}{C_{17}H_{19}NO_3} - \underset{\text{Water}}{H_2O} = \underset{\text{Apomorphine}}{C_{17}H_{17}NO_2}$$

Official Description.—Minute grayish-white monoclinic prisms, glistening, and acquiring a greenish tint upon exposure to light and air.

Odor, Taste, and Reaction.—Odorless; slightly bitter taste; neutral reaction.

Solubility.—*Water.* In 39.5 parts at 25° C. (77° F.); in 16 parts at 80° C. (176° F.).

Alcohol. In 38.2 parts at 25° C. (77° F.); in 30 parts at 60° C. (140° F.).

Other solvents. In 1864 parts of ether and in 3800 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—The salt decomposes between 200° and 210° C. (392° and 410° F.).

If the salt imparts at once an emerald-green color to 100 parts of water on being shaken with it a few times in a test-tube, it should be rejected.

Apomorphine Hydrochloride is not colored when treated with sulphuric acid; with nitric acid a deep purple color fading to orange is produced; with sulphuric acid containing a trace of selenous acid, a dark blue color, fading to violet, and then turning black; with sulphuric acid containing a trace of nitric acid, a blood-red color, fading to orange; with sulphuric acid containing a trace of ferric chloride, a pale blue color; with sulphuric acid containing a trace of ammonium vanadate, a violet-blue color, changing to deep greenish-blue; with sulphuric acid containing a little paraldehyde, a green color, fading to reddish-brown; with sulphuric acid containing potassium iodate, a black color, changing to brown, and finally to pale brown.

If sulphuric acid be added to a crystal of Apomorphine Hydrochloride and a crystal of potassium nitrate, the latter is colored red, and on stirring with a glass rod the solution becomes green, then blue, then purple, and finally cherry-red. Acetic acid dissolves the salt without color, but on adding a trace of potassium iodate, the solution turns blood-red, changes to purple, and on adding a little ether and shaking, the latter assumes a blue color.

Gold chloride T.S. produces a reddish-purple precipitate in a solution of the salt. Diluted ferric chloride T.S. colors Apomorphine Hydrochloride solution red (distinction from *morphine*, which, by the same test, is colored blue).

Silver nitrate T.S. added to the aqueous solution of the salt throws down a white precipitate, insoluble in nitric acid, soon turning black by reduction to metallic silver, and instantly reduced by the addition of ammonia water.

If 0.05 Gm. of the salt be shaken with a solution made by dissolving 0.05 Gm. of ferrous sulphate in 10 Cc. of water, the solution will gradually turn blue and then black; upon the addition of some alcohol, the solution resumes its blue color (difference from *codeine*, *morphine*, *narceine*, and *narcotine*).

Uses.—This remarkable compound is devoid of narcotic properties, but is expectorant in doses of one-thirtieth of a grain (0.002 Gm.), and a powerful emetic in one-tenth grain (0.005 Gm.) doses; it is often given hypodermically and should be employed with caution to avoid excessive emesis.

CINCHONA. U.S. Cinchona

[PERUVIAN BARK]

The dried bark of *Cinchona Ledgeriana* Moens, *Cinchona Calisaya* Weddell, *Cinchona officinalis* Linné, and of hybrids of these with other species of Cinchona (Fam. *Rubiaceæ*). It should yield not less than 5 percent. of total anhydrous cinchona alkaloids, and at least 4 percent. of anhydrous ether-soluble alkaloids when assayed by the process given below.

In quills or curved pieces of variable size, usually 2 or 3, sometimes 5 Mm. thick; externally gray, rarely brownish-gray, with numerous intersecting transverse and longitudinal fissures, which have nearly vertical sides; the outer bark may be absent, the color externally being then cinnamon-brown; inner surface light cinnamon-brown, finely striate; fracture of the outer bark short and granular, of the inner finely splintery; powder light brown or yellowish-brown; odor slight aromatic; taste bitter and somewhat astringent.

CINCHONA RUBRA. U.S. Red Cinchona

[PERUVIAN BARK]

The dried bark of *Cinchona succirubra* Pavon (Fam. *Rubiaceæ*), or of its hybrids, yielding not less than 5 percent. of anhydrous cinchona alkaloids when assayed by the process given for these alkaloids under Cinchona.

In quills or curved pieces of variable size, the bark 2 to 5 Mm. thick; externally gray or grayish-brown, more or less rough from longitudinal rows of warts, or from warty ridges which are sometimes fissured, the transverse fissures rarely numerous or much intersected, and having their sides sloping; inner surface reddish or orange-brown, distinctly striate; fracture short and granular in the outer, shortly and rather coarsely splintery in the inner bark; slightly odorous; taste bitter and astringent; powder reddish-brown.

The value of cinchona bark depends entirely upon the percentage of alkaloids present in it; and, as barks are found in the market greatly varying in quality, it is necessary to prove their worth by assay.

Assay of Cinchona

Cinchona, in No. 80 (or finer) powder . . . . **15 Gm.**
Ether, sp. gr. not above 0.720 at 25° C. (77° F.),
Chloroform,
Ammonia Water,
Distilled Water,
Normal Sulphuric Acid V.S., each, a sufficient quantity

Introduce the Cinchona into an Erlenmeyer flask or bottle of about 400 Cc. capacity, and add a mixture of 250 Cc. of ether and 50 Cc. of chloroform; then insert the stopper securely, shake the flask vigorously, and allow it to stand for ten minutes. Then add 10 Cc. of ammonia water, and allow it to stand for five hours, shaking at frequent intervals (or continuously with the aid of a mechanical shaker). Next add 15 Cc. of distilled water, shake the flask vigorously, and allow it to stand for a few minutes, so as to cause the powder to settle readily. When the supernatant fluid is quite clear, decant into a measuring flask or cylinder exactly 200 Cc. of the supernatant liquid (representing 10 Gm. of Cinchona), transfer this to a separator and add 15 Cc. of normal sulphuric acid V.S., or sufficient to make the liquid distinctly acid. Shake the separator vigorously for one minute, and allow the two layers of liquid to separate completely. Draw off the lower aqueous layer into a flask. Then add 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water to the separator and shake it vigorously for about one minute, allow the liquids to separate as before, and again draw off the lower aqueous layer into the flask. Repeat the operation, using 5 Cc. of distilled water in the separator (without acid), drawing off the aqueous liquid into the flask. Filter the combined acid liquids into a measuring cylinder, and wash the filter and flask with enough distilled water to make the contents of the cylinder measure exactly 50 Cc. Pour half (25 Cc.) of the acid liquid into a separator marked No. 1, and the remaining half (25 Cc.) into another separator marked No. 2, which set aside.

I. **For Anhydrous Cinchona Alkaloids.**—To separator No. 1 (see above) add 25 Cc. of a mixture of chloroform 3 volumes and ether 1 volume, also 5 Cc. of ammonia water, or sufficient to render the liquid alkaline. Insert the stopper and shake the separator carefully for one minute, and then draw off the lower layer into a tared flask or beaker. Add 20 Cc. more of the chloroform-ether mixture to the separator, insert the stopper, and shake the liquid carefully for one minute, again drawing off the lower layer into the tared flask. Repeat the operation with 10 Cc. of chloroform, and draw this off into the tared flask. Evaporate the chloroform-ether solutions in the tared flask or beaker slowly and carefully to dryness on a water-bath. Add 3 Cc. of ether to the dry residue, and again evaporate to dryness. Then place the flask or beaker in an air-bath and heat at 110° C. (230° F.) until the weight after cooling remains constant. This weight in grammes multiplied by 20 will give the percentage of anhydrous cinchona alkaloids (total alkaloids) in the Cinchona.

II. **For Ether-Soluble Alkaloids.**—To separator No. 2 (see above), containing the other 25 Cc. of acid liquid, add 25 Cc. of ether and 5 Cc. of ammonia water, or sufficient to render the liquid alkaline. The temperature of the liquid should be kept below 20° C. (68° F.), by cooling it, if necessary. Shake the separator moderately for two minutes, and allow the liquid to stand for ten minutes at 15° C. (59° F.); after the liquids have separated, draw off and reject the lower aqueous layer and transfer the ethereal liquid to a tared beaker. Add 5 Cc. more of ether to the separator, rinse carefully, and add the rinsings to the tared beaker. Evaporate the ether carefully by the aid of a water-bath, dry the beaker and contents in an air-bath at 110° C. (230° F.) for two hours, cool, and weigh. This weight in grammes multiplied by 20 gives the percentage of the anhydrous ether-soluble alkaloids contained in the Cinchona.

NOTE.—Ether-soluble alkaloids include quinine, quinidine, and cinchonidine.

About twenty alkaloids have been discovered in cinchona barks. Some of these are found in only one kind of bark, some are doubtless "split products,"—that is, not existing naturally in the bark, but the result of the action of chemical agents upon it.

Quinine, *Quinidine*, *Cinchonine*, and *Cinchonidine* are the most important alkaloids found in cinchona barks, and they, or their important salts, will be considered in separate articles. The acids present are *kinic*, or *quinic*, *quinotannic*, and *kinovic*, or *quinovic*. The neutral principle is *kinovin*, or *quinovin*, while *cinchonic red*, volatile oil, and red and yellow coloring matter are also present. The first four of the alkaloids in the following list are used in medicine. The list is as follows:

Natural Alkaloids.—Quinine, $C_{20}H_{24}N_2O_2$; Quinidine, $C_{20}H_{24}N_2O_2$; Cinchonine, $C_{19}H_{22}N_2O$; Cinchonidine, $C_{19}H_{22}N_2O$; Quinamine, $C_{19}H_{24}N_2O_2$; Conquinamine, $C_{19}H_{24}N_2O_2$; Homoquinine, $C_{39}H_{46}N_4O_4$; Cinchonamine, $C_{19}H_{24}N_2O$; Paytine, $C_{21}H_{24}N_2O.H_2O$; Homocinchonidine, $C_{19}H_{22}N_2O$; Cusconine, $C_{23}H_{26}N_2O_4$; Cusconidine, $C_{23}H_{26}N_2O_4$; Concusconine, $C_{22}H_{26}N_2O_4$; Aricine, $C_{23}H_{26}N_2O_4$; Paricine, $C_{16}H_{18}N_2O$; Paytamine, $C_{21}H_{24}N_2O$; Hydroquinine, $C_{20}H_{26}N_2O_2$; Hydroquinidine, $C_{20}H_{26}N_2O_2$; Cinchotine, $C_{19}H_{24}N_2O$; Hydrocinchonine, $C_{19}H_{24}N_2O$; Hydrocinchonidine, $C_{19}H_{24}N_2O$; Diquinidine, $C_{40}H_{46}N_4O_3$; Cupreine, $C_{19}H_{22}N_2O_2$.

The Artificial Alkaloids are: Quinicine, $C_{20}H_{24}N_2O_2$; Cinchonicine, $C_{19}H_{22}N_2O$; Quinamicine, $C_{19}H_{24}N_2O_2$; Apoquinamine, $C_{19}H_{22}N_2O$. These are chiefly produced by the action of heat upon the natural alkaloids and usually in the presence of diluted acids. In addition there have been many others made which are not of pharmaceutical interest.

One of the principal difficulties in preserving galenical preparations of cinchona arises from the alteration and precipitation which the cinchotannic acid and its compounds undergo upon keeping. Glycerin has proved to be very useful by dissolving and holding these in solution, and hence it is present in nearly every one of the preparations.

Uses.—Cinchona is a febrifuge and tonic in doses of fifteen grains (1 Gm.).

Official Preparations

Fluidextractum Cinchonæ Fluidextract of Cinchona	Made from cinchona with a menstruum of 8 parts of alcohol, 1 part of glycerin, and 1 part of water, finishing with a menstruum of 8 parts of alcohol and 2 parts of water (see page 389). Dose, fifteen minims (1 Cc.)
Tinctura Cinchonæ Tincture of Cinchona	Made by percolating 200 Gm. of cinchona with a menstruum of 675 Cc. of alcohol, 250 Cc. of water, and 75 Cc. of glycerin, to obtain 1000 Cc. (see page 349). Dose, one to four fluidrachms (4 to 16 Cc.)
Tinctura Cinchonæ Composita Compound Tincture of Cinchona	Made by percolating 100 Gm. of *red* cinchona, 80 Gm. of bitter orange peel, and 20 Gm. of serpentaria with a menstruum of 675 Cc. of alcohol, 250 Cc. of water, and 75 Cc. of glycerin, to obtain 1000 Cc. (see page 349). Dose, one to four fluidrachms (4 to 16 Cc.)

QUININA. U.S. Quinine

$C_{20}H_{24}N_2O_2 + 3H_2O = 375.46$

An alkaloid obtained from the bark of various species of *Cinchona* (Fam. *Rubiaceæ*). Quinine should be kept in well-stoppered, amber-colored bottles.

Preparation.—This alkaloid is usually made by adding to the *cooled* acid solution of the sulphate a quantity of ammonia water or solution of sodium hydroxide just sufficient to precipitate the quinine, carefully avoiding an excess.

Official Description.—A white, flaky or micro-crystalline powder; slightly efflorescent in dry air. When freshly crystallized it should contain three molecules of water of crystallization. When heated, it fuses at 57° C. (134.6° F.), and loses two molecules of water of crystallization at 100° C. (212° F.), and the third molecule at 125° C. (257° F.); at ordinary temperatures the loss is gradual.

Odor, Taste, and Reaction.—Odorless; bitter taste; alkaline reaction.

Solubility.—When free from water it has the following solubility:

Water. In 1750 parts at 25° C. (77° F.); in 810 parts at 80° C. (176° F.).

Alcohol. In 0.6 part at 25° C. (77° F.).

Other solvents. In 4.5 parts of ether, 1.9 parts of chloroform, 158 parts of glycerin, 120 parts of benzene, 3450 parts of a solution of potassium hydroxide (1 in 20), and in 1810 parts of ammonia water at 25° C. (77° F.).

Containing 3 molecules of water:

Water. In 155 parts at 25° C. (77° F.); in 775 parts at 80°C. (176° F.).

Alcohol. In 0.6 parts at 25° C. (77° F.).

Other solvents. In 1.3 parts of ether, 1.6 parts of chloroform, 212 parts of glycerin, 166 parts of benzene, 3450 parts of a solution of potassium hydroxide (1 in 20), and in 1810 parts of ammonia water at 25° C. (77° F.).

Tests for Identity.—The aqueous solution is lævogyrate.

When rendered anhydrous by heating to constant weight at 125° C. (257° F.), its melting point is 174.9° C. (346.8° F.).

If to 1 Cc. of an aqueous solution of quinine (1 in 100), containing just sufficient diluted sulphuric acid to effect complete solution, there be added 2 Cc. of bromine T.S., followed by 1 Cc. of ammonia water, the liquid should acquire an emerald-green color (*thalleioquin*).

If 0.7 Gm. of Quinine be dissolved in a mixture of 15 Cc. of acetic acid, 6 Cc. of alcohol, and 0.5 Cc. of sulphuric acid, the solution heated to boiling, and 7 Cc. of a saturated solution of iodine in alcohol be added slowly, bronze or olive-green crystals of quinine iodo-sulphate will separate on gradually cooling the solution. These crystals are insoluble in cold water.

If 0.2 Gm. of Quinine be dissolved in 1 Cc. of diluted sulphuric acid, the solution diluted with distilled water to 20 Cc. and neutralized with ammonia water, and 1 drop of solution of hydrogen dioxide and 1 drop of copper sulphate T.S. be added, and the liquid boiled, an intensely red color should appear, which slowly changes to a blue, and finally to a green color. (Quinine and quinidine alone respond to this test.)

Quinine should not produce a red color with nitric acid (difference from *morphine*).

Impurities and Tests for Impurities.—*Cinchonine and cinchonidine.* One Gm. of Quinine should dissolve completely in a slightly warmed mixture of 6 Cc. of absolute alcohol and 3 Cc. of ether, which solution should remain clear on cooling.

Limit of readily carbonizable organic impurities. Quinine should not impart more than a faintly yellowish tint to sulphuric acid.

Excess of water. Quinine should not lose more than 14.3 percent. of water on heating to 125° C. (257° F.).

Ammonium salts. When heated with 2 Cc. of potassium hydroxide T.S., no ammonia should be evolved.

Other cinchona alkaloids. Dissolve 2 Gm. of Quinine, which has previously been dried at 50° C. (122° F.) for two hours in a porcelain dish, in 20 Cc. of alcohol. Add 2 drops of hematoxylin T.S., neutralize exactly with sulphuric acid, and evaporate to dryness on a water-bath. Complete the test by following the directions given under *Quininæ Sulphas*, page 937 (Test for Other Cinchona Alkaloids, Section II).

Uses.—The alkaloid quinine is rarely used medicinally. It is used officially in the preparation of elixir of the phosphates of iron, quinine, and strychnine, glycerite of the phosphates of iron, quinine, and strychnine, oleate of quinine, compound syrup of hypophosphites, and also in making iron and quinine citrate, soluble iron and quinine citrate, elixirs, etc.

QUININÆ SULPHAS. U.S. Quinine Sulphate

$$(C_{20}H_{24}N_2O_2)_2.H_2SO_4 + 7H_2O = 866.15$$

The sulphate $[SO_2(OH)_2.(C_{20}H_{24}N_2O_2)_2 + 7H_2O]$ of the alkaloid quinine. It should be kept in well-stoppered bottles, preferably of an amber color, and in a dark place.

Preparation.—The processes which are used for making quinine sulphate, commercially, are regarded as valuable trade secrets, and the manufacturers carefully guard them. The following process, which was formerly official, illustrates one method of making the sulphate of the principal alkaloid from cinchona :

Take of Yellow Cinchona, in coarse powder, 48 oz. troy ; Hydrochloric Acid, 3½ oz. troy ; Lime, in fine powder, 5 oz. troy ; Animal Charcoal, in fine powder, Sulphuric Acid, Alcohol, Water, Distilled Water, each, a sufficient quantity. Boil the Cinchona in 13 pints of Water mixed with one-third of the Hydrochloric Acid, and strain through muslin. Boil the residue twice successively with the same quantity of Water and Acid as before, and strain. Mix the decoctions, and, while the liquid is hot, gradually add the Lime, previously mixed with 2 pints of Water, stirring constantly, until the quinine is completely precipitated. Wash the precipitate with Distilled Water, and, having pressed, dried, and powdered it, digest it in boiling Alcohol. Pour off the liquid, and repeat the digestion several times, until the Alcohol is no longer rendered bitter. Mix the liquids, and distil off the Alcohol until a brown viscid mass remains. Upon this, transferred to a suitable vessel, pour 4 pints of Distilled Water, and, having heated the mixture to the boiling point, add as much Sulphuric Acid as may be necessary to dissolve the quinine. Then add 1½ oz. troy of Animal Charcoal, boil the liquid for two minutes, filter while hot, and set it aside to crystallize. Should the liquid, before filtration, be entirely neutral, acidulate it very slightly with Sulphuric Acid ; should it, on the contrary, change the color of litmus paper to a bright red, add more Animal Charcoal. Separate the crystals from the liquid, dissolve them in boiling Distilled Water slightly acidulated with Sulphuric Acid, add a little Animal Charcoal, filter the solution, and set it aside to crystallize. Lastly, dry the crystals on bibulous paper with a gentle heat, and keep them in a well-stoppered bottle. The mother-water may be made to yield an additional quantity of Sulphate of Quinine by precipitating the quinine with Water of Ammonia, and treating the precipitated alkaloid with Distilled Water, Sulphuric Acid, and Animal Charcoal, as before.

The hydrochloric acid forms with the alkaloids soluble hydrochlorides. The lime decomposes the salts by uniting with the acid, and the alkaloids are precipitated with the excess of lime. These are dissolved out with boiling alcohol, the solution evaporated, acidulated with sulphuric acid, decolorized with animal charcoal, and crystallized.

Sodium hydroxide is often used instead of lime to precipitate the alkaloids, because quinine is less soluble in a solution of sodium chloride than in calcium chloride : while several manufacturers prefer to use amyl alcohol for exhausting the lime precipitate of alkaloids. Oil of turpentine and refined petroleum have also been used as solvents to some extent.

At least three sulphates of quinine have been obtained, of which two are now official. The first of these $(C_{20}H_{24}N_2O_2)_2.H_2SO_4 + 7H_2O$, is "diquinic sulphate," is known and prescribed in Great Britain as *Quininæ Disulphas*, and is the official salt known as quinine sulphate, or *Quininæ Sulphas*, U. S.; the second, formed by dissolving the first in diluted sulphuric acid, has the formula $C_{20}H_{24}N_2O_2.H_2SO_4 + 7H_2O$, and is the official quinine bisulphate, or *Quininæ Bisulphas*, U. S.; while the third which is not official, is the acid sulphate,

$C_{20}H_{24}N_2O_2.2H_2SO_4 + 7H_2O$, and may be obtained from a solution of quinine in an excess of diluted sulphuric acid.

Official Description.—White, silky, light, flexible, glistening crystals, or hard, prismatic, monoclinic needles, making a very light and easily compressible mass; it effloresces very rapidly when exposed to dry air, and then becomes lustreless; when exposed to light it acquires a brownish tint. It sometimes crystallizes with 8 molecules of water of crystallization (16.18 percent.).

Odor, Taste, and Reaction.—Odorless; persistent, very bitter taste. Its aqueous solution is neutral to litmus paper, and when acidulated with diluted sulphuric acid, develops a vivid blue fluorescence.

Solubility.—*Water.* In 720 parts at 25° C. (77° F.); in 45 parts at 80° C. (176° F.). Diluted acids increase its solubility.

Alcohol. In 86 parts at 25° C. (77° F.); in 9 parts at 60° C. (140° F.).

Other solvents. In 400 parts of chloroform and 36 parts of glycerin at 25° C. (77° F.); very difficultly soluble in ether; easily soluble in a mixture of chloroform 2 parts and absolute alcohol 1 part.

Tests for Identity.—Quinine Sulphate which has been dried over sulphuric acid melts at 205° C. (401° F). When heated to 60° C. (140° F.), or when exposed to dry air, it loses all but 2 molecules of its water of crystallization, and upon heating it to 115° C. (239° F.), the remainder is expelled. Upon ignition, the salt is slowly consumed, without leaving a residue.

Barium chloride T.S. produces a white precipitate, insoluble in hydrochloric acid.

On treating 10 Cc. of an aqueous solution of the salt (about 1 in 1300) with 5 drops of bromine T.S., then with an excess of ammonia water, the liquid should acquire an emerald-green color (*thalleioquin*). With proper adjustment of the reagents, more diluted solutions will give a paler tint, while more concentrated ones will acquire a deeper color, or throw down a green precipitate.

Impurities and Tests for Impurities.—*Ammonium sulphate and inorganic salts.* One Gm. of the salt should dissolve completely when heated to 50° C. (122° F.) in 7 Cc. of a mixture of 2 volumes of chloroform and 1 volume of absolute alcohol, and should remain clear on cooling.

Limit of readily carbonizable organic impurities. Sulphuric acid should impart to the salt not more than a faintly yellowish tint.

Nitric acid should not produce a red color (difference from *morphine*).

If 1 Gm. of the salt be dried at a temperature of 115° C. (239° F.), until it ceases to lose weight, the residue should weigh not less than 0.838 Gm. (indicating not more than *8 molecules or 16.18 percent. of water*).

Tests for Other Cinchona Alkaloids.—Dry Quinine Sulphate at 50° C. (122° F.) for two hours. If 1.8 Gm. of this Dry Quinine Sulphate (which should be neutral or slightly alkaline to test paper) be agitated with 20 Cc. of water, at 65° C. (149° F.) for half an hour, then allowed to cool to 15° C. (59° F.) and be macerated at this temperature for two hours, with occasional shaking of the test-tube, the liquid filtered through filter paper of 8 to 10 Cm. diameter, then if 5 Cc. of the filtrate be transferred to a test-tube, and gently mixed (without shaking) with 7 Cc. of ammonia water which must be of official strength, have a temperature of 15° C. (59° F.) and be all added at once, a clear liquid should be produced.

If the temperature during the maceration has been 16° C. (60.8° F.) 7.5 Cc. of ammonia water may be added. If 17° C. (62.8° F.), 8 Cc. may be added (limit of allowable foreign cinchona alkaloids).

Uses.—Quinine sulphate is used as an antiperiodic, tonic, and antipyretic. The dose varies from two to twenty grains (0.125 to 1.3 Gm.). It may be given in the form of pills or in solution. In the latter case it is better to suspend it in syrup without using acid, with the addition of a little fluidextract of glycyrrhiza and a small quantity of ammonia water.

QUININÆ BISULPHAS. U.S. Quinine Bisulphate

$C_{20}H_{24}N_2O_2.H_2SO_4 + 7H_2O = 544.33$

The acid sulphate $[SO_2(OH)_2.C_{20}H_{24}N_2O_2 + 7H_2O]$ of the alkaloid quinine. It should be kept in well-stoppered, dark amber-colored vials.

Preparation.—This salt is made by adding sulphuric acid to quinine sulphate suspended in water, evaporating the solution, and crystallizing the bisulphate.

Official Description.—Colorless, transparent or whitish, orthorhombic crystals or small needles. It effloresces on exposure to the air, and turns yellow on exposure to the light.

Odor, Taste, and Reaction.—Odorless; very bitter taste. Its aqueous solution has a strongly acid reaction and shows a blue fluorescence.

Solubility.—*Water.* In 8.5 parts at 25° C. (77° F.); in 0.68 part at 80° C. (176° F.).

Alcohol. In 18 parts at 25° C. (77° F.); in 0.5 part at 60° C. (140° F.).

Other solvents. In 1770 parts of ether, 920 parts of chloroform, and in 18 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—When heated, the salt softens at 60° C. (140° F.), becomes semi-fluid at 70° C. (158° F.), and melts at about 160° C. (320° F.), with decomposition. It loses all of its water of crystallization at 100° C. (212° F.). On ignition, the salt is slowly consumed, leaving no residue.

Its aqueous solution has a strongly acid reaction and shows a blue fluorescence.

Barium chloride T.S. produces a white precipitate, insoluble in hydrochloric acid.

If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.77 Gm. (corresponding to 7 molecules or 23 percent. of water of crystallization).

If to 1 Cc. of an aqueous solution of Quinine Bisulphate (1 in 100) there be added 2 Cc. of bromine T.S., and then 1 Cc. of ammonia water, the liquid should acquire an emerald green color (*thalleioquin*).

Impurities and Tests for Impurities.—*Limit of carbonizable organic impurities.* Sulphuric acid should produce not more than a faintly yellow tint.

Other cinchona alkaloids. Dissolve 2 Gm. of Quinine Bisulphate, which has been dried at 50° C. (122° F.) for two hours, in 20 Cc. of distilled water, carefully neutralize with diluted sodium hydroxide T.S., and evaporate the solution to dryness on a water-bath. Complete the test by following the directions under *Quininæ Sulphas*, page 937 (Test for Other Cinchona Alkaloids, Section II).

Uses.—The bisulphate has been introduced into medicine in preference to the ordinary sulphate, because of its greater solubility. Being nearly ninety times more soluble, it is better adapted for making into pills than is the sulphate. It contains about 15 percent. less of the alkaloid than does the sulphate. The difference is to some extent compensated for by the greater solubility, and the dose given is usually the same as that of the sulphate.

QUININÆ HYDROCHLORIDUM. U.S. Quinine Hydrochloride

$C_{20}H_{24}N_2O_2.HCl + 2H_2O = 393.76$

[QUININÆ HYDROCHLORAS, PHARM. 1890 QUININE HYDROCHLORATE]

The hydrochloride [$HCl.C_{20}H_{24}N_2O_2 + 2H_2O$] of the alkaloid quinine. It should be kept in well-stoppered, amber-colored vials.

Preparation.—Quinine hydrochloride may be made by double decomposition between quinine sulphate and barium chloride, or by dissolving the alkaloid quinine in diluted hydrochloric acid, evaporating, and crystallizing.

Official Description.—White, silky, glistening needles. The salt effloresces when exposed to warm air.

Odor, Taste, and Reaction.—Odorless; very bitter taste. Its aqueous solution is neutral or faintly alkaline to red litmus paper, and is not fluorescent except when greatly diluted, or when diluted sulphuric acid is added to it.

Solubility.—*Water.* In 18 parts at 25° C. (77° F.); in 0.4 part at 80° C. (176° F.).

Alcohol. In 0.6 part at 25° C. (77° F.).

Other solvents. In 240 parts of ether, 0.8 part of chloroform, and 8 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—When heated to 120° C. (248° F.), the salt loses its water of crystallization. At about 156° C. (312.8° F.), it begins to melt, but is not fully melted until the temperature reaches 190° C. (374° F.). On ignition it is slowly consumed, leaving no residue.

Silver nitrate T.S. produces in aqueous solutions of the salt a white precipitate, insoluble in nitric acid.

If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should weigh 0.91 Gm. (corresponding to 2 molecules or 9.1 percent. of water of crystallization).

If to 1 Cc. of a solution of Quinine Hydrochloride (1 in 100) 2 Cc. of bromine T.S. be added, and then 1 Cc. of ammonia water, an emerald-green color should be produced (*thalleioquin*).

If to 5 Cc. of a saturated solution of potassium ferricyanide 25 Cc. of water, 15 drops of ferric chloride T.S., and 5 Cc. of diluted hydrochloric acid be added, a clear brown solution should result. On adding to this 0.1 Gm. of Quinine Hydrochloride, shaking well, and allowing it to stand for five minutes, no blue color should be developed (difference from *morphine*).

Impurities and Tests for Impurities.—*Absence of readily carbonizable organic impurities.* Sulphuric acid should produce no color.

Limit of Sulphate. Aqueous solutions of the salt should not be rendered more than faintly turbid by barium chloride T.S.

Other cinchona alkaloids. Dissolve 3 Gm. of Quinine Hydrochloride, which has been dried at 50° C. (122° F.) for two hours, in 30 Cc. of hot distilled water in an evaporating dish, and add 1.5 Gm. of crystallized sodium sulphate gradually, with constant stirring, and evaporate the liquid on a water-bath to dryness. Complete the test by following the directions under *Quininæ Sulphas*, page 937 (Test for Other Cinchona Alkaloids, Section II), using 30 Cc. of distilled water for maceration instead of 20 Cc. as there directed.

Uses.—This salt is used like the sulphate. It is much more soluble, and is preferable for hypodermic use. The dose is from two to twenty grains (0.125 to 1.3 Gm.).

QUININÆ HYDROBROMIDUM. U.S. Quinine Hydrobromide

$C_{20}H_{24}N_2O_2.HBr + H_2O = 420.06$

[QUININÆ HYDROBROMAS, PHARM. 1890 QUININE HYDROBROMATE]

The hydrobromide [$HBr.C_{20}H_{24}N_2O_2 + H_2O$] of the alkaloid quinine. It should be kept in well-stoppered, amber-colored vials.

Preparation.—Quinine hydrobromide may be made by decomposing 40 parts of quinine sulphate dissolved in 400 parts of hot alcohol with 11 parts of potassium bromide dissolved in 30 parts of distilled water. Potassium sulphate crystallizes out, and the quinine hydrobromide in solution may be obtained by evaporation and crystallization. In drying the salt, care must be observed not to subject the crystals to heat sufficient to fuse them. A warm dry atmosphere should be relied upon to effect the drying, and all unnecessary exposure to light should be avoided.

Quinine hydrobromide may also be made by double decomposition between quinine sulphate and barium bromide, both in hot alcoholic solution. It is sometimes made by dissolving the alkaloid quinine in hot diluted hydrobromic acid until the latter is no longer acid to litmus paper, evaporating, and crystallizing.

Official Description.—White, light, silky needles; efflorescent on exposure to the air.

Odor, Taste, and Reaction.—Odorless; very bitter taste. Its solutions are neutral, or slightly alkaline to litmus paper, and when acidulated with diluted sulphuric acid show a vivid blue fluorescence.

Solubility.—*Water.* In 40 parts at 25° C. (77° F.); in three parts at 80° C. (77° F.).

Alcohol. In 0.67 part at 25° C. (77° F.).

Other solvents. In 16 parts of ether, 8 parts of glycerin, and very soluble in chloroform at 25° C. (77° F.).

Tests for Identity.—When heated to 100° C. (212° F.) the salt loses its water of crystallization. At 152° C. (305.6° F.) it begins to fuse, forming a syrupy liquid at 200° C. (392° F.). On ignition it is slowly consumed, leaving no residue.

Ammonia water added to an aqueous solution of the salt produces a white precipitate, which is soluble in a large excess of the reagent.

On precipitating a saturated aqueous solution of the salt with sodium hydroxide T.S., filtering, supersaturating the filtrate with acetic acid, adding chloroform and a little chlorine water, and shaking, the chloroform will separate with a yellow color.

If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should weigh not less than 0.957 Gm. (corresponding to 1 molecule, or 4.25 percent. of water of crystallization).

If to 1 Cc. of a solution of Quinine Hydrobromide (1 in 100) 2 Cc. of bromine T.S. be added, and then 1 Cc. of ammonia water, an emerald-green color should be produced (*thalleioquin*).

Quinine Hydrobromide should not produce a red color with nitric acid (difference from *morphine*).

If to 5 Cc. of a saturated aqueous solution of potassium ferricyanide 25 Cc. of water, 15 drops of ferric chloride T.S., and 5 Cc. of diluted hydrochloric acid be added, a clear brown solution should result. On adding to this 0.1 Gm. of Quinine Hydrobromide, shaking well, and allowing it to stand for five minutes, no blue color should be developed (difference from *morphine*).

Impurities and Tests for Impurities.—*Limit of readily carbonizable organic impurities.*—Quinine Hydrobromide should not impart more than a faintly yellowish tint to concentrated sulphuric acid.

Limit of sulphate. Aqueous solutions of the salt should not be rendered more than faintly turbid by barium chloride T.S.

Other cinchona alkaloids. Dissolve 3 Gm. of Quinine Hydrobromide, which has been dried at 50° C. (122° F.) for two hours, in 30 Cc. of hot distilled water in an evaporating dish, and add 1.5 Gm. of crystallized sodium sulphate gradually, with constant stirring, and evaporate the liquid on a water-bath to dryness. Complete the test by following the directions under *Quininæ Sulphas*, page 937 (Test for Other Cinchona Alkaloids, Section II), using 30 Cc. of distilled water for maceration instead of 20 Cc. as there directed.

Uses.—Quinine hydrobromide is sometimes used hypodermically. Its dose is that of the sulphate, two to twenty grains (0.125 to 1.3 Gm.).

QUININÆ SALICYLAS. U.S. Quinine Salicylate

$2C_{20}H_{24}N_2O_2.C_7H_6O_3 + H_2O = 935.54$

The salicylate [$2C_6H_4(OH)COOH.C_{20}H_{24}N_2O_2 + H_2O$] of the alkaloid quinine. It should be kept in amber-colored, well-stoppered vials.

Preparation.—Quinine salicylate may be made by double decomposition between solutions of quinine hydrochloride, and ammonium salicylate, or by saturating an alcoholic solution of quinine with an alcoholic solution of salicylic acid and purifying the crystals.

Official Description.—Colorless needles, permanent in the air, but on keeping readily assuming a pinkish color.

Taste and Reaction.—Its aqueous solution is alkaline to red litmus paper, and has a bitter taste.

Solubility.—*Water.* In 77 parts at 25° C. (77° F.); in 35 parts at 80° C. (176° F.).

Alcohol.—In 11 parts at 25° C. (77° F.); in 11 parts at 60° C. (140° F.).

Other solvents. In 110 parts of ether, 37 parts of chloroform, and in 16 parts of glycerin at 25° C. (77° F.).

Tests for Identity.—When heated, it begins to melt at 183° C. (361.4° F.), with decomposition, and at 187° C. (368.6° F.) is entirely melted to a red liquid. When ignited, it is slowly consumed, without leaving a residue.

When treated with diluted sulphuric acid, its aqueous solution develops a blue fluorescence.

Its aqueous solution, when treated with a drop of ferric chloride T.S., should give a violet color.

Sulphuric acid containing about one-fifth of its volume of solution of formaldehyde gives a pink color.

If to 10 Cc. of a dilute aqueous solution of Quinine Salicylate there be added 3 Cc. of bromine T.S. and then an excess of ammonia water, an emerald-green color should be produced (*thalleioquin*).

Impurities and Tests for Impurities.—*Excessive moisture.* When heated at 100° C. (212° F.), to constant weight, it should lose not more than 2 percent. in weight.

Other cinchona alkaloids. Mix 2 Gm. of Quinine Salicylate with 10 Cc. of distilled water, in a separator, add a slight excess of ammonia water, and shake the liquid with three successive portions of 25, 20, and 10 Cc. of ether, collect the ether-solution in a porcelain dish and evaporate it to dryness on a water-bath, dissolve the residue in alcohol, add just sufficient sulphuric acid to render the liquid exactly neutral, and again evaporate to dryness. Complete the test by following the directions given under *Quininæ Sulphas*, page 937 (Test for Other Cinchona Alkaloids, Section II).

Uses.—Quinine salicylate is preferred to quinine sulphate by some physicians when they wish to obtain the medicinal action of the salicylic constituent. Dose, two to twenty grains (0.125 to 1.3 Gm.).

CINCHONINÆ SULPHAS. U.S. Cinchonine Sulphate

$(C_{19}H_{22}N_2O)_2.H_2SO_4 + 2H_2O = 717.17$

The neutral sulphate $[SO_2(OH)_2.(C_{19}H_{22}N_2O)_2 + 2H_2O]$ of an alkaloid obtained from the bark of several species of Cinchona.

Preparation.—In consequence of its greater solubility, cinchonine sulphate remains behind in the mother waters, when quinine sulphate crystallizes, in the process for preparing the latter. Cinchonine is obtained from quinine mother liquors by precipitation with solution sodium hydroxide. The precipitated cinchonine is washed, converted into a sulphate by the addition of sulphuric acid, decolorized, and crystallized.

Official Description.—White, hard, lustrous, prismatic crystals; permanent in the air. At 100° C. (212° F.) it loses its water of crystallization. If crystallized from water it will contain two, and if from alcohol, one, molecule of water of crystallization. Its aqueous solution should not show fluorescence.

Odor, Taste, and Reaction.—Odorless; bitter taste; neutral reaction.

Solubility.—*Water.* In 58 parts at 25° C. (77° F.): in 32 parts at 80° C. (176° F.).

Alcohol. In 10 parts at 25° C. (77° F.); in 5.2 parts at 60° C. (140° F.).

Other solvents. In 2300 parts of ether and in 69 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—It melts at 198.5° C. (389.5° F.), and leaves no residue on incineration.

Its aqueous solution is dextrogyrate.

An aqueous solution of Cinchonine Sulphate (1 in 100) yields with barium chloride T.S. a white precipitate, insoluble in hydrochloric acid.

Impurities and Tests for Impurities.—*Undue amount of water.* One Gm. of the salt dried to constant weight at 100° C. (212° F.) should weigh not less than 0.95 Gm.

Limit of quinine or quinidine sulphates. A solution of the salt (1 in 1000) in diluted sulphuric acid should not exhibit more than a faint blue fluorescence.

Limit of quinine or cinchonidine sulphates. If 1 part of the powdered salt be macerated with frequent agitation in 80 parts of chloroform, at ordinary temperatures, it should be wholly, or almost wholly, dissolved.

Limit of readily carbonizable, organic impurities. The salt should not impart more than a faintly yellowish tinge to sulphuric acid.

Uses.—Cinchonine sulphate is used as a tonic and febrifuge. Its cheapness has led to its extensive employment as a substitute for quinine. The dose as an antiperiodic is, however, larger. Fifteen to forty grains (1 to 2.6 Gm.) have been given.

CINCHONIDINÆ SULPHAS. U.S. Cinchonidine Sulphate

$(C_{19}H_{22}N_2O)_2.H_2SO_4 + 3H_2O = 735.05$

The neutral sulphate $[SO_2(OH)_2.(C_{19}H_{22}N_2O)_2 + 3H_2O]$ of an alkaloid obtained from the bark of several species of Cinchona.

Preparation.—This alkaloidal salt is also obtained from the quinine mother liquors by fractional crystallization. The Indian barks contain a larger proportion of it than the South American varieties.

Official Description.—White, glistening, silky needles or prisms; permanent in the air. When crystallized from dilute solutions, it contains six molecules of water of crystallization, and when from concentrated solutions, three molecules.

Odor, Taste, and Reaction.—Odorless, and having a very bitter taste. The aqueous solution is neutral or only faintly alkaline to phenolphthalein T.S. or litmus T.S., and is lævogyrate.

Solubility.—*Water.* Soluble in 63 parts at 25° C. (77° F.): in 21 parts at 80° C. (176° F.).

Alcohol. In 72 parts at 25° C. (77°); in 32 parts at 60° C. (140° F.).

Other solvents. In 4400 parts of ether and in 900 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—When heated to 100° C. (212° F.), the salt loses its water of crystallization, and at 203° C. (397.4° F.), it darkens, and then melts at 205.3° C. (401.5° F.). At a higher temperature it ignites and is consumed without leaving a residue.

Its aqueous solution yields with barium chloride T.S. a white precipitate, insoluble in hydrochloric acid.

On adding ammonia water to the aqueous solution of the salt, a white precipitate (cinchonidine) is produced, which is but slightly soluble in ammonia, but which, when freshly precipitated, dissolves in ten parts of ether, the greater part afterwards separating in crystals.

Impurities and Tests for Impurities.—*Limit of readily carbonizable organic impurities.* If sulphuric acid be added to a small quantity of the salt, not more than a faintly yellowish color should be developed. Upon adding to this liquid a crystal of potassium dichromate, a yellowish-green color is produced, which gradually changes to grass-green.

Undue amount of water. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.920 Gm.

More than traces of quinine or quinidine sulphates. A solution of the salt (1 in 1000) in diluted sulphuric acid should not exhibit more than a faint blue fluorescence.

More than small quantities of cinchonine or quinidine sulphates. If 0.5 Gm. of the salt be macerated, with frequent agitation, at the ordinary temperature, with 20 Cc. of water, 0.5 Gm. of potassium and sodium tartrate then added, the maceration continued, under repeated agitation, for one hour at 15° C. (59° F.), and the mixture filtered, the addition of 1 drop of ammonia water to the filtrate should not produce more than a slight turbidity.

Uses.—This salt closely resembles quinine sulphate in its medicinal effects, and may be used for the same purposes in somewhat larger doses. Dose, five to thirty grains (0.3 to 2 Gm.).

NUX VOMICA. U.S. Nux Vomica

The dried, ripe seed of *Strychnos Nux-vomica* Linné (Fam. *Loganiaceæ*), yielding, when assayed by the process given below, not less than 1.25 percent. of strychnine.

Orbicular, nearly flat, sometimes irregularly bent, 15 to 30 Mm. in diameter, 3 to 5 Mm. thick; externally grayish or greenish-gray, the surface covered with short, closely appressed, satiny hairs; rounded or somewhat acute at the margin, with a slight ridge extending from the centre of one side to the edge; internally whitish gray, horny, very tough, the endosperm in two more or less regular concavo-convex halves, between which, at one end, lie the heart-shaped, palmately nerved cotyledons; inodorous; taste intensely and persistently bitter.

Powder light gray, the epidermal cells modified to strongly lignified hairs; endosperm cells thick-walled, containing a fixed oil and aleurone grains, and giving a blue or violet color with potassium dichromate and sulphuric acid; in the tissues of adhering fruit pulp occur a few small, nearly spherical starch grains.

Nux vomica contains *strychnine*, *brucine* ($C_{23}H_{26}N_2O_4$), probably *loganin*, *igasuric acid*, protein compounds, gum, fixed oil, sugar, etc. Strychnine is official, and will be considered separately. Brucine is readily soluble in alcohol and in chloroform; it is colored bright red by nitric acid, and its solution acquires a rose red coloration with chlorine water. The presence of igasurine is now considered doubtful. The fixed oil is soluble in alcohol, and the alkaloids are soluble in the oil. In making the extract, the nux vomica is exhausted with an acetic acid menstruum, so that the oil will not be extracted and require subsequent removal.

Uses.—Nux vomica is poisonous in large doses; in doses of one grain (0.065 Gm.) it is tonic.

Assay of Nux Vomica

Nux Vomica, in No. 60 powder . . . . **20 Gm.**
Ammonia Water,
Ether,
Chloroform,
Alcohol,
Normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Nitric Acid (sp. gr. 1.42),
Sodium Hydroxide Solution (1 in 10),
Tenth-normal Sulphuric Acid V.S.,
Sulphuric Acid Solution (3 percent. H_2SO_4),
Iodeosin T.S., each, a sufficient quantity

Introduce the Nux Vomica into a 250 Cc. Erlenmeyer flask and add to it 200 Cc. of a mixture of 137.5 Cc. of ether, 44 Cc. of Chloroform, 13.5 Cc. of alcohol and 5 Cc. of ammonia water; insert the stopper securely and macerate with frequent shaking during one hour and allow it to stand in a cool place for twelve hours. Decant into a measuring cylinder 100 Cc. of the liquid (representing 10 Gm. of Nux Vomica), and pour this into a separator, preferably of a globular shape. Rinse the cylinder with a little chloroform, add this to the separator, and then add 15 Cc. of normal sulphuric acid V.S.; shake the mixture moderately during one minute, being careful to avoid emulsification; when the liquids have separated completely, draw off the acid liquid into a beaker. Repeat the shaking out with successive portions of 5 and 3 Cc. of normal sulphuric acid V.S.; collect the acid solutions and pour them into a separator. If a drop of the last acid solution yields a precipitate with mercuric potassium iodide T.S., repeat the shaking out of the ether solution with 5 Cc. of normal sulphuric acid V.S. To the combined acid solutions in the separator, add a small piece of red litmus paper, 25 Cc. of chloroform, and then sufficient ammonia water to render the liquid alkaline, and shake the separator thoroughly. When the liquids have separated draw off the chloroform into a flask of 100 Cc. capacity, and repeat the shaking out of the alkaline liquid with two successive portions of 15 Cc. each of chloroform, adding the latter to that already in the flask. Evaporate the combined chloroformic solutions in the flask until the alkaloidal residue is dry, then dissolve it in 15 Cc. of sulphuric acid (3 percent.), warming it on a water-bath. When the solution has cooled, add 3 Cc. of a cooled mixture of equal volumes of nitric acid (specific gravity 1.42) and distilled water, and after rotating the liquid a few times, set it aside for exactly ten minutes, shaking it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous solution of sodium hydroxide (1 in 10) and wash the flask three times with very small amounts of distilled water, and add the washings to the separator. If the liquid is not turbid add 2 Cc. more of the solution of sodium hydroxide. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter wetted with chloroform, into a flask. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the flask, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath very carefully, to avoid decrepitation. To the alkaloidal residue add 6 Cc. of tenth-normal sulphuric acid V.S., 5 drops of iodeosin T.S., about 80 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. until the aqueous liquid just turns pink. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 6 (the 6 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.0332, and this product by 10, which will give the percentage of strychnine in the Nux Vomica.

Official Preparations

Extractum Nucis Vomicæ Extract of Nux Vomica	Made by exhausting 1000 Gm. of nux vomica with a 10 percent. acetic acid menstruum, setting aside the first 750 Cc. of percolate, evaporating the remainder to a soft extract, dissolving it in the reserved portion, adding 3000 Cc. of alcohol, setting aside, with occasional agitation during twenty-four hours, filtering, evaporating to dryness on a water-bath, assaying, and adding sugar of milk, if necessary, to make it contain 5 percent. of strychnine (see page 448). Dose, one-fourth grain (0.015 Gm.)
Fluidextractum Nucis Vomicæ Fluidextract of Nux Vomica	Made with a menstruum of 3 parts of alcohol and 1 part of water, with 5 percent. of acetic acid (see page 406). Dose, one to three minims (0.05 to 0.2 Cc.)
Tinctura Nucis Vomicæ Tincture of Nux Vomica	Made by dissolving 20 Gm. of extract of nux vomica in a mixture of 3 parts of alcohol and 1 part of water, to make 1000 Cc. (see page 358). Dose, ten minims (0.6 Cc.)

STRYCHNINA. U.S. Strychnine

$C_{21}H_{22}N_2O_2 = 331.73$

An alkaloid obtained from Nux Vomica, and also obtainable from other plants of the *Loganiaceæ*.

Preparation.—Strychnine may be made by the process formerly official, as follows:

Take of Nux Vomica, rasped, 48 oz. troy; Lime, in fine powder, 6 oz. troy; Hydrochloric Acid, $3\frac{1}{2}$ oz. troy; Alcohol, Diluted Alcohol, Diluted Sulphuric Acid, Water of Ammonia, Purified Animal Charcoal, Water, each, a sufficient quantity. Macerate the Nux Vomica for twenty-four hours in 16 pints of water, acidulated with one-third of the Hydrochloric Acid; then boil for two hours, and strain with expression through a strong muslin bag. Boil the residue twice successively in the same quantity of acidulated Water, each time straining as before. Mix the decoctions and evaporate to the consistence of thin syrup; then add the Lime previously mixed with a pint of Water, and boil for ten minutes, frequently stirring. Pour the whole into a double muslin bag, and, having thoroughly washed the precipitate, press, dry, and powder it. Treat the powder repeatedly with Diluted Alcohol, in order to remove the brucine, until the washings are but faintly reddened by nitric acid. Then boil it repeatedly with Alcohol until deprived of its bitterness, mix the several tinctures, and distil off the Alcohol by means of a water-bath. Having washed the residue, mix it with a pint of water, and, applying a gentle heat, drop in enough Diluted Sulphuric Acid to neutralize and dissolve the alkaloid. Then add Purified Animal Charcoal, and, having boiled the mixture for a few minutes, filter, evaporate, and set aside to crystallize. Dissolve the crystals in Water, and add sufficient Water of Ammonia to precipitate the Strychnine. Lastly, dry this on bibulous paper, and keep it in a well-stoppered bottle.

In this process strychnine hydrochloride is formed. This is decomposed by lime, and the strychnine is dissolved out of the excess of lime with boiling alcohol (the brucine having been previously removed by treatment with diluted alcohol), the alcoholic solution is evaporated, and sulphuric acid added to dissolve the alkaloid; the solution is decolorized and evaporated to crystallize. The crystals of strychnine sulphate are dissolved and strychnine precipitated by adding ammonia water.

Official Description.—Colorless, transparent, prismatic crystals, or a white crystalline powder; permanent in the air.

Odor, Taste, and Reaction.—Odorless; intensely bitter taste, perceptible even in solutions of 1 in 700,000. *Strychnine should be tasted with extreme caution.* Alkaline reaction.

Solubility.—*Water.* In 6400 parts at 25° C. (77° F.); in 3000 parts at 80° C. (176° F.).

Alcohol. In 110 parts at 25° C. (77° F.); in 28 parts at 60° C. (140° F.).

Other solvents. In 5500 parts of ether, 6 parts of chloroform, 150 parts of benzene, and in 180 parts of amyl alcohol at 25° C. (77° F.).

Tests for Identity.—Its melting point is 268° C. (514.4° F.). Upon ignition it is consumed, leaving no residue.

Its solutions are lævogyrate.

Sulphuric Acid containing 1 percent. of ammonium vanadate produces with Strychnine a deep violet-blue color, changing to a deep purple, and finally to a cherry-red. Sulphuric acid containing a trace of potassium iodate produces a violet color, changing momentarily to reddish-purple.

If 0.1 Gm. of Strychnine dissolved in a few drops of nitric acid be evaporated to dryness, and a few drops of ammonia water added to the yellow residue, an orange color will be produced, which will turn reddish-purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide T.S.

Impurities and Tests for Impurities.—*Sugar and other readily carbonizable organic impurities.* Sulphuric acid should produce no color.

But on adding a fragment of potassium dichromate, a deep blue color is momentarily produced, changing to deep violet, then to purplish-red, cherry-red, and finally to orange or yellow.

Limit of brucine. Nitric acid, when added to a crystal of Strychnine on a white porcelain surface, may produce a yellow but not a red or reddish color.

Uses.—Strychnine is a cardiac and nervous stimulant, and is given in doses of one sixty-fourth of a grain (0.001 Gm.). It may sometimes be given in doses of one-twentieth of a grain (0.003 Gm.).

STRYCHNINÆ NITRAS. U.S. Strychnine Nitrate

$C_{21}H_{22}N_2O_2.HNO_3 = 394.30$

The nitrate [$NO_2OH.C_{21}H_{22}N_2O_2$] of the alkaloid Strychnine. It should be kept in well-stoppered vials.

Preparation.—Strychnine nitrate may be made by dissolving strychnine in warm diluted nitric acid, evaporating and crystallizing.

Official Description.—Colorless, glistening needles; permanent in the air.

Odor, Taste, and Reaction.—Odorless; intensely bitter taste. *Strychnine Nitrate should be tasted with extreme caution.* Neutral reaction.

Solubility.—*Water.* In 42 parts at 25° C. (77° F.); in 8 parts at 80° C. (176° F.).
Alcohol.—In 120 parts at 25° C. (77° F.); in 60 parts at 60° C. (140° F.).
Other solvents. In 156 parts of chloroform, and in 60 parts of glycerin at 25° (77° F.); insoluble in ether.

Tests for Identity.—When heated, the salt decomposes, but it does not melt, and when ignited it is consumed without leaving a residue.

Its aqueous solutions are lævogyrate.

A solution of the salt, when poured carefully into a test-tube upon a layer of sulphuric acid containing in solution a little diphenylamine, will develop a blue zone at the juncture of the two liquids.

On being heated with hydrochloric acid a bright red color is formed.

Sulphuric acid containing 1 percent. of ammonium vanadate produces with Strychnine Nitrate a dark violet-blue color, changing to purple, and then to red. Sulphuric acid containing a trace of potassium dichromate produces momentarily a blue color, changing to violet, then to purplish-red, cherry-red, and finally to orange or yellow.

If 0.1 Gm. of the salt, dissolved in a few drops of nitric acid, be evaporated to dryness, and a few drops of ammonia water added to the residue, an orange color will be produced, which will turn reddish-purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide T.S.

Impurities and Tests for Impurities.—*Limit of brucine.* The addition of sulphuric acid to a crystal of Strychnine Nitrate on a white porcelain surface may produce a yellow but not a red or reddish color.

Uses.—Strychnine nitrate is a cardiac and nervous stimulant, and is given in the dose of one sixty-fourth of a grain (0.001 Gm.).

STRYCHNINÆ SULPHAS. U.S. Strychnine Sulphate

$(C_{21}H_{22}N_2O_2)_2.H_2SO_4 + 5H_2O = 850.21$

The sulphate [$SO_2(OH)_2.(C_{21}H_{22}N_2O_2)_2 + 5H_2O$] of the alkaloid strychnine It should be kept in well-stoppered vials.

Preparation.—This salt is prepared during the process for making strychnine. (See Strychnina.)

Official Description.—Colorless, or white prismatic crystals, or a white, crystalline powder; efflorescent in dry air.

Odor and Taste.—Odorless; intensely bitter taste, perceptible even in solutions of 1 in 700,000. *Strychnine Sulphate should be tasted with extreme caution.*

Solubility.—*Water.* In 31 parts at 25° C. (77° F.); in 6 parts at 80° C. (176° F.).
Alcohol. In 65 parts at 25° C. (77° F.); in 20 parts at 60° C. (140° F.).
Other solvents. In 325 parts of chloroform at 25° C. (77° F.); insoluble in ether.

Tests for Identity.—When heated at 100° C. (212° F.), the salt loses its water of crystallization (10.59 percent.), and when anhydrous melts at 200° C. (392° F.). Upon ignition, it is consumed, leaving no residue.

Barium chloride T.S. produces in a solution of the salt a white precipitate, which is insoluble in hydrochloric acid.

Sulphuric acid should produce no color with strychnine sulphate, but on adding a fragment of potassium dichromate, a blue color should be formed, changing to deep violet, then to purplish-red, cherry-red, and finally to orange or yellow. Sulphuric acid containing 1 percent. of ammonium vanadate produces a deep violet-blue color, changing to deep purple, and finally to cherry-red. Sulphuric acid containing a trace of potassium iodate produces a violet color, changing to reddish-purple.

If 0.1 Gm. of the salt be dissolved in a few drops of nitric acid, evaporated to dryness, and a few drops of ammonia water added to the yellow residue, an orange color will be produced, which will turn momentarily reddish-purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide T.S.

Impurities and Tests for Impurities.—*Limit of brucine.* Nitric acid, when added to a crystal of Strychnine Sulphate on a white porcelain surface, may produce a yellow but not a red or reddish color.

Uses.—Strychnine sulphate is more useful, medicinally, than strychnine, only because it is much more soluble. The dose is one sixty-fourth of a grain (0.001 Gm.).

GELSEMIUM. U.S. Gelsemium

The dried rhizome and roots of *Gelsemium sempervirens* (Linné) Aiton filius (Fam. *Loganiaceæ*).

Cylindrical, usually in cut pieces of variable length, from 5 to 20, or even 30, Mm. in diameter; externally light yellowish-brown, with purplish-brown longitudinal lines; fracture of the rhizome splintery, the roots breaking with one-half the fracture transverse, the other half oblique or short-splintery; bark about 1 Mm. thick; wood pale yellow, porous, but tough, with numerous distinct medullary rays, in the rhizome excentric, and with four groups of internal phloem; odor pronounced, characteristic; taste slightly aromatic, bitter.

Gelsemium contains *gelsemine*, $C_{24}H_{28}N_2O_4$, *gelseminine*, $C_{22}H_{26}N_2O_3$, gelseminic acid, volatile oil, starch, resin, fat, coloring matter, etc. Alcohol is the best menstruum.

Uses.—It is used as an antispasmodic and sedative. Dose, one grain (0.065 Gm.).

Official Preparations

Fluidextractum Gelsemii Fluidextract of Gelsemium	Made with alcohol (see page 397). Dose, one to three minims (0.05 to 0.2 Cc.)
Tinctura Gelsemii Tincture of Gelsemium	Made by percolating 100 Gm. of Gelsemium with a menstruum of 65 parts of alcohol and 35 parts of water until 1000 Cc. are obtained (see page 352). Dose, eight to twenty minims (0.5 to 1.2 Cc.)

PHYSOSTIGMA. U.S. Physostigma

[CALABAR BEAN]

The ripe seed of *Physostigma venenosum* Balfour (Fam. *Leguminosæ*), yielding, when assayed by the process given below, not less than 0.15 percent. of alkaloids soluble in ether.

Oblong, somewhat reniform, 15 to 30 Mm. long, 10 to 15 Mm. thick; externally reddish- or chocolate-brown, smooth, somewhat roughened near the brownish-black groove which extends almost the entire length of the convex edge, its reddish, rounded margins elevated and somewhat thickened; embryo whitish, with a short, curved hypocotyl and two large, concavo-convex cotyledons; having a bean-like and heavy odor when crushed; taste at first starchy, afterwards acrid.

Physostigma contains *physostigmine* ($C_{15}H_{21}N_3O_2$), or *eserine*, as it is more frequently called. This alkaloid is amorphous and without taste, soluble in water, but more soluble in alcohol, ether, chloroform, carbon disulphide, and benzene. It also contains *calabarine*, an alkaloid derived from eserine, with a neutral principle *physosterin*, starch, protein compounds, mucilage, etc.

Assay of Physostigma

Physostigma, in No. 60 powder . . . . **20 Gm.**
Ether,
Solution of Sodium Bicarbonate (1 in 20),
Normal Sulphuric Acid V.S.,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Distilled Water,
Iodeosin T.S., each, a sufficient quantity

Introduce the Physostigma into an Erlenmeyer flask of about 250 Cc. capacity, add 200 Cc. of ether, and shake the flask well during ten minutes. Then add 10 Cc. of an aqueous solution of sodium bicarbonate (1 in 20), and shake the mixture vigorously at intervals during four hours. Allow the powder to settle, and decant 100 Cc. of the ether-solution (representing 10 Gm. of Physostigma) into a measuring cylinder; then transfer it to a separator, introduce a small piece of blue litmus paper, and add sufficient normal sulphuric acid V.S. to render the liquid acid, and then 10 Cc. of distilled water. Shake the liquid well for several minutes, and draw off the aqueous layer into another separator. Repeat the extraction, using 2 Cc. of normal sulphuric acid V.S. and 8 Cc. of distilled water, add the acid aqueous layer to the second separator, and finally again shake out the ether-solution, using 1 Cc. of normal sulphuric acid V.S. and 9 Cc. of distilled water, adding this also to the second separator. To the combined acid liquids in the second separator, add 25 Cc. of ether, a small piece of red litmus paper, and sufficient sodium bicarbonate solution (1 in 20) to render it alkaline. Shake the separator for one minute, allow the liquids to separate, and draw off the ether into a beaker. Repeat the shaking out process with 20 Cc. and again with 15 Cc. of ether added to the separator, shake each time for one minute, allow the liquids to separate, and draw off the ether into the beaker. Carefully evaporate the ether from the combined solutions by means of a water-bath, and when dry, dissolve the residue in 5 Cc. of tenth-normal sulphuric acid V.S. and 20 Cc. of ether, which must be strictly neutral, and transfer this solution to a bottle, rinsing with 80 Cc. of water; add 5 drops of iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., until, after shaking, the aqueous liquid just acquires a pink color. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0273, and this product by 10; the result will be the percentage of alkaloids soluble in ether contained in the Physostigma. The figure 0.0273 represents the weight in grammes of alkaloids (mainly physostigmine) required to neutralize 1 Cc. of tenth-normal sulphuric acid V.S.

Uses.—Physostigma is sedative, and acts as a powerful poison, contracting the pupil of the eye. Dose, one to three grains (0.065 to 0.2 Gm.).

Official Preparations

Extractum Physostigmatis Extract of Physostigma	Made with alcohol (see page 451). Dose, one-eighth of a grain (0.008 Gm.)
Tinctura Physostigmatis Tincture of Physostigma	Made by percolating 100 Gm. of physostigma with sufficient alcohol to make 1000 Cc. (see page 360). Dose, fifteen minims (1 Cc.)

PHYSOSTIGMINÆ SALICYLAS. U.S. Physostigmine Salicylate

$C_{15}H_{21}N_3O_2.C_7H_6O_3 = 410.21$

[ESERINE SALICYLATE]

The salicylate [$C_6H_4(OH)COOH.C_{15}H_{21}N_3O_2$] of an alkaloid obtained from Physostigma. It should be kept in small, dark amber-colored, well-stoppered vials.

Preparation.—This salt may be made by adding 2 parts of physostigmine to a solution of 1 part of salicylic acid in 35 parts of boiling distilled water, and allowing the salt to crystallize on cooling.

Official Description.—Colorless, or faintly yellowish, shining, acicular, or short columnar crystals. It acquires a reddish tint when long exposed to light and air.

Odor, Taste, and Reaction.—Odorless; slightly bitter taste. *It should be tasted with great caution.* Its aqueous solution shows an acid reaction to litmus paper, and upon standing twenty-four hours the solution acquires a pink color.

Solubility.—*Water.* In 72.5 parts at 25° C. (77° F.); in 15 parts at 80° C. (160° F.).

Alcohol. In 12.7 parts at 25° C. (77° F.), and in 4 parts at 60° C. (140° F.).

Other solvents. In 175 parts of ether and in 8.6 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—When heated, Physostigmine Salicylate begins to soften and turn slightly yellow at 160° C. (320° F.), and melts at 178.9° C. (354° F.). It leaves no residue on incineration.

Ferric chloride T.S., produces in an aqueous solution of Physostigmine Salicylate a deep violet color; a solution of chlorinated lime added to the aqueous solution produces a red color.

On evaporating an aqueous solution of the salt to dryness with a few drops of ammonia water, a blue residue is produced, which is soluble in alcohol, and when so dissolved, yields a red fluorescent solution upon the addition of acetic acid in excess.

An aqueous solution of the salt is colored cherry-red by the addition of potassium hydroxide T.S., changing to a darker red, and finally to green.

Platinic chloride T.S. produces no precipitate in solutions of the salt (distinction from *physostigmine sulphate*).

Sulphuric acid containing in each Cc. 1 drop of solution of formaldehyde gives with Physostigmine Salicylate a bright pink color; sulphuric acid with a few particles of cane sugar produces a yellow color, turning to brown, then to purple, and finally to greenish-black.

If 0.005 Gm. of the salt be dissolved in nitric acid, a yellow solution results, which, on being heated, changes to an orange-color, then to blood-red, and on evaporation to dryness yields a green residue. When exposed to the fumes of nitric acid this residue becomes violet-blue, and when a drop of nitric acid is added to it, it forms a reddish-violet solution, which soon changes to blood-red, and finally, on standing, or on dilution, becomes greenish-yellow.

Uses.—The salts of physostigmine, or eserine, are used to contract the pupil of the eye. The advantage possessed by the salicylate is that it is more permanent and less liable to deliquesce. The dose for internal administration should not be more than one sixty-fourth of a grain (0.001 Gm.).

PHYSOSTIGMINÆ SULPHAS. U.S. Physostigmine Sulphate

$(C_{15}H_{21}N_3O_2)_2.H_2SO_4 = 643.75$

[ESERINE SULPHATE]

The sulphate $[SO_2(OH)_2.(C_{15}H_{21}N_3O_2)_2]$ of an alkaloid obtained from Physostigma. It should be kept in well-stoppered, dark amber-colored vials.

This salt has the disadvantage of being very deliquescent; the salicylate is to be preferred.

Official Description.—A white, or yellowish-white, micro-crystalline powder. Very deliquescent, and gradually turns reddish by exposure to air and light.

Odor, Taste, and Reaction.—Odorless; bitter taste. *It should be tasted with great caution.* Acid reaction.

Solubility.— *Water.* Very soluble.

Alcohol. Very soluble.

Other solvents. Very soluble in chloroform; soluble in 1200 parts of ether at 25° C. (77° F.).

Tests for Identity.—When heated to 130° C. (266° F.), the salt becomes soft, and melts at about 140° C. (284° F.). Upon ignition, it is slowly consumed, leaving no residue.

Its aqueous solution shows an acid reaction to blue litmus paper.

Barium chloride T.S. produces in an aqueous solution of the salt a white precipitate, which is insoluble in hydrochloric acid.

An aqueous solution of Physostigmine Sulphate yields, with alkalies, a white precipitate, which quickly turns pink, and dissolves in an excess of the alkali, forming a pink or red solution, which soon fades to yellowish-green.

Gold chloride T.S. gives with aqueous solutions of the salt a purple color.

Platinic chloride T.S. produces in aqueous solutions of the salt a yellowish-white precipitate (distinction from *physostigmine salicylate*).

Sulphuric acid with Physostigmine Sulphate yields only a faint yellow color.

Sulphuric acid containing a crystal of potassium iodate, on being added to a crystal of the salt, gives a light purple color, immediately changing to yellowish-red.

If 0.005 Gm. of the salt be dissolved in nitric acid, a yellow solution results, which, on being heated, changes to an orange-color, then to blood-red, and, on evaporation to dryness, yields a green residue. When exposed to the fumes of nitric acid, this residue becomes violet-blue, and when a drop of nitric acid is added to it, it forms a reddish-violet solution, which soon changes to blood-red, and finally, on standing, or on dilution, becomes greenish-yellow.

Uses.—The dose of physostigmine sulphate is one sixty-fourth of a grain (0.001 Gm.).

BELLADONNÆ FOLIA. U.S. Belladonna Leaves

The dried leaves of *Atropa Belladonna* Linné (Fam. *Solanaceæ*), yielding, when assayed by the process given below, not less than 0.3 percent. of mydriatic alkaloids.

Usually of a dull brownish-green color, the leaves much wrinkled and matted together, frequently with the flowering tops intermixed; leaves from 6 to 20 Cm. long, 4 to 12 Cm. broad, broadly ovate, apex acute, margin entire, narrowed into the petiole, upper surface brownish-green, lower surface grayish-green, epidermis more or less papillose, particularly on the under surface ; odor distinctly narcotic, especially on moistening ; taste somewhat bitter and acrid.

The powder is characterized by few hairs and numerous, small, arrow-shaped crystals of calcium oxalate.

Assay of Belladonna Leaves

Belladonna Leaves, in No. 60 powder	**10 Gm.**

Chloroform,
Ether,
Normal Sulphuric Acid V.S.,
Ammonia Water,
Distilled Water,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Cochineal T.S., or **Iodeosin T.S.,** each, a sufficient quantity.

Place the Belladonna Leaves in an Erlenmeyer flask, and add 50 Cc. of a mixture of chloroform 1 part and ether 4 parts (both by volume). After inserting the stopper securely allow the flask to stand ten minutes, then add 2 Cc. of ammonia water mixed with 3 Cc. of distilled water, and shake the flask well at frequent intervals during one hour. Then transfer as much as possible of the contents of the flask to a small percolator which has been provided with a pledget of cotton packed firmly in the neck and inserted in a separator containing 6 Cc. of normal sulphuric acid V.S. diluted with 20 Cc. of distilled water. When the liquid has passed through the cotton, pack the Belladonna Leaves firmly in the percolator with the aid of a glass rod, and having rinsed the flask with 10 Cc. of the chloroform-ether mixture, transfer the remaining contents of the flask to the percolator, by the aid of several small portions (5 Cc.) of the chloroform-ether mixture, and continue the percolation with successive small portions of the same liquid (using in all 50 Cc.). Next, shake the separator well for one minute, after securely inserting the stopper, and when the liquids have completely separated, draw off the acid solution into another separator. Add to the chloroform-ether mixture 10 Cc. of sulphuric acid mixture of the same strength as that previously used, agitate well, and again draw off the acid solution into the second separator ; repeat this operation once more, drawing off the acid solution as before ; introduce into the acid solutions contained in the second separator a small piece of red litmus paper, then add ammonia water until the liquid is distinctly alkaline, and shake out with three successive portions of chloroform, 15, 15, and 5 Cc.; collect the chloroform solutions in a beaker, place it on a water-bath containing warm water, and allow the chloroform to entirely evaporate. Dissolve the residue in 3 Cc. of ether, and let this also evaporate completely. To the alkaloidal residue add 3 Cc. of tenth-normal sulphuric acid V.S. and 5 drops of cochineal T.S. (or iodeosin T.S.), then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 3 (the 3 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0287, and this product by 10 ; the result will be the percentage of total mydriatic alkaloids contained in the Belladonna Leaves.

BELLADONNÆ RADIX. U.S. Belladonna Root

The dried root of *Atropa Belladonna* Linné (Fam. *Solanaceæ*), yielding, when assayed as directed below, not less than 0.45 percent. of mydriatic alkaloids.

In cylindrical or somewhat tapering, longitudinally wrinkled pieces, 1 to 2.5 Cm. thick, the bark somewhat incurved at the edges of roots which have been split before drying ; externally pale brownish-gray, dusty or mealy, outer layers of the periderm rather soft, frequently abraded, and thus showing lighter patches ; fracture nearly smooth, mealy, and emitting a characteristic puff of dust ; internally whitish, the older roots showing medullary rays near the bark ; nearly inodorous ; taste sweetish, afterwards bitterish and strongly acrid.

The powder contains relatively few sclerenchymatous fibres and numerous starch grains which are single or 2- to 3-compound, somewhat spherical, and 0.005 to 0.010 Mm. in diameter.

Assay of Belladonna Root.—The method to be employed is identical with that given above for Belladonna Leaves, using *ten grammes* of Belladonna Root in No. 60 powder.

All of the alkaloids from the Solanaceæ stand in close chemical relation to each other, and recent investigations show that some are capable of being converted into others during the process of extraction.

Belladonna owes its activity to *atropine*, $C_{17}H_{23}NO_3$, and *hyoscyamine*, $C_{17}H_{23}NO_3$; *belladonnine* is also present. Atropine and some of the salts of hyoscyamine are official.

Uses.—Belladonna is narcotic and poisonous. It dilates the pupil of the eye. Dose, one to two grains (0.065 to 0.125 Gm.).

Official Preparations

Leaves	
Extractum Belladonnæ Foliorum Extract of Belladonna Leaves	Made from belladonna leaves with a menstruum of 2 parts of alcohol and 1 part of water (see page 441). Dose, one-fifth grain (0.01 Gm.)
Emplastrum Belladonnæ Belladonna Plaster	Made by incorporating 3 parts of extract of belladonna leaves with 7 parts of adhesive plaster. (See Emplastra)
Tinctura Belladonnæ Foliorum Tincture of Belladonna Leaves	Made by percolating 100 Gm. of belladonna leaves with sufficient diluted alcohol to make 1000 Cc. (see page 345). Dose, eight to twenty minims (0.5 to 1.2 Cc.)
Unguentum Belladonnæ Belladonna Ointment	Made by rubbing 10 Gm. of extract of belladonna leaves with 5 Cc. of diluted alcohol, and incorporating 20 Gm. of hydrous wool-fat and 65 Gm. of benzoinated lard. (See Unguenta)
Root	
Fluidextractum Belladonnæ Radicis Fluidextract of Belladonna Root	Made from belladonna root with a menstruum of 4 parts of alcohol and 1 part of water (see page 384). Dose, one to two minims (0.05 to 0.12 Cc.)
Linimentum Belladonnæ Belladonna Liniment	Made by dissolving 50 Gm. of camphor in sufficient fluidextract of belladonna root to make 1000 Cc. (see page 322)

ATROPINA. U.S. Atropine

$C_{17}H_{23}NO_3 = 287.04$

An alkaloid obtained from *Atropa Belladonna* Linné (Fam. *Solanaceæ*) and from other plants of the same family. As it occurs in commerce, it is usually accompanied by a small amount of hyoscyamine, from which it cannot be readily separated. It should be kept in amber-colored, well-stoppered vials.

Preparation.—This alkaloid may be prepared by adding sulphuric acid to a concentrated alcoholic tincture of the root to convert the atropine into the sulphate, distilling off the alcohol, adding water to the residuary liquid, filtering to separate oil and resin, and treating the filtrate with potassium hydroxide and chloroform. By evaporating the latter, atropine is obtained. This is purified by redissolving the crystals and filtering the solution, decolorizing with animal charcoal and recrystallization.

Official Description.—White rhombic prisms, more or less elongated in the direction of the major axis, as they contain more or less hyoscyamine.

Odor, Taste, and Reaction.—Odorless; bitter, acrid taste. *It should be tasted with the utmost caution, and only in dilute solution.* Alkaline reaction with litmus, phenolphthalein, and hematoxylin T.S.

Solubility.—*Water.* In 450 parts at 25° C. (77° F.); in 86.7 parts at 80° C. (176° F.).

Alcohol. In 1.46 parts at 25° C. (77° F.); in 0.9 part at 60° C. (140° F.).

Other solvents. In 16.6 parts of ether, and in 1.56 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—Atropine chloraurate may be made by adding gold chloride T.S. to a solution of Atropine in diluted hydrochloric acid, washing, collecting, and drying the precipitate.

Pure atropine chloraurate melts at 136° C. (276.8° F.).

Pure hyoscyamine chloraurate melts at 160° C. (320° F.).

Pure hyoscine chloraurate melts at 197° C. (386.6° F.). Atropine chloraurate alone melts under boiling water.

At about 113.8° C. (237° F.) Atropine melts, forming a colorless liquid; the melting point of Atropine free from hyoscyamine is about 115.8° C. (240.4° F.). When ignited, it is consumed without leaving a residue.

If a few crystals of Atropine be placed in a porcelain dish on a water-bath with a few drops of nitric acid, and heated to dryness, a yellow residue will be produced; if on cooling, a few drops of alcoholic potassium hydroxide T.S. and a fragment of potassium hydroxide be added, an intense violet color is produced; hyoscyamine and hyoscine will produce the same color, but the presence of strychnine masks the reaction.

If a small quantity of Atropine, or one of its salts, be heated with a few Cc. of sulphuric acid, a peculiar odor, recalling that of a mixture of rose, orange flower, and melilot, will become noticeable. The addition of a few fragments of potassium dichromate will change this odor to that of bitter almond.

If a crystal of Atropine be added to a few drops of sulphuric acid containing 1 drop of creosol, a pink color should be produced, which is not dissipated by the addition of 0.5 Gm. of hydrated chloral (distinction from *other alkaloids*, *hyoscyamine* producing a brown color and *strychnine* a black, *hyoscine* remaining colorless).

In a solution of Atropine in hydrochloric acid, platinic chloride T.S. produces no precipitate (difference from *most other alkaloids*). Gold chloride T.S. yields a yellow, lustreless precipitate in such a solution.

Readily carbonizable organic impurities. On adding sulphuric acid to Atropine, no color should be produced.

Absence of, and difference from, morphine. Nor should any color be developed upon the subsequent addition of nitric acid.

Uses.—Atropine is chiefly used to dilate the pupil of the eye. The sulphate, however, is preferred, on account of its solubility. It has the properties of belladonna when given internally, and is narcotic. Dose, the one-hundred-and-sixtieth to one-sixtieth of a grain (0.0004 to 0.001 Gm.).

ATROPINÆ SULPHAS. U.S. Atropine Sulphate

$(C_{17}H_{23}NO_3)_2.H_2SO_4 = 671.43$

The sulphate $[SO_2(OH)_2.(C_{17}H_{23}NO_3)_2]$ of an alkaloid obtained from *Atropa Belladonna* Linné (Fam. *Solanaceæ*), and from other plants of the same family. As it occurs in commerce, it usually contains a small amount of hyoscyamine sulphate, from which it cannot be readily separated.

Preparation.—Atropine sulphate may be prepared by suspending 120 grains of atropine in 4 fl. dr. of distilled water and adding diluted sulphuric acid until the alkaloid is dissolved and the solution is neutral. The latter is then evaporated to dryness at a temperature not exceeding 37.7° C. (100° F.).

Official Description.—A white crystalline powder or microscopical needles and prisms (the form of the latter being probably due to the hyoscyamine present); permanent in the air.

Odor and Taste.—Odorless; very bitter, nauseating taste. *It should be tasted with the utmost caution, and only in dilute solution.*

Solubility.—*Water.* In 0.38 part at 25° C. (77° F.); in 0.22 part at 80° C. (176° F.).

Alcohol. In 3.7 parts at 25° C. (77° F.); in 1.9 parts at 60° C. (140° F.).

Other solvents. In 2140 parts of ether and in 620 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—At about 189.9° C. (373.5° F.) Atropine Sulphate melts; when free from hyoscyamine it melts at about 188° C. (370.4° F.). When ignited it chars, emits acrid vapors, and is rapidly and completely consumed.

On adding potassium hydroxide T.S. to a solution of Atropine Sulphate, a white precipitate of atropine is obtained, which should respond to the reactions and tests given under *Atropina.*

Uses.—Atropine sulphate is preferred to the alkaloid for use as a mydriatic. An aqueous solution is generally employed for this purpose. The internal dose is from the one-hundred-and-sixtieth to one-sixtieth of a grain (0.0004 to 0.001 Gm.).

HOMATROPINÆ HYDROBROMIDUM. U.S. Homatropine Hydrobromide

$C_{16}H_{21}NO_3.HBr = 353.49$

[HOMATROPINE HYDROBROMATE]

The hydrobromide $[HBr.C_{16}H_{21}NO_3]$ of an alkaloid obtained by the condensation of tropine and mandelic acid. It should be kept in well-stoppered vials, protected from light.

Preparation.—It is made by heating *tropine*, $C_8H_{15}NO$, with *mandelic* (*phenyl glycolic*) *acid*, in the presence of hydrochloric acid; ammonia is added, and the homatropine which is liberated is dissolved out by chloroform; the solution is evaporated, hydrobromic acid added, and the crystals of homatropine hydrobromide purified by recrystallization.

Official Description.—A white, crystalline powder, or rhombic prisms.

Odor, Taste, and Reaction.—Odorless, and having a bitter taste. Its aqueous solution is neutral to litmus paper.

Solubility.—*Water.* In 5.7 parts at 25° C. (77° F.).

Alcohol. In 32.5 parts at 25° C. (77° F.), and in 8.7 parts at 60° C. (140° F.).

Other solvents. In 620 parts of chloroform at 25° C. (77° F.); insoluble in ether.

Tests for Identity.—At 213.8° C. (417° F.) it melts. It leaves no residue upon incineration.

Its aqueous solution is not precipitated by tannic acid T.S. or platinic chloride T.S. It contains no water of crystallization.

If 2 Cc. of chloroform be shaken with 1 Cc. of an aqueous solution of the salt (1 in 10) to which a few drops of chlorine water have been cautiously added, the chloroform should assume a brownish color.

Iodine T.S., when added to solutions of Homatropine Hydrobromide, produces a brown precipitate; silver nitrate T.S. a creamy white precipitate.

If to an aqueous solution containing 0.1 Gm. of the salt an excess of potassium hydroxide T.S. be added, this liquid shaken out with ether, and the ether allowed to evaporate spontaneously, the crystals which form should have a melting point of 96° C. (204.8° F.).

If sulphuric acid containing a trace of potassium dichromate be added to a crystal of the salt, an evanescent pink color will be produced, which changes rapidly to green.

Impurities and Tests for Impurities.—*Most other alkaloids except atropine and hyoscyamine.* If 1 Cc. of an aqueous solution of the salt (1 in 100) be made alkaline with ammonia water, shaken out with chloroform, and the chloroformic solution evaporated to dryness, the residue should turn yellow and finally brick-red when warmed with about 1.5 Cc. of a solution made by dissolving 1 part of mercuric chloride in 50 parts of a mixture of alcohol 5 volumes and water 3 volumes.

Atropine, hyoscyamine, or hyoscine. If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should not acquire a violet color upon the addition of a few drops of alcoholic potassium hydroxide T.S.

Uses.—Homatropine hydrobromide is preferred by many physicians to atropine as a mydriatic, because it is less toxic, and the effects subside far more rapidly. Dose, the one-hundred-and-twenty-eighth of a grain (0.0005 Gm.).

SCOPOLA. U.S. Scopola

The dried rhizome of *Scopola Carniolica* Jacquin (Fam. *Solanaceæ*), yielding, when assayed as directed below, not less than 0.5 percent. of mydriatic alkaloids.

Of horizontal growth, more or less curved and shortly and sharply flexuous, cylindraceous and somewhat flattened vertically, occurring mostly in pieces from 2.5 to 7.5 Cm. long and 0.8 to 1.6 Cm. broad, often split before drying; upper surface marked with closely set, large, cup-shaped stem scars, margins irregularly contracted; externally varying from yellowish-brown to dark brownish-gray, finely and irregularly wrinkled longitudinally, obscurely annulate and more or less nodular-roughened; fracture short and sharp, exhibiting a yellowish-white bark, its corky layer dark brown, or pale brown, wood indistinctly radiate, and central pith rather horny; nearly inodorous; taste sweetish, afterwards bitterish and strongly acrid.

Scopola contains *scopolamine*, $C_{17}H_{21}NO_4.H_2O$, *hyoscyamine*, and *atropine*. Scopolamine was isolated by Schmidt, and it is believed to be identical with hyoscine.

Assay of Scopola.—The method to be employed is identical with that given for Belladonna Leaves, on page 949, using *ten grammes* of Scopola, in No. 60 powder.

Uses.—Scopola is largely used in place of belladonna root by manufacturers in making belladonna plasters. It is narcotic and mydriatic. Dose, three-fourths of a grain (0.045 Gm.).

Official Preparation

Fluidextractum Scopolæ Fluidextract of Scopola	Made with a menstruum of 4 parts of alcohol and 1 part of water (see page 417). Dose, one minim (0.05 Cc.)

SCOPOLAMINÆ HYDROBROMIDUM. U. S. Scopolamine Hydrobromide

$C_{17}H_{21}NO_4.HBr + 3H_2O = 434.92$

The hydrobromide [$HBr.C_{17}H_{21}NO_4 + 3H_2O$] of an alkaloid obtained from plants of the *Solanaceæ;* chemically identical with Hyoscine Hydrobromide (see *Hyoscinæ Hydrobromidum*).

Uses.—Scopolamine hydrobromide is a powerful mydriatic and cerebral and spinal sedative. Dose, the one-hundred-and-twenty-eighth of a grain (0.0005 Gm.).

HYOSCYAMUS. U. S. Hyoscyamus

[HENBANE]

The dried leaves and flowering tops of *Hyoscyamus niger* Linné (Fam. *Solanaceæ*), collected from plants of the second year's growth, and yielding, when assayed as directed below, not less than 0.08 percent. of mydriatic alkaloids.

Leaves ovate or ovate-oblong, the lower with a short petiole, the upper sessile, 5 to 25 Cm. long, 2 to 10 Cm. broad, acute, coarsely and angularly toothed or lobed, grayish-green, glandular-hairy, particularly on the lower surface; flowers nearly sessile, with an urn-shaped, unequally 5-toothed calyx and a campanulate, purple-veined corolla, which in the fresh state is yellowish; fruit capsular, 2-celled, and enclosed in the calyx; odor heavy, narcotic; taste somewhat bitter and nauseous. The powder is grayish-green and contains calcium oxalate in single or twin monoclinic prisms about 0.010 Mm. in diameter.

Assay of Hyoscyamus.—The method to be employed is identical with that given for Belladonna leaves on page 949, with the exception that *twenty-five grammes* of Hyoscyamus in No. 60 powder are to be used, the quantity of chloroform-ether mixture which is added at first increased from 50 Cc. to 100 Cc., and the product at the end of the assay multiplied by 4 instead of 10.

Hyoscyamus contains *hyoscyamine*, $C_{17}H_{23}NO_3$, *hyoscine*, $C_{17}H_{21}N_4O$, *hyoscypicrin*, $C_{27}H_{52}O_{14}$, chlorophyll, mucilage, extractive, etc.

Uses.—Hyoscyamus is narcotic, hypnotic, and slightly laxative. Dose, four grains (0.25 Gm.).

Official Preparations

Extractum Hyoscyami Extract of Hyoscyamus	Made by evaporating 100 Cc. of the fluidextract to a pilular consistence (see page 447). Dose, one to two grains (0.065 to 0.125 Gm.)
Fluidextractum Hyoscyami Fluidextract of Hyoscyamus	Made with 2 parts of alcohol and 1 part of water (see page 402). Dose, three minims (0.2 Cc.)
Tinctura Hyoscyami Tincture of Hyoscyamus	Made by percolating 100 Gm. of hyoscyamus with sufficient diluted alcohol to make 1000 Cc. (see page 354). Dose, fifteen minims (1 Cc.)

HYOSCINÆ HYDROBROMIDUM. U. S. Hyoscine Hydrobromide

$C_{17}H_{21}NO_4.HBr + 3H_2O = 434.92$

[HYOSCINÆ HYDROBROMAS, PHARM. 1890 HYOSCINE HYDROBROMATE]

The hydrobromide [$HBr.C_{17}H_{21}NO_4 + 3H_2O$] of an alkaloid, chemically identical with scopolamine, obtained from Hyoscyamus and other plants of the *Solanaceæ*. It should be kept in well-stoppered, amber-colored vials.

Preparation.—Hyoscine is prepared by evaporating the mother waters obtained after the crystallization of hyoscyamine; the hydrobromide by dissolving hyoscine in diluted hydrobromic acid, evaporating and crystallizing.

Official Description.—Colorless, transparent, rhombic crystals, sometimes of large size; slightly efflorescent.

Odor, Taste, and Reaction.—Odorless; acrid, slightly bitter taste; slightly acrid reaction.

Solubility.—*Water.* In 1.5 parts at 25°C. (77° F.).

Alcohol.—In 16 parts of alcohol at 25° C. (77° F.), and in 1.33 parts at 60° C. (140° F.).

Other solvents. In 750 parts of chloroform at 25° C. (77° F.); insoluble in ether.

Tests for Identity.—Hyoscine Hydrobromide, when heated, softens at about 100° C. (212° F.); it first melts and then loses its water of crystallization at 110° C. (230° F.). If dried over sulphuric acid until deprived of its water of crystallization, it melts from 191° to 192° C. (375.8° to 377.6° F.). When ignited, it leaves no residue.

Hyoscine chloraurate crystallizes in yellow prisms and melts at 197° C. (386.6° F.). Hyoscyamine chloraurate crystallizes in yellow leaflets and melts at 160° C. (320° F). Atropine chloraurate crystallizes in dull yellow grains and melts at 136° C. (276.8° F.).

If 2 Cc. of chloroform be shaken with 1 Cc. of a solution of Hyoscine Hydrobromide (1 in 10), to which a few drops of chlorine water have been cautiously added, it should assume a brownish color.

If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should yield a violet color upon the addition of alcoholic potassium hydroxide T.S.

Silver nitrate T.S., when added to a solution of the salt, affords a yellowish-white precipitate insoluble in nitric acid, but the washed precipitate is soluble in an excess of ammonia water.

Mercuric potassium iodide T.S., in aqueous solutions of the salt acidified with hydrochloric acid, yields a yellowish-white precipitate.

Mercuric chloride T.S. and solution of phosphotungstic acid give a white precipitate when added to an aqueous solution of the salt.

Picric acid T.S. and platinic chloride T.S. yield yellow precipitates when added to a concentrated solution of the salt.

Impurities and Tests for Impurities.—*Carbonizable impurities.* Sulphuric acid should give but a faint yellow color when added to Hyoscine Hydrobromide.

Morphine. Nor should any color be developed on the subsequent addition of a drop of nitric acid.

Uses.—The salts of hyoscine are very powerful, and impure amorphous hyoscyamine often contains hyoscine. Hyoscine hydrobromide is a soporific in small doses, as the one-hundred-and-twenty-eighth of a grain (0.0005 Gm.), but is very powerfully narcotic in larger doses.

HYOSCYAMINÆ HYDROBROMIDUM. U.S. Hyoscyamine Hydrobromide

$C_{17}H_{23}NO_3.HBr = 367.40$

[HYOSCYAMINÆ HYDROBROMAS, PHARM. 1890 HYOSCYAMINE HYDROBROMATE]

The hydrobromide [$HBr.C_{17}H_{23}NO_3$] of an alkaloid obtained from Hyoscyamus and other plants of the *Solanaceæ.* It should be kept in amber-colored, well-stoppered vials.

Preparation.—It is made by dissolving hyoscyamine in diluted hydrobromic acid, evaporating and crystallizing. This salt was introduced into the U. S. P. 1890. It is somewhat more stable than the sulphate.

Official Description.—White, prismatic crystals, deliquescent on exposure to the air.

Taste and Reaction.—Acrid, nauseous, and bitter taste; neutral reaction.

Solubility.—*Water.* Very soluble.

Alcohol. In 2 parts of alcohol at 25° C. (77° F.).

Other solvents. In 1600 parts of ether and 2.5 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—Its aqueous solution is strongly lævogyrate.

It melts at 151.8° C. (305.3° F.). It leaves no residue on incineration.

Hyoscyamine chloraurate melts at 160° C. (320° F.). Atropine chloraurate melts at 136° C. (276.8° F.). Hyoscine chloraurate melts at 197° C. (386.6° F.). Hyoscyamine picrate melts at 162° C. (323.6° F.). Atropine picrate melts at 175° C. (347° F.).

Silver nitrate T.S., when added to a solution of the salt, yields a yellowish-white precipitate which is insoluble in nitric acid, but the washed precipitate is soluble in an excess of ammonia water.

Gold chloride T.S., when added to a solution of the salt, yields a precipitate which, when recrystallized from a small quantity of boiling water acidulated with hydrochloric acid, is deposited, on cooling, in minute, lustrous, golden-yellow scales (difference from *atropine*).

Platinic chloride T.S. does not form a precipitate with solutions of the salt (difference from *most alkaloids*).

If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should yield a violet color upon the addition of alcoholic potassium hydroxide T.S.

Impurities and Tests for Impurities.—*Carbonizable impurities.* Sulphuric acid should produce but a faint yellow color when added to Hyoscyamine Hydrobromide.

Morphine. Nor should any color be developed upon the subsequent addition of a drop of nitric acid.

Uses.—Hyoscyamine hydrobromide is used as a narcotic and sedative. The dose is the one-hundred-and-twenty-eighth of a grain (0.0005 Gm.).

HYOSCYAMINÆ SULPHAS. U. S. Hyoscyamine Sulphate

$(C_{17}H_{23}NO_3)_2.H_2SO_4 = 671.43$

The neutral sulphate $[SO_2(OH)_2.(C_{17}H_{23}NO_3)_2]$ of an alkaloid obtained from Hyoscyamus and other plants of the *Solanaceæ.* It should be kept in amber-colored, well-stoppered vials.

Preparation.—It is made by adding hyoscyamine to diluted sulphuric acid until neutralized, evaporating and crystallizing.

Official Description.—White, indistinct crystals, or a white powder; deliquescent when exposed to the air.

Odor, Taste, and Reaction.—Odorless; bitter, acrid taste; neutral reaction.

Solubility.—*Water.* Very soluble.

Alcohol. In 6.4 parts at 25° C. (77° F.).

Other solvents. In 2500 parts of ether and in 2300 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—Its aqueous solution is lævogyrate.

It melts at 198.9° C. (390.1° F.). Upon ignition it is rapidly consumed without residue.

Hyoscyamine chloraurate melts at 160° C. (320° F.). Atropine chloraurate melts at 136° C. (276.8° F.). Hyoscine chloraurate melts at 197° C. (386.6° F.). Hyoscyamine picrate melts at 162° C. (323.6° F.). Atropine picrate melts at 175° C. (347° F.).

Barium chloride T.S., when added to an aqueous solution, yields a white precipitate, insoluble in hydrochloric acid.

If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should yield a violet color upon the addition of alcoholic potassium hydroxide T.S.

Gold chloride T.S., when added to an aqueous solution, yields a precipitate which, when recrystallized from a small quantity of boiling water, acidulated with hydrochloric acid, is deposited on cooling in minute, lustrous, golden-yellow scales (difference from *atropine*).

Platinic chloride T.S. does not form a precipitate with solutions of the salt (difference from *most alkaloids*).

Impurity and Test.—*Carbonizable impurities.* Sulphuric acid should produce no color when added to Hyoscyamine Sulphate.

Uses.—This salt of hyoscyamine is used as a narcotic and sedative, in doses of the one-hundred-and-twenty-eighth of a grain (0.0005 Gm.). It is largely used by alienists in controlling maniacal excitement. It is occasionally used as a mydriatic.

STRAMONIUM. U.S. Stramonium

[STRAMONII FOLIA, PHARM. 1890]

The dried leaves of *Datura Stramonium* Linné (Fam. *Solanaceæ*), yielding, when assayed as directed below, not less than 0.25 percent. of mydriatic alkaloids.

Usually of a dark green or grayish-green color, much wrinkled and matted together; petiolate, 6 to 20 Cm. long, inequilaterally ovate, acuminate, very oblique at the base, the large teeth few, acute, with rounded sinuses; thin, brittle; odor distinct, heavy, and narcotic; taste nauseous.

The powder contains few hairs and has numerous rosette-shaped calcium oxalate crystals from 0.010 to 0.020 Mm. in diameter.

Assay of Stramonium.—The method to be employed is identical with that given on page 949 for Belladonna Leaves, using *ten grammes* of Stramonium, in No. 60 powder.

Stramonium contains *hyoscyamine* and *atropine* ; the mixed alkaloids were formerly called *daturine.* The leaves contain albumin, mucilage, malic acid, and potassium nitrate. In the seeds, which are no longer official, there is found about 25 percent. of fixed oil, with resins, mucilage, etc.

Uses.—Stramonium is narcotic and poisonous. Dose, one to three grains (0.065 to 0.2 Gm.).

Official Preparations

Extractum Stramonii Extract of Stramonium	Made by evaporating 100 Cc. of fluidextract of stramonium to a pilular consistence (see page 453). Dose, one-fifth grain (0.01 Gm.)
Fluidextractum Stramonii Fluidextract of Stramonium	Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 420). Dose, one to two minims (0.05 to 0.12 Cc.)
Tinctura Stramonii Tincture of Stramonium	Made by percolating 100 Gm. of stramonium with sufficient diluted alcohol to make 1000 Cc. (see page 364). Dose, eight minims (0.5 Cc.)
Unguentum Stramonii Stramonium Ointment	Made by rubbing 10 Gm. of extract of stramonium with 5 Cc. of diluted alcohol, and incorporating with 20 Gm. of hydrous wool-fat and 65 Gm. of benzoinated lard. (See Unguenta)

PILOCARPUS. U. S. Pilocarpus

[JABORANDI]

The leaflets of *Pilocarpus Jaborandi* Holmes or of *Pilocarpus microphyllus* Stapf (Fam. *Rutaceæ*), yielding, when assayed by the process given below, not less than 0.5 percent. of alkaloids.

Pilocarpus Jaborandi.—Very shortly and stoutly petioluled, the blades 6 to 12 Cm. long and 2 to 4 Cm. broad, oblong or oval, mostly unequal at the base, blunt and emarginate at the summit, the margin entire and narrowly revolute ; yellowish-green, very smooth, shining, thick and coriaceous, the reticulate venation prominent on both sides, especially beneath ; strongly pellucid-glandular ; peculiarly aromatic when crushed ; taste bitterish, slightly salty, aromatic, later somewhat pungent and sialagogue.

Pilocarpus microphyllus.—Leaflets 1.2 to 3.7 Cm. long, 0.8 to 1.6 Cm. broad ; the lateral without petiolules, rhomboidally oval to obovate, acute at the base, blunt and unequally emarginate at the summit ; the terminal on short, margined petiolules, almost equally oval to obovate, rather narrower than the lateral ; all thickish and rigid, with entire margin, smooth and dull green, finely pellucid-glandular ; midrib stout, the veins rather coarsely reticulate, lightly prominent ; almost odorless ; taste similar to that of *Pilocarpus Jaborandi.*

Assay of Pilocarpus

Pilocarpus, in No. 60 powder . . . . **10 Gm.**
Chloroform,
Ammonia Water,
Normal Sulphuric Acid V.S.,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Cochineal T.S., or **Iodeosin T.S.,** each, a sufficient quantity

Moisten the Pilocarpus with 2 Cc. of ammonia water and 3 Cc. of chloroform, and at once pack it firmly in a small cylindrical percolator, which has been provided with a pledget of cotton packed firmly in the neck. Percolate the powder slowly with chloroform containing about 2 percent. of ammonia water, until it is exhausted, about 100 Cc. of menstruum usually being sufficient. Pour into a separator the percolate, and shake it out with 15 Cc. of normal sulphuric acid V.S., transferring the acid aqueous layer to another separator, and repeating the shaking out of the chloroform solution with 2 Cc. of normal sulphuric acid V.S., mixed with 8 Cc. of distilled water. Add the acid layer to the second separator, and again repeat the shaking out with 10 Cc. of distilled water, and add the aqueous liquid to the second separator. Introduce into the second separator a small piece of red litmus paper, add enough ammonia water to render the liquid alkaline, and shake out the liquid with 20 Cc. of chloroform, drawing off the chloroformic solution into a beaker. Repeat the shaking out with two portions of 15 and 10 Cc. each of chloroform, and add the chloroformic solutions to the beaker. Evaporate the chloroform by means of a water-bath, and dissolve the alkaloidal residue in 7 Cc. of tenth-normal sulphuric acid V.S. Add 5 drops of cochineal T.S. or iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 7 (the 7 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.02, and this product by 10; the result will be the percentage of alkaloids contained in the Pilocarpus. The figure 0.02 represents the weight in grammes of alkaloids (mainly pilocarpine) required to neutralize 1 Cc. of tenth-normal sulphuric acid V.S.

Pilocarpus contains *pilocarpine*, $C_{11}H_{16}N_2O_2$, *jaborine*, $C_{11}H_{16}N_2O_2$, and a volatile oil consisting principally of *dipentene*, $C_{10}H_{16}$, a terpene. The leaves are coriaceous and difficult to powder.

Uses.—It is diaphoretic and sialagogue. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Pilocarpi Fluidextract of Pilocarpus	Made with diluted alcohol (see page 409). Dose, fifteen to thirty minims (1 to 2 Cc.)

PILOCARPINÆ HYDROCHLORIDUM. U.S. Pilocarpine Hydrochloride

$C_{11}H_{16}N_2O_2.HCl = 242.81$

[PILOCARPINÆ HYDROCHLORAS, PHARM. 1890 PILOCARPINE HYDROCHLORATE]

The hydrochloride [$HCl.C_{11}H_{16}N_2O_2$] of an alkaloid obtained from Pilocarpus. It should be kept in well-stoppered, amber-colored vials.

Preparation.—Pilocarpine is added to diluted hydrochloric acid until it is neutralized, and the solution is then concentrated and crystallized.

Official Description.—Colorless, or white, transparent crystals; deliquescent on exposure to the air. It contains no water of crystallization.

Odor, Taste, and Reaction.—Odorless; faintly bitter taste; neutral or faintly acid reaction.

Solubility.—*Water.* In 0.3 part at 25° C. (77° F.).

Alcohol. In 2.3 parts of alcohol at 25° C. (77° F.); in 1.1 parts at 60° C. (140° F.).

Other solvents. In 540 parts of chloroform at 25° C. (77° F.); insoluble in ether.

Tests for Identity.—After drying for several hours at 100° C. (212° F.), the salt melts at 195.9° C. (384.5° F.), and upon ignition it is entirely consumed.

Its aqueous solution is neutral, or has a faintly acid reaction upon blue litmus paper.

Sulphuric acid dissolves Pilocarpine Hydrochloride, with elimination of hydrochloric acid gas and the formation of a colorless liquid; upon adding to the solution a small fragment of potassium dichromate on a white porcelain surface, a bright, grass-green color is produced.

If 0.01 to 0.02 Gm. of the salt be dissolved in 2 Cc. of water in a test-tube, 2 Cc. of a slightly acid solution of hydrogen dioxide added, and a small layer of benzene be carefully poured upon the liquid, then if 3 or 4 drops of a solution of potassium dichromate (1 in 300) be added and the mixture be gently shaken, the benzene layer will acquire a violet color, while the aqueous layer will remain yellow (distinction from *other alkaloids*. If more than 0.02 Gm. be used, the benzene turns blue, and the reaction is no longer characteristic).

On rubbing together equal parts of Pilocarpine Hydrochloride and mercurous chloride, a black color is produced.

Silver nitrate T.S. produces, in an aqueous solution of the salt, a white precipitate insoluble in nitric acid.

Uses.—Pilocarpine hydrochloride is a diaphoretic and sialagogue, and is often used hypodermically. Dose, one-eighth to one-fourth of a grain (0.008 to 0.016 Gm.).

PILOCARPINÆ NITRAS. U.S. Pilocarpine Nitrate

$C_{11}H_{16}N_2O_2.HNO_3 = 269.20$

The nitrate [$NO_2OH.C_{11}H_{16}N_2O_2$] of an alkaloid obtained from Pilocarpus. It should be kept in well-stoppered, amber-colored vials.

Preparation.—Pilocarpine nitrate is made by adding pilocarpine to diluted nitric acid until neutralized, evaporating and crystallizing.

Official Description.—Colorless, or white, shining crystals; permanent in the air. It contains no water of crystallization.

Odor, Taste, and Reaction.—Odorless; faintly bitter taste; acid reaction.

Solubility.—*Water.* In 4 parts at 25° C. (77° F.)

Alcohol. In 60 parts at 25° C. (77° F.); in 16 parts at 60° C. (140° F.).

Other solvents. Insoluble in ether and chloroform.

Tests for Identity.—It melts at 170.9° C. (339.7° F.). Upon ignition, it is quickly consumed, leaving no residue.

The aqueous solution (1 in 100) shows an acid reaction to blue litmus paper.

Sulphuric acid dissolves Pilocarpine Nitrate, forming a colorless solution, and on adding a fragment of potassium dichromate, a bright grass-green color is produced.

On rubbing together equal parts of the salt and mercurous chloride, no black color is produced (distinction from *Pilocarpine Hydrochloride*).

If 0.01 to 0.02 Gm. of the salt be dissolved in 2 Cc. of water in a test-tube, 2 Cc. of a slightly acid solution of hydrogen dioxide added, and a small layer of benzene be carefully poured upon the liquid, then if 3 or 4 drops of a solution of potassium dichromate (1 in 300) be added and the mixture be gently shaken, the benzene layer will acquire a violet color, while the aqueous layer will remain yellow (distinction from *other alkaloids*. If more than 0.02 Gm. be used, the benzene turns blue and the reaction is no longer characteristic).

If to an aqueous solution of the salt, mixed with an equal volume of ferrous sulphate T.S., sulphuric acid be carefully added without shaking, a brown ring will appear at the juncture of the two layers.

Uses.—Pilocarpine nitrate is used as a diaphoretic and sialagogue. Dose, one-eighth to one-fourth of a grain (0.008 to 0.016 Gm.).

COLCHICI CORMUS. U.S. Colchicum Corm

[COLCHICI RADIX, PHARM. 1890 COLCHICUM ROOT]

The dried corm of *Colchicum autumnale* Linné (Fam. *Liliaceæ*), yielding, when assayed by the process given below, not less than 0.35 percent. of colchicine.

Ovoid, somewhat compressed laterally, and with a groove on one side, or more commonly in transverse, reniform, or longitudinal, ovate slices; externally brownish and finely wrinkled; internally whitish, with numerous circular groups of fibrovascular bundles, giving the surfaces of the transverse sections a papillose appearance; fracture short, mealy; odor slight; taste sweetish, bitter, and somewhat acrid.

Assay of Colchicum Corm

Colchicum Corm, in No. 60 powder . . . . **10 Gm.**
Ether,
Chloroform,
Alcohol,
Ammonia Water,
Distilled Water, each, a sufficient quantity

Introduce the Colchicum Corm into a 200 Cc. Erlenmeyer flask, and add to it 100 Cc. of a mixture of 77 Cc. of ether, 25 Cc. of chloroform, 8 Cc. of alcohol, and 3 Cc. of ammonia water, insert the stopper securely, and macerate, with frequent shaking, for twelve hours (or preferably for four hours in a mechanical shaker). Filter a sufficient quantity of the liquid into a measuring cylinder until 50 Cc. of filtrate (representing 5 Gm. of Colchicum Corm) have been obtained; then transfer this to a beaker or dish, and evaporate it nearly to dryness by applying a gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether has evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container and filter with a little water, and shake the combined aqueous solutions well for one minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a beaker, and again shake out the aqueous liquid successively with three portions of 10 Cc. each of chloroform, collecting these solutions in the beaker. Evaporate the chloroform completely: dissolve the residue in a little alcohol, evaporate the latter, redissolve the residue in 5 Cc. of ether, add 5 Cc. of water, and stir the liquid for a few seconds. Then evaporate the ether on a water-bath containing warm water, and filter the remaining aqueous liquid through a small wetted filter into a separator, washing the dish and filter with 5 Cc. of water, and adding the washings to the separator. Shake out the aqueous liquid with 15 Cc. of chloroform, and when the liquids have separated, draw off the chloroform into a tared flask. Repeat the shaking out successively with three portions of 10 Cc. of chloroform and add each to the tared flask. Evaporate the chloroform completely, dissolve the residue in a little alcohol, evaporate the latter, redissolve the residue in alconol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.) until the weight, after cooling, remains constant. The weight of the residue multiplied by 20 gives the percentage of colchicine in the Colchicum Corm.

COLCHICI SEMEN. U.S. Colchicum Seed

The seed of *Colchicum autumnale* Linné (Fam. *Liliaceæ*), yielding, when assayed by the process given below, not less than 0.45 percent. of colchicine.

Subglobular, about 2 Mm. in diameter, very slightly pointed at the hilum; externally reddish-brown, finely pitted; internally whitish; tough and of almost bony hardness; nearly inodorous; taste bitter and somewhat acrid.

Assay of Colchicum Seed

Colchicum Seed, in No. 60 powder . . . . 10 Gm.
Ether,
Chloroform,
Alcohol,
Ammonia Water,
Distilled Water, each, a sufficient quantity

Introduce the Colchicum Seed into a 200 Cc. Erlenmeyer flask, and add to it 100 Cc. of a mixture of 77 Cc. of ether, 25 Cc. of chloroform, 8 Cc. of alcohol, and 3 Cc. of ammonia water, insert the stopper securely, and macerate, with frequent shaking, for twelve hours (or preferably for four hours in a mechanical shaker). Filter a sufficient quantity of the liquid into a measuring cylinder until 50 Cc. of filtrate (representing 5 Gm. of Colchicum Seed) have been obtained; then transfer this to a beaker or dish, and evaporate it nearly to dryness by applying a very gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether has evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container and filter with a little water, and shake the combined aqueous solutions well for one minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a tared flask, and again shake out the aqueous liquid successively with three portions of 10 Cc. each of chloroform, collecting these solutions in the tared flask. Evaporate the chloroform completely; dissolve the residue in a little alcohol, evaporate the latter, redissolve the residue in alcohol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.) until the weight, after cooling, remains constant. The weight of the residue multiplied by 20 gives the percentage of colchicine in the Colchicum Seed.

The alkaloid *colchicine*, $C_{22}H_{15}NO_6$, is found in both the corm and seed of colchicum. It is the active principle. There are present in the corm starch, gum, fat, sugar, resin, etc. In the seed a fixed oil is found in addition to the other principles. The toughness of the seeds is due to their composition and structure, being composed chiefly of horny albumin made up of cells having very thick walls and surrounded by a closely adherent testa. The seeds may be exhausted of their active principle by digesting them in hot alcohol without bruising or powdering them.

Uses.—Colchicum is used in gout and rheumatism. Dose, of the seed, three grains (0.2 Gm.); of the corm, four grains (0.25 Gm.).

Official Preparations

Extractum Colchici Cormi Extract of Colchicum Corm	Made with a menstruum of 35 parts of acetic acid and 150 parts of water (see page 443). Dose, one to two grains (0.065 to 0.125 Gm.)
Fluidextractum Colchici Seminis Fluidextract of Colchicum Seed	Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 391). Dose, two to eight minims (0.125 to 0.5 Cc.)
Tinctura Colchici Seminis Tincture of Colchicum Seed	Made by percolating 100 Gm. of colchicum seed with a menstruum of 3 parts of alcohol and 2 parts of water, to make 1000 Cc. (see page 350). Dose, one-half fluidrachm (2 Cc.)
Vinum Colchici Seminis Wine of Colchicum Seed	Made by mixing 100 Cc. of fluidextract of colchicum seed with 150 Cc. of alcohol and 750 Cc. of white wine, and filtering (see page 369). Dose, one-half fluidrachm (2 Cc.)

COLCHICINA. U.S. Colchicine

$C_{22}H_{15}NO_6 = 396.24$

An alkaloid obtained from Colchicum. It should be kept in dark amber-colored, well-stoppered vials.

Preparation.—Colchicine may be made by percolating colchicum with alcohol, evaporating the percolate, diluting with water, filtering, precipitating coloring matter with lead subacetate, treating the liquid with sodium phosphate to separate lead compounds, and precipitating the colchicine with tannic acid; the tannate is then digested with lead oxide, dried, and the colchicine dissolved out with alcohol.

Official Description.—Pale yellow leaflets, or a pale yellow, amorphous powder, turning darker on exposure to light.

Odor, Taste, and Reaction.—An odor suggesting damp hay, and a very bitter taste; neutral reaction.

Solubility.—*Water.* In 22 parts at 25° C. (77° F.), and in 20 parts at 80° C. (176° F.).
Alcohol. Very soluble.
Other solvents. In 155 parts of ether and in 87 parts of benzene at 25° C. (77° F.); very soluble in chloroform; insoluble in petroleum benzin.

Tests for Identity.—After drying over sulphuric acid, it melts if heated to 142.5° C. (288.5° F.). It leaves no residue upon incineration.

Its aqueous solution is lævogyrate, and of a yellow color, which is intensified by mineral acids.

With Colchicine, sulphuric acid produces a citron-yellow color, which, upon adding a drop of nitric acid, changes to greenish-blue, then to red, and finally to yellow. On adding an excess of potassium hydroxide, the color is changed to red.

Ferric chloride T.S., on being added to an aqueous solution of Colchicine, gives no color, but on heating, a brownish-red color is developed, which changes to brownish-black; if ferric chloride T.S. be added to an alcoholic solution of Colchicine, a garnet-red color is at once produced.

To 5 drops of an aqueous Colchicine solution, add 5 drops of fuming hydrochloric acid, 5 drops of ferric chloride T.S., and then heat to boiling, when a yellow solution will be formed, changing to olive-green. When cool, shake the liquid with a little chloroform, when the latter will turn ruby-red, and the aqueous solution will remain green.

Sulphuric acid containing a fragment of potassium dichromate gives a greenish-blue color, changing to orange.

Uses.—Colchicine is used in the treatment of gout and rheumatism. Dose, the one-hundred-and-twenty-eighth of a grain (0.0005 Gm.).

VERATRUM. U.S. Veratrum

[VERATRUM VIRIDE, PHARM. 1890 AMERICAN HELLEBORE WHITE HELLEBORE]

The dried rhizome and roots of *Veratrum viride* Aiton (American Hellebore) or *Veratrum album* Linné (White Hellebore) (Fam. *Liliaceæ*).

Rhizome upright, ovoid or obconical, 2.5 to 7 Cm. long and 2 to 5 Cm. thick, externally light to dark brown or blackish, frequently bearing at the summit some coarsely fibrous remains of leaf bases; internally grayish- or yellowish-white, showing numerous short, irregular wood-bundles. Roots emanating from all sides of the rhizome, numerous shrivelled, whitish, or light yellowish-brown, from 10 to 20 Cm. long, and 1 to 2 Mm. thick. Inodorous, but strongly sternutatory when powdered; taste bitterish and very acrid.

The U. S. P. (8th Rev.) includes under the name of Veratrum, both Veratrum album and Veratrum viride; formerly the latter was alone official.

Veratrum contains the alkaloids *jervine*, *pseudojervine*, *rubijervine*, *protoveratrine*, and *protoveratridine*. The most active of these appears to be protoveratrine, which is very poisonous and sternutatory. It was supposed for many years to owe its activity to veratrine.

There are also present resins, starch, coloring matter, etc. The acid present in white hellebore has been named *jervic acid.*

Uses.—It is a cardiac sedative, poisonous, with emetic and diaphoretic properties. Dose, one to two grains (0.065 to 0.125 Gm.).

Official Preparations

Fluidextractum Veratri Fluidextract of Veratrum	Made with alcohol (see page 423). Dose, one to two minims (0.05 to 0.12 Cc.)
Tinctura Veratri Tincture of Veratrum	Made by percolating 100 Gm. of veratrum with sufficient alcohol to make 1000 Cc. (see page 366). Dose, two to four minims (0.12 to 0.24 Cc.)

VERATRINA. U.S. Veratrine

A mixture of alkaloids obtained from the seed of *Asagræa officinalis* (Chamisso and Schlechtendal) Lindley (Fam. *Liliaceæ*). It should be kept in well-stoppered, amber-colored vials.

Preparation.—The seeds are exhausted with alcohol, and the alcohol recovered by distillation. The residuary liquid contains veratrine in its natural combination with veratric acid ; this is diluted with water (which precipitates the resins) and filtered ; potassium hydroxide or ammonia is added to the filtrate, when veratine is precipitated. It is then redissolved, decolorized, and reprecipitated.

Official Description.—A white, or grayish-white, amorphous powder ; slightly hygroscopic in moist air.

Odor, Taste, and Reaction.—Odorless, but causing intense irritation and sneezing when even a minute quantity reaches the nasal mucous membrane ; acrid taste, and leaving a sensation of tingling and numbness on the tongue. *It should be tasted with great caution.* Alkaline reaction in alcoholic solutions.

Solubility.—*Water.* In 1750 parts at 25° C. (77° F.) ; in 1300 parts at 80° C. (176° F.).

Alcohol. In 2.2 parts at 25° C. (77° F.).

Other solvents. In 3 parts of ether and in 1 part of chloroform at 25° C. (77° F.) ; very soluble in benzene and amyl alcohol ; insoluble in petroleum benzin.

Tests for Identity.—When heated to 145° C. (293° F.), it softens, and melts at 152° C. 305.6° F.). Upon ignition it is consumed, leaving no residue.

On triturating Veratrine with sulphuric acid, in a glass mortar, the yellow or orange-red solution exhibits, by reflected light, a greenish fluorescence, which becomes more intense upon the addition of an equal volume of acid. Upon standing, the solution gradually assumes a deep red color.

Sulphuric acid when heated with Verataine gives a cherry-red color. Sulphuric acid containing a trace of selenous acid produces a brownish-green color. Sulphuric acid added to a mixture of 1 part of Veratrine and 6 parts of sugar produces a green color, changing to blue, and the mixture then becomes colorless.

Uses.—Veratrine is used externally, in neuralgia, rheumatism, etc. It is sternutatory and very poisonous. Dose, one-thirtieth of a grain (0.002 Gm.)

Official Preparations

Oleatum Veratrinæ Oleate of Veratrine	Made by dissolving 2 Gm. of veratrine in 50 Gm. of oleic acid and sufficient olive oil to make 100 Gm. (see page 325). Used externally
Unguentum Veratrinæ Veratrine Ointment	Made by rubbing 4 Gm. of veratrine with 6 Gm. of expressed oil of almond and 90 Gm. of benzoinated lard. (See Unguenta.) Used externally

SANGUINARIA. U.S. Sanguinaria

[Bloodroot]

The dried rhizome of *Sanguinaria canadensis* Linné (Fam. *Papaveraceæ*), collected after the death of the foliage.

Of horizontal growth, cylindrical, often somewhat branched, 2 to 7 Cm. long, 5 to 15 Mm. in diameter ; externally reddish-brown, slightly annulate ; fracture short and somewhat waxy, brownish-red, or yellowish-white with numerous reddish resin cells ; odor slight, the powder sternutatory ; taste persistently acrid and bitter.

Sanguinaria contains *sanguinarine*, $C_{20}H_{15}NO_4 + H_2O$, a colorless alkaloid, which yields bright red salts. Another alkaloid is present which as yet is unnamed. It also contains malic and citric acids, starch, resins, coloring matter, etc. The liquid preparations invariably deposit a reddish precipitate upon the sides of the bottle.

Uses.—It is alterative, sternutatory, stimulant, and emetic. The dose is two to ten grains (0.125 to 0.6 Gm.).

Official Preparations

Fluidextractum Sanguinariæ Fluidextract of Sanguinaria	Made with a menstruum of about 10 percent. acetic acid (see page 415). Dose, one to five minims (0.05 to 0.3 Cc.)
Tinctura Sanguinariæ Tincture of Sanguinaria	Made by percolating 100 Gm. of sanguinaria with a menstruum of 3 parts of alcohol and 2 parts of water with 2 percent. of acetic acid, to make 1000 Cc. (see page 363). Dose, fifteen to thirty minims (1 to 2 Cc.)

STAPHISAGRIA. U. S. Staphisagria

[STAVESACRE]

The ripe seed of *Delphinium Staphisagria* Linné (Fam. *Ranunculaceæ*).

Irregularly tetrahedral, one side convex, 5 to 6 Mm. long and 3 to 6 Mm. broad; externally blackish-brown, becoming lighter with age, strongly reticulate; endosperm oily, enclosing a small, straight embryo; odor slight; taste intensely bitter and acrid.

Staphisagria contains three alkaloids, *delphinine*, *delphisine*, and *delphinoidine;* also *staphisain*, with fixed oil, protein compounds, mucilage, etc. The alkaloids are soluble in chloroform, fixed oils, alcohol, and ether, and an oleoresin made with petroleum benzin is a good preparation. It is used principally externally, for killing body vermin, and is very poisonous. Dose, one grain (0.065 Gm.).

ACONITUM. U. S. Aconite

The dried tuberous root of *Aconitum Napellus* Linné (Fam. *Ranunculaceæ*), collected in autumn; yielding, when assayed by the process given below, not less than 0.5 percent. of aconitine.

Slenderly conical, 4 to 10 Cm. long, 10 to 20 Mm. thick at the crown; occasionally split; longitudinally wrinkled; dark brown and marked with coarse whitish root-scars; fracture short, horny or mealy; internally whitish or light brown; the cambium zone irregular and 5- to 7-angled; odor very slight; taste sweetish, soon becoming acrid and developing a tingling sensation, followed by numbness.

Assay of Aconite

Aconite, in No. 40 powder . . . . **10 Gm.**
Alcohol,
Distilled Water,
Ether,
Ammonia Water,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Cochineal T.S., each a sufficient quantity.

Introduce the Aconite into a 200 Cc. Erlenmeyer flask, add 75 Cc. of a mixture of alcohol, 7 parts, and distilled water, 3 parts (by volume), stopper the flask securely, and agitate it at intervals during four hours. After placing a pledget of cotton in the bottom of a small cylindrical glass percolator (25 Mm. in diameter), carefully transfer the contents of the flask to the percolator. When the liquid has all passed through, continue the percolation with more of the same mixture until 150 Cc. of percolate have been obtained. Pour the percolate into a shallow porcelain evaporating dish, and evaporate it to dryness at a temperature not exceeding 60° C. (140° F.). Add 5 Cc. of tenth-normal sulphuric acid V.S., and 25 Cc. of distilled water. When the extract is dissolved, filter the liquid into a separator, washing the dish and filter with about 25 Cc. of distilled water, and add the washings to the separator. Add 25 Cc. of ether and 2 Cc. of ammonia water to the separator, and agitate it for one minute. Draw off the lower layer into a flask, and filter the ether-solution into a beaker. Return the contents of the flask to the separator, add 15 Cc. of ether, and again agitate it for one minute. Draw off the lower layer into the flask, and filter the ether-solution into the beaker. Repeat the shaking out with two other portions of 10 Cc. each of ether. Evaporate the combined ether-solutions to dryness, and dissolve the residue in 3 Cc. of tenth-normal sulphuric acid V.S. Add to the solution 5 drops of cochineal T.S., and then carefully run in fiftieth-normal potassium hydroxide V.S. until a pink color is produced. Divide the number of Cc. of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 3 (the 3 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.064, and this product by 10, which will give the percentage of aconitine in the Aconite.

Aconite contains *aconitine*, $C_{34}H_{47}NO_{11}$, and *picraconitine*, $C_{32}H_{45}NO_{10}$. *Aconitic acid*, $H_6C_6O_6$, is present, together with resins, sugar, fat, coloring matter, etc. Aconitic acid may be produced by heating citric acid to 155° C. (311° F.). Alcohol is the best menstruum for preparations of aconite.

Uses.—Aconite is a cardiac and nervous sedative producing numbness and tingling when applied to the tongue or lips. It is very poisonous. Dose, one grain (0.065 Gm.).

Official Preparations

Fluidextractum Aconiti Fluidextract of Aconite	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 382). Dose, one-half to one minim (0.03 to 0.05 Cc.)
Tinctura Aconiti Tincture of Aconite	Made by percolating 100 Gm. of aconite with a menstruum of 70 parts of alcohol and 30 parts of water, to make 1000 Cc. (see page 342). Dose, five to ten minims (0.3 to 0.6 Cc.)

ACONITINA. U.S. Aconitine

$C_{34}H_{47}NO_{11} = 640.55$

An alkaloid obtained from Aconite. It should be kept in amber-colored, well-stoppered vials.

Preparation.—Aconitine may be made by acidifying an alcoholic tincture of aconite with tartaric acid to remove resin and fatty matter, precipitating the filtrate with sodium bicarbonate, dissolving the precipitate in ether, and crystallizing.

Official Description.—Colorless or white rhombic tables or prisms; permanent in the air.

Odor, Taste, and Reaction.—Odorless, and producing, in extremely diluted solutions, a characteristic tingling sensation when brought in contact with the mucous surfaces of the tongue or lips. *The alkaloid itself should never be tasted, and its solution only when largely diluted, and then with the utmost caution.* Alkaline reaction.

Solubility.—*Water.* In 3200 parts at 25° C. (77° F.).

Alcohol. In 22 parts at 25° C. (77° F.).

Other solvents. In 44 parts of ether, 5.6 parts of benzene, and 3580 parts of petroleum benzin at 25° C. (77° F.); very soluble in chloroform.

Tests for Identity.—When heated rapidly, Aconitine melts at 195° C. (383° F.); when heated slowly, decomposition takes place, and it melts at 182° C. (359.6° F.). Upon ignition, it is consumed without leaving a residue.

Aconitine solutions are lævogyrate.

Aconitine, when dropped upon sulphuric or nitric acids, should produce no color, but if rubbed with sulphuric acid containing a crystal of ammonium vanadate, an orange color is produced.

Dilute solutions of Aconitine yield precipitates with mercuric potassium iodide T.S., tannic acid T.S., and gold chloride T.S., but only concentrated solutions yield precipitates with platinic chloride T.S., mercuric chloride T.S., and picric acid T.S.

On evaporating 0.01 Gm. of Aconitine with 5 drops of fuming nitric acid, the resulting yellow residue, when cooled, should not yield a violet color when treated with alcoholic potassium hydroxide T.S. (difference from *pseudaconitine* and *atropine*).

Any soluble salt of Aconitine in dilutions of 1 in 1000 produces, with a drop of potassium permanganate T.S., a blood-red precipitate of aconitine permanganate. Aconitine containing decomposition products (amorphous Aconitine) produces this precipitate only in solutions containing not less than 1 in 200. (Cocaine, hydrastine, and papaverine also yield similar precipitates, but only when in more concentrated solutions.)

Uses.—*Crystallized* aconitine is a *very powerful poison.* It is given in the dose of the one-four-hundredth of a grain (0.00015 Gm.). Amorphous or commercial aconitine is usually an impure product. It is a cardiac and nervous sedative.

HYDRASTIS. U.S. Hydrastis

[GOLDEN SEAL]

The dried rhizome and roots of *Hydrastis canadensis* Linné (Fam. *Ranunculaceæ*), yielding, when assayed by the process given below, not less than 2.5 percent. of hydrastine.

Rhizome of oblique growth, subcylindrical, straight or somewhat tortuous, 2 to 5 Cm. long, and 3 to 6 Mm. in diameter, with short stem remnants, or stem scars, and slightly annulate; externally brownish-gray to yellowish-brown; fracture short, waxy, deep yellow; bark about 0.5 Mm. thick, wood wedges bright yellow, pith large, light yellow; the roots thin, brittle, with a thick yellow bark and a somewhat quadrangular wood; odor distinct; taste bitter.

Sections of Hydrastis treated with sulphuric acid show under the microscope the separation of the alkaloids in prismatic, tabular, and acicular crystals.

Assay of Hydrastis

Hydrastis, in No. 60 powder . . . . **15 Gm.**
Ether,
Ammonia Water,
Distilled Water,
Normal Sulphuric Acid V.S., each, a sufficient quantity

Introduce the Hydrastis into an Erlenmeyer flask of 250 Cc. capacity, add 150 Cc. of ether, shake the flask occasionally during ten minutes, and add 5 Cc. of ammonia water, again shaking the flask at intervals during half an hour. Then add 15 Cc. of distilled water to the mixture in the flask and shake it until the drug collects in masses, and at once pour off, into a measuring cylinder, 100 Cc. of the supernatant ether-solution and transfer it to a separator. Add 15 Cc. of normal surphuric acid V.S. to the separator, and shake it moderately during one minute. Allow the liquids to separate, and draw off the lower acid liquid into a second separator. Again shake out the ether-solution with 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, and shake the separator for one minute. After the liquids have separated, draw off the acid solution as before into the second separator. Repeat the same process with 5 Cc. of distilled water, drawing this also into the second separator. Introduce a small piece of red litmus paper into the second separator, add enough ammonia water to render the liquid alkaline, and then 25 Cc. of ether, and shake the separator moderately during one minute, and when the liquids have separated draw off the lower alkaline liquid into another separator, and the ether-solution into a tared beaker. Again shake out the alkaline liquid, using 20 Cc. of ether, shake the separator for one minute, and when the liquids have separated, draw off the alkaline liquid into the other separator, and the ether-solution into the tared beaker. Finally, again shake out the alkaline liquid, using 15 Cc. of ether, proceeding as before, and adding the ether-solution to the liquid in the tared beaker. Evaporate the ether carefully with the aid of a water-bath, and dry the alkaloidal residue in the beaker to a constant weight at 100° C. (212° F.). The weight found, multiplied by 10, will give the percentage of hydrastine in the Hydrastis.

Hydrastis contains *hydrastine*, $C_{21}H_{21}NO_6$, *berberine*, $C_{20}H_{17}NO_4$, and *canadine*, $C_{20}H_{21}NO_4$, sugar, starch, resin, coloring matter, etc. The salts of hydrastine are white, those of berberine are bright yellow.

Uses.—Hydrastis is used as an alterative and tonic, in doses of twenty to forty grains (1.3 to 2.6 Gm.).

Official Preparations

Fluidextractum Hydrastis Fluidextract of Hydrastis	Made with a menstruum of 6 parts of alcohol, 3 parts of water, and 1 part of glycerin (see page 401). Dose, one-half to one fluidrachm (2 to 4 Cc.)
Tinctura Hydrastis Tincture of Hydrastis	Made by percolating 200 Gm. of hydrastis with a menstruum of 65 parts of alcohol and 35 parts of water (see page 353). Dose, one to two fluidrachms (4 to 8 Cc.)

Official Preparations—*Continued*

Glyceritum Hydrastis Glycerite of Hydrastis	Made by exhausting 1000 Gm. of hydrastis with alcohol, evaporating off the alcohol, adding the concentrated liquid to 500 Cc. of water, filtering, and adding 500 Cc. of glycerin and enough water to make 1000 Cc. (see page 308). Dose, thirty minims (2 Cc.)

HYDRASTINA. U.S. Hydrastine

$C_{21}H_{21}NO_6 = 380.32$

An alkaloid obtained from Hydrastis. It should be kept in well-stoppered bottles.

Preparation.—Hydrastine is made by adding hydrochloric or sulphuric acid to an alcoholic tincture of hydrastis, the berberine is deposited as a crystalline precipitate, ammonia is added to the filtered mother liquor, and the precipitated hydrastine is purified by recrystallization.

Official Description.—White to creamy white, glistening prisms, sometimes of a large size; permanent in the air. It contains no water of crystallization.
Taste and Reaction.—Bitter taste; alkaline reaction.
Solubility.—*Water.* Almost insoluble at 25° C. (77° F.); soluble in 4000 parts at 80° C. (176° F.).
Alcohol. In 135 parts of alcohol at 25° C. (77° F.), and in 17 parts at 60° C. (140° F.).
Other solvents. In 124 parts of ether and in 2 parts of chloroform at 25° C. (77° F.); easily soluble in benzene.
Tests for Identity.—Hydrastine melts at 131° C. (267.8° F.).
It is lævogyrate.
Sulphuric acid produces a yellow color when added to Hydrastine, and on heating, a purple color is developed.
Sulphuric acid containing a trace of molybdic acid gives a green color, changing to olive-green and then to brown; nitric acid yields a reddish-yellow color; sulphuric acid containing a trace of selenous acid gives a yellowish-red color, changing to brown.
Sulphuric acid containing a trace of potassium dichromate produces a red color, changing to brown.
If a crystal of Hydrastine be dissolved in diluted sulphuric acid and a solution of potassium permanganate (1 in 10) be added, a blue fluorescence will be developed (distinction from *hydrastinine*).

Uses.—Hydrastine is alterative, tonic, and stimulant. Dose, one-fifth of a grain (0.01 Gm.).

HYDRASTININÆ HYDROCHLORIDUM. U.S. Hydrastinine Hydrochloride

$C_{11}H_{11}NO_2.HCl = 223.88$

[HYDRASTININÆ HYDROCHLORAS, PHARM. 1890 HYDRASTININE HYDROCHLORATE]

The hydrochloride [$HCl.C_{11}H_{11}NO_2$] of an artificial alkaloid derived from hydrastine. It should be kept in well-stoppered bottles.

This is the hydrochloride of an artificial alkaloid, *hydrastinine*, $C_{11}H_{11}NO_2$, made by acting on colorless hydrastine with oxidizing agents. It was introduced into the U. S. P. 1890.

Official Description.—Light yellowish needles, or a yellowish-white, crystalline powder.
Odor, Taste, and Reaction.—Odorless; bitter taste. Its aqueous solution, especially when highly diluted, shows a blue fluorescence, and is neutral to litmus paper.
Solubility.—*Water.* Very soluble in cold and hot water.
Alcohol. Very soluble in alcohol.
Other solvents. In 286 parts of chloroform and 1300 parts of ether at 25° C. (77° F.).
Tests for Identity.—Hydrastinine Hydrochloride melts at 212° C. (413.6 F.).
On ignition the salt should be completely consumed.
In an aqueous solution of the salt (1 in 20), bromine T.S. produces a yellow precipitate, which should be perfectly soluble in ammonia water, forming an almost colorless solution.

In an aqueous solution of the salt, potassium dichromate T.S. produces a precipitate which redissolves if gently heated, but on cooling the solution, it separates in glistening needles.

If ammonia water be added to an aqueous solution of Hydrastinine Hydrochloride (1 in 20), no turbidity should be produced.

On slowly adding to a solution of 0.2 Gm. of the salt in 3 Cc. of water 4 to 5 drops of a solution of sodium hydroxide (1 in 7), each drop will cause a milky turbidity, which disappears again on shaking. From this solution, after standing for some time, pure white hydrastinine should separate, and the supernatant fluid should be almost odorless.

With a crystal of the salt, sulphuric acid or nitric acid produces a deep yellow color; sulphuric acid with a trace of nitric acid, a reddish-brown color; sulphuric acid with a crystal of ammonium vanadate, a light brown color changing to dark brown.

Uses.—Hydrastinine hydrochloride is an oxytocic, in doses of one-half to one grain (0.03 to 0.065 Gm.).

BERBERIS. U.S. Berberis

[BERBERIS AQUIFOLIUM OREGON GRAPE ROOT]

The rhizome and roots of *Berberis Aquifolium* Pursh, and other species of Berberis (Fam. *Berberidaceæ*).

In more or less knotty, irregular pieces of varying length and from 3 to 20 Mm. in diameter; bark from ½ to 2 Mm. thick; wood yellowish, distinctly radiate with narrow medullary rays, hard and tough; rhizome with a small pith; odor distinct; taste strongly bitter.

Pieces without the bark should be rejected.

Berberis contains a yellow alkaloid, *berberine*, $C_{20}H_{17}NO_4$, and *oxyacanthine*.

Uses.—It is used as a tonic and febrifuge. Dose, thirty grains (2 Gm.).

Official Preparation

Fluidextractum Berberidis Fluidextract of Berberis	Made with a menstruum of diluted alcohol (see page 385). Dose, thirty minims (2 Cc.)

GRANATUM. U.S. Pomegranate

The bark of the stem and root of *Punica Granatum* Linné (Fam. *Punicaceæ*).

Stem Bark.—In single quills or transversely curved pieces, mostly 2 to 10 Cm. long, 5 to 20 Mm. in diameter; bark 0.5 to 3 Mm. thick; outer surface yellowish- to brownish-gray, with brownish-black fruit-heads of a lichen and small lenticels; inner surface grayish-yellow to brownish, finely striate; fracture short, smooth, the phelloderm layer dark green, the inner bark dull greenish-yellow; odor distinct; taste astringent, somewhat bitter.

Root Bark.—Dark brown, with more or less longitudinal patches and scales of cork; green phelloderm layer absent; medullary rays extending nearly to the periderm.

Pomegranate contains four alkaloids, *pelletierine*, $C_8H_{15}NO$, *isopelletierine*, *methylpelletierine*, *pseudopelletierine*. The first named is sometimes called *punicine*; the mixed alkaloids are official in the form of pelletierine tannate; pseudopelletierine is solid and crystallizable; the others are liquid. It also contains punico-tannic acid, $C_{20}H_{16}O_{13}$, sugar, mannite, pectin, gum, etc.

Uses.—Pomegranate is anthelmintic, in doses of thirty grains (2 Gm.).

Official Preparation

Fluidextractum Granati Fluidextract of Pomegranate	Made with a menstruum of diluted alcohol containing 10 per cent. of glycerin (see page 399). Dose, thirty minims (2 Cc.)

PELLETIERINÆ TANNAS. U.S. Pelletierine Tannate

A mixture in varying proportions of the tannates of four alkaloids (punicine, iso-punicine, methyl-punicine, and pseudo-punicine), obtained from *Punica Granatum* Linné (Fam *Punicaceæ*). It should be kept in small, well-stoppered, dark amber-colored vials.

Preparation.—Pelletierine tannate may be made by precipitating a solution of a sulphate of the alkaloids from pomegranate bark with a solution of tannic acid containing ammonia, washing and drying the precipitate.

Official Description.—A light yellow, amorphous powder.
Odor, Taste, and Reaction.—Odorless; astringent taste; weak acid reaction.
Solubility.—*Water.* In 235 parts at 25° C. (77° F.).
Alcohol. In 12.6 parts at 25° C. (77° F.).
Other solvents. In 300 parts of ether at 25° C. (77° F.); insoluble in chloroform; soluble in warm diluted acids.

Tests for Identity.—Pelletierine Tannate, when dried over sulphuric acid and heated, turns brown at 150° C. (302° F.), softens at about 165° C. (329° F.), and when heated to a higher temperature, decomposes and chars without melting. It leaves no residue on ignition.

Ferric chloride T.S. colors aqueous solutions of the salt blue-black.

In aqueous solutions of Pelletierine Tannate, soluble lead, mercury, and zinc salts produce white precipitates.

Platinic chloride T.S. produces no precipitate.

Ammonia water produces a white precipitate, soluble in excess of the precipitant, forming a yellowish-red solution.

Aqueous solutions of Pelletierine Tannate immediately reduce silver nitrate T.S., or gold chloride T.S., to metallic silver or gold, respectively, the former as a black precipitate, and the latter as a thin, purplish mirror on the test-tube.

Sulphuric acid gives a yellow color; the liquid, on being heated, turns slowly to green, and finally to purple. Nitric acid produces no color.

Sulphuric acid containing a trace of selenous acid produces a light bluish-green color, gradually becoming dark green, and developing a pink border.

Uses.—Pelletierine tannate is used as a tænifuge. Dose, four grains (0.25 Gm.).

PAREIRA. U. S. Pareira

[Pareira Brava]

The dried root of *Chondrodendron tomentosum* Ruiz and Pavon (Fam. *Menispermaceæ*).

Subcylindrical, knotty, and somewhat tortuous, cut into pieces of various lengths, 1 to 6 Cm. in diameter; externally blackish-brown, with transverse ridges and fissures and longitudinal furrows; hard, heavy, and tough; when freshly cut having a waxy lustre, internally yellowish- or brownish-gray, the dried transverse sections exhibiting several inequilaterally concentric circles of interrupted, porous wood-wedges projecting beyond the markedly retracted intervening tissue of the rather large medullary rays; odor slight; taste bitter.

This root contains *pelosine*, or *cissampeline*. This has been proved to be identical with *buxine* and *beberine*, alkaloids obtained from *Buxus sempervirens* and *Nectandra Rodiæi*.

Uses.—Pareira is tonic, diuretic, and aperient. The dose is thirty grains (2 Gm.).

Official Preparation

Fluidextractum Pareiræ Fluidextract of Pareira	Made with a menstruum of 60 parts of alcohol, 30 parts of water, and 10 parts of glycerin (see page 408). Dose, thirty minims (2 Cc.)

IPECACUANHA. U. S. Ipecac

The dried root, to which may be attached a portion of the stem not exceeding 7 Cm. in length, of *Cephaëlis Ipecacuanha* (Brotero) A. Richard (Fam. *Rubiaceæ*), known commercially as *Rio*, *Brazilian*, or *Para ipecac*, or the corresponding portion of *C. acuminata* Karsten, known commercially as *Carthagena ipecac*, yielding, when assayed by the process given below, not less than 1.75 percent. of ipecac alkaloids.

Rio Ipecac.—In pieces of irregular length, rarely exceeding 25 Cm.; stem-portion 2 to 3 Mm. thick, light gray-brown, cylindrical and smoothish; root-portion usually red-brown, occasionally blackish-brown, rarely gray-brown, 3 to 6 Mm. thick, curved and sharply flexuous, nearly free from rootlets, occasionally branched, closely annulated with thickened, incomplete rings, and usually exhibiting transverse fissures, with vertical sides, through the bark; fracture short, the very thick, easily separable bark whitish, usually resinous, the thin, tough wood yellowish-white, without vessels; odor very slight, peculiar, the dust sternutatory; taste bitter and nauseous, somewhat acrid.

Carthagena Ipecac.—Similar to Rio Ipecac, but about one-half thicker, dull gray externally, with thinner, merging annulæ, and the fractured surface of the bark gray.

Assay of Ipecac

Ipecac, in No. 80 powder . . . . **15 Gm.**
Ether,
Chloroform,
Ammonia Water,
Distilled Water,
Normal Sulphuric Acid V S ,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Cochineal T.S., a sufficient quantity.

Introduce the Ipecac into an Erlenmeyer flask of 250 Cc. capacity, add 115 Cc. of ether and 35 Cc. of chloroform, shake the flask during five minutes, and then add 3 Cc. of ammonia water and again shake the flask at intervals during half an hour. Now add 10 Cc. of distilled water, shake the liquid until the powder collects in masses, and pour off 100 Cc. of the clear ethereal solution into a measuring cylinder. Transfer the latter to a separator, add 10 Cc. of normal sulphuric acid V.S. and 10 Cc. of distilled water. Shake the separator moderately during two minutes, and when the liquids have separated, draw off the lower acid solution into a second separator. Repeat the shaking out of the ether-solution with 3 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, drawing the acid solution into the second separator. Repeat the shaking out again, using 10 Cc. of distilled water, and add the aqueous solution to the second separator. Reject the ether in the first separator, introduce a small piece of red litmus paper into the second separator, add enough ammonia water to render the liquid alkaline, and 25 Cc. of ether, and then shake the separator vigorously during one minute; draw off the alkaline aqueous liquid into another separator, and transfer the ether-solution to a flask. Add 20 Cc. of ether to the alkaline liquid in the separator, shake it for one minute, and, having allowed the liquids to separate, draw off the alkaline liquid into the other separator, and transfer the ether-solution to the flask. Again shake out the alkaline liquid with 10 Cc. of ether, and, when the fluids have separated, reject the alkaline liquid and add the ether-solution to the liquid in the flask. Distil the ether from the flask with the aid of a water-bath, and dissolve the alkaloidal residue in 12 Cc. of tenth-normal sulphuric acid V.S., warming it gently on a water-bath if necessary. Then add five drops of Cochineal T.S. and titrate with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 12 (the 12 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0238, and this product by 10, which will give the percentage of alkaloids in the Ipecac.

Ipecac contains *emetine*, $C_{30}H_{40}N_2O_5$, *cephaëline*, $C_{28}H_{40}N_2O_4$, and *psychotrine*, also *ipecacuanhic acid*, pectin, starch, resin, sugar, etc. The apothegmatic matter, which is dissolved by hydroalcoholic liquids when percolating it, is slowly precipitated when added to water or syrup. It may be separated by allowing the aqueous liquid to stand until the separation is completed, and then filtering. Ipecac is an ingredient in compound laxative pills, mixture of rhubarb and soda, and in the following:

Official Preparations

Fluidextractum Ipecacuanhæ Fluidextract of Ipecac	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 402). Dose, one to thirty minims (0.05 to 2 Cc.)
Syrupus Ipecacuanhæ Syrup of Ipecac	Made from 70 Cc. of fluidextract of ipecac, 10 Cc. of acetic acid, 100 Cc. of glycerin, 700 Gm. of sugar, and water to make 1000 Cc. (see page 294). Dose, fifteen minims to four fluidrachms (1 to 15 Cc.)
Tinctura Ipecacuanhæ et Opii Tincture of Ipecac and Opium	Made by evaporating 1000 Cc. of tincture of deodorized opium to 800 Gm., and adding 100 Cc. of fluidextract of ipecac and sufficient diluted alcohol to make 100 Cc. (see page 355). Dose, eight minims (0.5 Cc.)
Vinum Ipecacuanhæ Wine of Ipecac	Made by mixing 100 Cc. of fluidextract of ipecac with 100 Cc. of alcohol and 800 Cc. of white wine (see page 370). Dose, fifteen minims (1 Cc.)
Pulvis Ipecacuanhæ et Opii Powder of Ipecac and Opium	Made by triturating together 10 Gm. of powdered ipecac, 10 Gm. of powdered opium, and 80 Gm. of powdered sugar of milk. (See Pulveres.) Dose, eight grains (0.5 Gm.)

Uses.—Ipecac is an emetic, in doses of fifteen grains (1 Gm.), and expectorant, in doses of one grain (0.065 Gm.).

COCA. U.S. Coca

[Erythroxylon]

The dried leaves of *Erythroxylon Coca* Lamarck (Fam. *Erythroxylaceæ*), known commercially as Huanuco Coca, or of *E. Truxillense* Rusby, known commercially as Truxillo Coca, yielding, when assayed by the process given below, not less than 0.5 percent. of the ether-soluble alkaloids of Coca.

Huanuco Coca.—Greenish-brown to clear brown, smooth and slightly glossy, thickish and slightly coriaceous, stoutly and very shortly petioled; blade 2.5 to 7.5 Cm. long and nearly elliptical, with a very short and abruptly narrowed basal portion and a short point, the margin entire; midrib marked above by a slight ridge, very prominent underneath, the remaining venation rather obscure, especially above; underneath, a conspicuous line of collenchyma tissue runs longitudinally on either side of the midrib and about one-third of the distance between it and the margin, the enclosed areola being of a slightly different color from the adjacent surface; odor characteristic; taste bitterish, faintly aromatic, followed by a numbness of the tongue, lips, and fauces.

Truxillo Coca.—Pale green, thin, brittle and usually much broken, smooth but not shining, shortly and stoutly petioled; blade 1.6 to 5 Cm. long and one-third to one-half as broad, obovate to oblanceolate, narrowed from near the middle into the petiole, usually with a slight projecting point at the summit, the margin entire; underneath two irregular lines of collenchyma tissue, usually incomplete or obscure, and frequently wanting, run beside the midrib at about one-third the distance from it to the margin; odor more tea-like than that of Huanuco Coca; taste and numbing effect similar.

Assay of Coca

Coca, in No. 60 powder . . . . **10 Gm.**
Chloroform,
Ether,
Normal Sulphuric Acid V.S.,
Ammonia Water,
Distilled Water,
Tenth-normal Sulphuric Acid V.S.,
Fiftieth-normal Potassium Hydroxide V.S.,
Cochineal or **Iodeosin T.S.,** each, a sufficient quantity.

Place the Coca in an Erlenmeyer flask, add 50 Cc. of a mixture of chloroform 1 volume and ether 4 volumes and insert the stopper securely. Allow the flask to stand ten minutes, then add 2 Cc. of ammonia water mixed with 3 Cc. of distilled water, and shake the flask well, at frequent intervals, during one hour. Then transfer as much as possible of the contents of the flask to a small percolator which has been provided with a pledget of cotton packed firmly in the neck, and inserted in a separator containing 6 Cc. of normal sulphuric acid V.S., diluted with 20 Cc. of distilled water. When the liquid has passed through the cotton, pack the Coca firmly in the percolator with the aid of a glass rod, and, having rinsed the flask with 10 Cc. of chloroform-ether mixture, transfer the remaining contents of the flask to the percolator by the aid of several small portions (5 Cc.) of a chloroform-ether mixture, using the same proportions as before, and continue the percolation with successive small portions of the same liquid (in all 50 Cc.). Next, shake the separator well for one minute, after securely inserting the stopper, and when the liquids have completely separated, draw off the acid liquid into another separator. Add to the chloroform-ether mixture 10 Cc. of a sulphuric acid mixture, using the same proportions as before, agitate well and again draw off the acid liquid. Repeat this operation once more, drawing off the acid solution as before into the second separator, introduce a small piece of red litmus paper, add ammonia water until the liquid is distinctly alkaline, and shake out with 3 successive portions of ether (25, 20, and 15 Cc.). Collect the ether-solutions in a beaker, place it on a water-bath filled with warm water, and allow the ether to evaporate entirely. Dissolve the residue in 3 Cc. of ether, and let this also evaporate completely. To the alkaloidal residue add 4 Cc. of tenth-normal sulphuric acid V.S., and 5 drops of Cochineal or iodeosin T.S., then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 4 (the 4 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.03 and this product by 10, to obtain the percentage of ether-soluble alkaloids contained in the Coca.

Coca contains *cocaine*, $C_{17}H_{21}NO_4$, and *hygrine* combined with cocatannic acid.

Uses.—Coca is a nervous stimulant, with diaphoretic properties. The dose of coca is from thirty to sixty grains (2 to 4 Gm.).

Official Preparations

Fluidextractum Cocæ Fluidextract of Coca	Made with diluted alcohol (see page 390). Dose, one-half to one fluidrachm (2 to 4 Cc.)
Vinum Cocæ Wine of Coca	Made by mixing 60 Cc. fluidextract of coca, 75 Cc. of alcohol, 65 Gm. of sugar, and enough red wine to make 1000 Cc. (see page 368). Dose, four fluidrachms (16 Cc.)

COCAINA. U. S. Cocaine

$C_{17}H_{21}NO_4 = 300.92$

An alkaloid [$C_8H_{13}(C_6H_5CO)NO.COOCH_3$] obtained from several varieties of Coca.

Preparation.—It may be made by moistening ground coca leaves with solution of sodium hydroxide, percolating with petroleum benzin, shaking the liquid with diluted sulphuric acid, and adding to the acid solution an excess of solution of sodium hydroxide. The precipitated cocaine is purified by recrystallization. Cocaine can be made synthetically by treating benzoyl-ecgonine with hydrochloric or sulphuric acids in the presence of methyl alcohol.

Official Description.—Large, colorless, four-sided or six-sided, monoclinic prisms.
Odor and Taste.—Slightly bitter taste, and producing on the tongue a temporary numbness.
Solubility.—*Water.* In 600 parts at 25° C. (77° F).; in 260 parts at 80° C. (176° F.).
Alcohol. In 5 parts at 25° C. (77° F.); very soluble in warm alcohol.
Other solvents. In 3.8 parts of ether at 25° C. (77° F.); very soluble in chloroform; soluble in benzene, carbon disulphide, ethyl acetate, in about 14 parts of oil of turpentine, and in about 12 parts of olive oil; insoluble in glycerin.
Tests for Identity.—It melts at 98° C. (208.4° F.), and should leave no residue on ignition. If an alcoholic solution of Cocaine be carefully neutralized with hydrochloric acid, and the solution evaporated to dryness, the residue should respond to the reactions and tests given under *Cocainæ Hydrochloridum.*

Uses.—The alkaloid is used when a solution of cocaine in oil or fatty substance is needed, or in making the official oleate, otherwise cocaine hydrochloride is preferred. It is a cerebral stimulant and local anæsthetic. Dose, one-fourth to one grain (0.015 to 0.065 Gm.).

COCAINÆ HYDROCHLORIDUM. U.S. Cocaine Hydrochloride

$C_{17}H_{21}NO_4.HCl = 337.10$

[Cocainæ Hydrochloras, Pharm. 1890 Cocaine Hydrochlorate]

The neutral hydrochloride $[HCl.C_8H_{13}(C_6H_5CO)NO.COOCH_3]$ of an alkaloid obtained from several varieties of Coca.

Preparation.—It may be made by adding cocaine to an alcoholic solution of hydrochloric acid and crystallizing.

Official Description.—Colorless, transparent, monoclinic prisms, flaky, lustrous leaflets or a white crystalline powder; permanent in the air; containing no water of crystallization.

Odor, Taste, and Reaction.—Odorless; of a saline, slightly bitter taste, and producing on the tongue a tingling sensation, followed by numbness of several minutes' duration; neutral reaction.

Solubility.—*Water.* Soluble in 0.4 part at 25° C. (77° F.); in 0.1 part at 80° C. (176° F.).

Alcohol. In 2.6 parts at 25° C. (77° F.); in 1.4 parts at 60° C. (140° F.).

Other solvents. In 18.5 parts of chloroform at 25° C. (77° F.); insoluble in benzene, petroleum benzin, and ether.

Tests for Identity.—It melts at about 189.9° C. (373.8° F.). Minute quantities of impurities may reduce the melting point to 180° C. (356° F.) or less. It leaves no residue on incineration.

Its aqueous solultion is lævogyrate.

If silver nitrate T.S. be added to the aqueous solution of the salt (1 in 100), a white precipitate is produced, which is insoluble in nitric acid.

On adding 5 drops of a solution of chromium trioxide (1 in 20) to 5 Cc. of a solution of Cocaine Hydrochloride (1 in 50), a yellow precipitate will be produced, which redissolves on shaking; on now adding 1 Cc. of hydrochloric acid, a permanent, orange-colored, crystalline precipitate will be formed.

On adding a solution of potassium chromate (1 in 20) to a hydrochloric acid solution of the salt, orange-yellow leaflets of cocaine chromate are precipitated.

If mercuric chloride T.S. be added to an aqueous solution of the salt, a white flocculent precipitate is produced.

Cocaine Hydrochloride is not colored by cold sulphuric acid, but if a crystal be heated with sulphuric acid, in a test-tube, vapors are produced, from which, benzoic acid is deposited on cooling.

If three drops of palladous chloride T.S., with 3 Cc. of chlorine water, be added to 3 drops of an aqueous solution of the salt (1 in 20), a red precipitate is produced.

When 0.01 Gm. of the salt is dissolved in 2 drops of water, the addition of 1 Cc. of a solution of potassium permanganate (1 in 30) produces a violet precipitate, which appears brownish-violet when collected on a filter.

A crystal of the salt dissolved in alcohol yields when stirred with a piece of potassium hydroxide an odor of ethyl benzoate.

Impurities and Tests for Impurities.—*Limit of cinnamyl-cocaine.* If 0.1 Gm. of the salt be dissolved in 5 Cc. of distilled water containing 3 drops of diluted sulphuric acid, the addition to this solution of 3 drops of tenth-normal potassium permanganate V.S. will produce a violet color, which should not fade in half an hour.

Limit of isatropyl-cocaine. If 0.1 Gm. of the salt be dissolved in 85 Cc. of cold distilled water, in a beaker, and 4 drops of ammonia water added, and the solution stirred vigorously for fifteen minutes, with occasional rubbing of the sides of the beaker with a stirring rod, a crystalline precipitate of cocaine should be formed, and the supernatant liquid should be perfectly clear.

The presence of 0.5 percent. of isatropyl-cocaine will prevent the formation of nearly all of the precipitate, and will cause the supernatant liquid to be opalescent.

Uses.—Cocaine hydrochloride is used as a local anæsthetic when applied to the mucous membrane or injected hypodermically; it is also a cerebral stimulant. The dose is from one-fourth to one grain (0.015 to 0.065 Gm.).

GUARANA. U.S. Guarana

A dried paste consisting chiefly of the crushed seeds of *Paullinia Cupana* Kunth (Fam. *Sapindaceæ*), yielding, when assayed by the process given below, not less than 3.5 percent. of its alkaloidal principles.

Usually in cylindrical sticks, about 3 to 5 Cm. in diameter, hard and heavy, dark reddish-brown; fracture uneven, often fissured in the centre, pale reddish-brown, showing numerous coarse fragments of seeds and their blackish-brown integuments; odor slight; taste astringent, somewhat smoky and pleasantly bitter, then sweetish.

Assay of Guarana

Guarana, in No. 60 powder . . . . 6 Gm.
Chloroform,
Ether,
Ammonia Water,
Normal Sulphuric Acid V.S.,
Distilled Water, each, a sufficient quantity

Introduce the Guarana into an Erlenmeyer flask, and pour upon it 120 Cc. of chloroform and 6 Cc. of ammonia water, and insert the stopper securely. Shake the flask at intervals for half an hour, and allow it to stand for four hours. Filter a sufficient quantity of the liquid into a measuring cylinder until 100 Cc. (representing 5 Gm. of Guarana) have been obtained, then transfer the filtrate to a flask, and distil off all of the chloroform by means of a water-bath. Dissolve the alkaloidal residue in a mixture of 2 Cc. of normal sulphuric acid V.S. and 20 Cc. of warm distilled water. Allow the liquid to cool, and filter it into a separator, rinse the flask and filter with several small portions of distilled water, add 20 Cc. of chloroform and 2 Cc. of ammonia water to the separator, and shake it for one minute. Draw off the chloroform into a tared flask and repeat the extraction with two portions of 10 Cc. each of chloroform. Distil off the chloroform from the combined liquids, and when the residue is dry, add 2 Cc. of ether and evaporate on a water-bath very carefully to avoid decrepitation; continue the heating until the weight of the residue after cooling remains constant. This weight multiplied by 20 will give the percentage of the alkaloidal principles contained in the Guarana.

Guarana contains *caffeine*, $C_8H_{10}N_4O_2$, and about 25 percent. of tannin, with resin, mucilage, starch, volatile oil, saponin, etc.

Uses.—It is used as a nervous stimulant, in doses of thirty to sixty grains (2 to 4 Gm.). It is effective only in comparatively large doses.

Official Preparation

Fluidextractum Guaranæ Fluidextract of Guarana	Made with diluted alcohol (see page 400). Dose, one to two fluidrachms (4 to 8 Cc.).

CAFFEINA. U.S. Caffeine

$$C_8H_{10}N_4O_2 + H_2O = 210.64$$

[THEINE]

A feebly basic substance $[C_5H(CH_3)_3N_4O_2 + H_2O]$ obtained from the dried leaves of *Thea sinensis* Linné (Fam. *Ternstrœmiaceæ*), or from the dried seeds of *Coffea arabica* Linné (Fam. *Rubiaceæ*); found also in other plants.

Caffeine may be prepared from tea or coffee by precipitating a decoction with lead acetate, removing the excess of lead from the filtrate by hydrogen sulphide, adding ammonia water, evaporating, and recrystallizing. It may also be made synthetically.

Official Description.—White, flexible, silky, glistening needles, usually matted together in fleecy masses, permanent in the air. If crystallized from water, it contains one molecule of water of crystallization, but if crystallized from alcohol, chloroform, or ether, it contains none.

Odor, Taste, and Reaction.—Odorless; bitter taste; neutral reaction.

Solubility.—*Water.* In 45.6 parts at 25° C. (77° F.); in 5.2 parts at 80° C. (176° F.). Its solubility in water is increased by the presence of certain salts,—*e.g.*, potassium bromide, sodium benzoate, sodium salicylate, and others.

Alcohol. In 53.2 parts at 25° C. (77° F.); in 17.1 parts at 60° C. (140° F.).

Other solvents. In 375 parts of ether and in 8 parts of chloroform at 25° C. (77° F.).

Tests for Identity.—Caffeine sublimes at about 178° C. (352.4° F.), and should leave no residue. When dried at 100° C. (212° F.), to constant weight, its melting point is 236.8° C. (458.3 F.).

If a small quantity of Caffeine be dissolved in about 1 Cc. of hydrochloric acid in a porcelain dish, a little potassium chlorate added, the whole evaporated to dryness on a water-bath, and the dish then inverted over a vessel containing a few drops of ammonia water, the residue will acquire a rich purple color, which is destroyed by fixed alkalies.

If a fragment of Caffeine be dissolved in sulphuric acid and a minute fragment of potassium dichromate be added to the liquid, a yellowish-green color, which gradually becomes green, will be produced.

Impurities and Tests for Impurities.—*Organic impurities.* Caffeine should dissolve in sulphuric acid or in nitric acid without producing a color.

Alkaloids. Its aqueous solution should not be precipitated by mercuric potassium iodide T.S.

Uses.—Caffeine is a nervous stimulant. It is chiefly used in nervous headaches of a certain type. The dose is from one to three grains (0.065 to 0.2 Gm.). It is used officially in preparing compound acetanilide powder and citrated caffeine.

CAFFEINA CITRATA. U. S. Citrated Caffeine

[CAFFEINE CITRATE]

	Metric	Old form
***Caffeine**	50 Gm.	1 oz. av.
Citric Acid	50 Gm.	1 oz. av.
Distilled Water, hot	100 Cc.	2 fl. oz.

Dissolve the Citric Acid in hot Distilled Water, add the Caffeine, and evaporate the resulting solution, on a water-bath, to dryness, constantly stirring toward the end of the operation. Reduce the product to a fine powder and transfer it to well-stoppered bottles.

This is not a definite chemical salt, but a mixture of caffeine and citric acid, caffeine being a feeble alkaloid. Hence the common name *citrate of caffeine* is improper.

Official Description.—A white powder.

Odor, Taste, and Reaction.—Odorless; slightly bitter, acid taste; acid reaction.

Solubility.—One part of Citrated Caffeine forms a clear, syrupy solution, with about 4 parts of hot water. Upon dilution with 5 parts of water, a white, crystalline precipitate (caffeine) separates, which redissolves when about 25 parts of water have been added. It is also soluble in a mixture of equal volumes of chloroform and alcohol.

Impurities and Tests for Impurities.—*Tartaric acid.* If 0.25 Gm. of Citrated Caffeine be mixed with 5 Cc. of concentrated sulphuric acid in a porcelain dish, the mixture protected from dust and heated for fifteen minutes on a water-bath, a lemon-yellow color, and not a brown or black color, should develop.

Uses.—It is used as a cerebral stimulant in doses of three to eight grains (0.2 to 0.5 Gm.), and in making the effervescent salt (see below).

CAFFEINA CITRATA EFFERVESCENS. U.S. Effervescent Citrated Caffeine

	Metric	Old form
***Citrated Caffeine**	40 Gm.	350 grains
Sodium Bicarbonate, dried and powdered	570 Gm.	11 oz. av. 175 gr.
Tartaric Acid, dried and powdered	300 Gm.	6 oz. av.
Citric Acid, uneffloresced crystals	195 Gm.	3 oz. av. 395 gr.
To make about	1000 Gm.	20 oz. av.

Powder the Citric Acid and mix it intimately with the Citrated Caffeine and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.).

When the mixture has acquired a moist consistence by the aid of careful manipulation with a wooden spatula, rub it through a No. 6 tinned iron sieve, and dry the granules at a temperature not exceeding 54°.C. (129.2° F.). Keep the product in well-stoppered bottles.

Uses.—This effervescent salt is used for preparing a pleasant stimulating draught by adding a teaspoonful (4 Gm.) to four fluidounces of water.

CONIUM. U.S. Conium

[POISON HEMLOCK]

The full-grown, but unripe fruit of *Conium maculatum* Linné (Fam. *Umbelliferæ*), carefully dried and preserved, and yielding, when assayed by the process given below, not less than 0.5 percent. of coniine. After being kept for more than two years, Conium is unfit for use.

Broadly ovoid, greenish-gray, the two carpels of most of the fruits separated, each about 3 Mm. long and about 1.5 Mm. in diameter, ovoid, somewhat curved, the inner, flattened side marked by a deep longitudinal groove, the outer, convex side with five pale yellow, somewhat crenate ribs, the intervening surfaces wrinkled but otherwise smooth ; pericarp without oil-tubes ; odor slight, but when triturated with a solution of potassium hydroxide, strong, disagreeable, and mouse-like ; taste characteristic, disagreeable, afterwards somewhat acrid.

Assay of Conium

Conium, in No. 60 powder . . . . **10 Gm.**
Ether,
Alcohol,
Ammonia Water,
Normal Sulphuric Acid V.S.,
Sodium Carbonate T.S.,
Distilled Water,
Hydrochloric Acid Solution (5 percent. HCl), each, a sufficient quantity

Place the Conium in a 200 Cc. Erlenmeyer flask, add 100 Cc. of a mixture of ether 98 parts, alcohol 8 parts, and ammonia water 3 parts (by volume), insert the stopper securely, and shake the flask at intervals during four hours. After the powder has settled, decant 50 Cc. of the clear liquid into a beaker (representing 5 Gm. of Conium), and add sufficient normal sulphuric acid V.S. to produce a distinctly acid reaction. Evaporate the ether at a gentle heat by the aid of a water-bath ; then add 15 Cc. of alcohol, and set the beaker aside in a cool place for two hours to allow the ammonium sulphate to deposit. Filter the liquid ; wash the residue and filter with a little alcohol, and add the washings to the filtrate ; neutralize any excessive amount of acid with sodium carbonate T.S., being careful to retain a slight acidity. Concentrate the liquid to 3 Cc. by the aid of a gentle heat on a water-bath, add 3 Cc. of distilled water and 2 drops of normal sulphuric acid V.S. Add 15 Cc. of ether to remove traces of fatty matter, pour off the ether-solution and repeat the washing with 15 Cc. of ether. Then transfer the acid liquid to a separator, introduce a small piece of red litmus paper, and add sufficient sodium carbonate T.S. to render the liquid slightly alkaline ; then shake out with successive portions of 15, 15, and 10 Cc. of ether. To the combined ether-solutions, in a tared beaker, add, drop by drop, sufficient hydrochloric acid solution (5 percent.) to insure an excess of acid, and then evaporate the ether by a gentle heat on a water-bath. Remove the excess of hydrochloric acid by adding to the residue 3 Cc. of alcohol and heating gently to evaporate the liquid, repeat this operation once, and dry the residue at a temperature not exceeding 60° C. (140° F.) until the weight, after cooling in a desiccator, remains constant. The weight of the residue multiplied by 0.777, and this product by 20, gives the percentage of coniine contained in the Conium.

Conium contains *coniine*, $C_8H_{17}N$, *conhydrine*, $C_8H_{17}NO$, and *methylconiine*, $C_8H_{16}CH_3N$; also a little volatile oil and fixed oil. Coniine is a liquid volatile alkaloid, and contains no oxygen. It was the first alkaloid to be made by synthesis. Its odor resembles that of the urine of mice. It is soluble in water, alcohol, and ether.

Uses.—Conium is narcotic and sedative. Dose, three grains (0.2 Gm.).

Official Preparation

Fluidextractum Conii Fluidextract of Conium	Made with diluted alcohol containing 2 percent. of acetic acid to fix the alkaloid (see page 392). Dose, three to twenty minims (0.2 to 1.2 Cc.)

SPIGELIA. U.S. Spigelia

[PINKROOT]

The dried rhizome and roots of *Spigelia marilandica* Linné (Fam. *Loganiaceæ*).

Rhizome of oblique and sharply flexuous growth, somewhat branched, 1.5 to 5 Cm. long, 2 to 4 Mm. in diameter ; externally dark purplish-brown or blackish, the upper surface knotty from approximate stem-bases bearing cup-shaped scars; the lower surface with numerous long, rather coarse, finely branched roots; fracture short, showing a yellowish wood and a dark pith; odor somewhat aromatic; taste bitter and pungent.

Spigelia contains a bitter principle, a liquid alkaloid named by Dudley *spigeline*, resin, and a trace of volatile oil, with tannin and wax. Alcohol and water extract its virtues.

Uses.—It is used as an anthelmintic. Dose, one drachm (4 Gm.).

Official Preparation

Fluidextractum Spigeliæ Fluidextract of Spigelia	Made with a menstruum of diluted alcohol (see page 419). Dose, one to two fluidrachms (4 to 8 Cc.)

SCOPARIUS. U.S. Scoparius

[BROOM]

The dried tops of *Cytisus Scoparius* (Linné) Link (Fam. *Leguminosæ*).

Thin, flexible, branched twigs, 2 to 3 Mm. thick; externally dark green, with five wings and numerous reddish-brown cork patches; internally yellowish; younger branches somewhat pubescent; fracture short-fibrous, that of thick pieces tough and splintery; usually free from the simple, obovate leaves; having a peculiar odor when bruised; taste disagreeably bitter.

Scoparius contains *sparteine*, a colorless liquid alkaloid, having the composition $C_{15}H_{26}N_2$. It also contains the glucoside *scoparin*, $C_{21}H_{22}O_{10}$, which probably represents the diuretic and purgative action of the drug. The dose of scoparius in dropsical complaints is fifteen to thirty grains (1 to 2 Gm.).

SPARTEINÆ SULPHAS. U.S. Sparteine Sulphate

$C_{15}H_{26}N_2.H_2SO_4 + 5H_2O = 419.26$

The sulphate $[SO_2(OH)_2.C_{15}H_{26}N_2 + 5H_2O]$ of an alkaloid obtained from Scoparius. Sparteine Sulphate should be kept in well-stoppered, amber-colored vials.

The salts of sparteine are mostly crystallizable, although the alkaloid itself is liquid.

Official Description.—Colorless, rhombohedral crystals, or a crystalline powder. It crystallizes with varying amounts of water of crystallization, but when recrystallized from a solution in diluted alcohol it contains 5 molecules of water. It is hygroscopic.

Odor, Taste, and Reaction.—Odorless and having a slightly saline and somewhat bitter taste; acid reaction.

Solubility.—*Water.* In 1.1 parts at 25° C. (77° F.).

Alcohol. In 2.4 parts at 25° C. (77° F.).

Other solvents. Insoluble in ether and chloroform.

Tests for Identity.—When heated to 110° C. (230° F.), the salt loses all of its water of crystallization (21.3 percent.), and when anhydrous, melts at 136° C. (276.8° F.).

If 25 Cc. of ether be added to about 0.1 Gm. of Sparteine Sulphate in a test-tube, followed by a few drops of diluted ammonia water, avoiding an excess, and if an ethereal solution of iodine (1 in 50) be afterwards added until the liquid, when shaken, turns from an orange to a dark reddish-brown color, the bottom and sides of the test-tube will, after a short time, be coated with minute, dark greenish-brown crystals.

Barium chloride T.S., in an aqueous solution of Sparteine Sulphate, produces a white precipitate insoluble in hydrochloric acid.

If a solution of potassium ferrocyanide (1 in 20) be added to a solution of the salt, a yellow precipitate is produced.

Impurities and Tests for Impurities.—*Sugar and other readily carbonizable organic impurities.* Sulphuric acid, when added to Sparteine Sulphate, should not become colored.

Ammonium salts. On shaking 0.05 Gm. of Sparteine Sulphate, in a test-tube, with 5 Cc. of potassium hydroxide T.S., the liquid will at first be turbid, and small drops of Sparteine will gradually collect on the surface. If a strip of moistened red litmus paper be suspended in the mouth of the test-tube, and a gentle heat then applied, the test paper will gradually acquire a blue color, but no odor of ammonia should be perceptible.

Uses.—Sparteine sulphate is a cardiac stimulant and narcotic. Dose, one-fifth of a grain (0.01 Gm.).

LOBELIA. U.S. Lobelia

The dried leaves and tops of *Lobelia inflata* Linné (Fam. *Campanulaceæ*), collected after a portion of the capsules have become inflated.

Leaves alternate, the lower short-petioled, the upper sessile, ovate or oblong, 4 to 9 Cm. long; irregularly serrate-denticulate, the divisions with a yellowish-brown, gland-like apex; pale green, pubescent; stems coarsely angled, often purplish, hairy, terminating in long racemes of small short-pedicelled flowers having an adherent 5-toothed calyx and a small tubular corolla, cleft to the base on the upper side, the one-sided limb 5-lobed, and pale blue in the fresh state, the five stamens united; capsule inflated, 2-celled, containing numerous minute brownish, ellipsoidal, coarsely reticulate seeds; odor slight, irritating; taste strongly acrid.

Lobelia contains *lobeline*, *lobelic acid*, *lobelacrin*, wax, resin, gum, etc. Lobeline, the alkaloid, is liquid, and contains no oxygen.

Uses.—Lobelia is expectorant and emetic. Dose, eight to forty grains (0.5 to 2.6 Gm.).

Official Preparations

Fluidextractum Lobeliæ Fuidextract of Lobelia	Made with a menstruum of about 10 percent. acetic acid (see page 405). Dose, eight to twenty minims (0.5 to 1.2 Cc.)
Tinctura Lobeliæ Tincture of Lobelia	Made by percolating 100 Gm. of lobelia with sufficient diluted alcohol to make 1000 Cc. (see page 357). Dose, thirty minims to one fluidrachm (2 to 4 Cc.)

Unofficial Drugs containing Alkaloids

Akazga (Boundou, Quai, Ikaga, Icaya)	An ordeal poison, used in a district on the west coast of Africa The alcoholic extract acts similarly to nux vomica
Alstonia Constricta Australian Fever Bark	The bark of *A. constricta*, found in Australia. It contains *alstonine*, which is very bitter
Aspidosperma Quebracho. U. S. P. 1890	The bark of *Aspidosperma Quebracho-blanco* Schlechtendal (Fam. *Apocynaceæ*). It contains *aspidospermine*, *aspidospermatine*, *aspidosamine*, *quebrachine*, *hypoquebrachine*, and *quebrachamine*. It is an antiperiodic. Dose, ten to twenty grains (0.6 to 1.2 Gm.)
Baptisia Baptisia	The root of *B. tinctoria*, found in North America. It contains an alkaloid and *baptisin*, which is an impure resin, containing some of the alkaloid
Boldus Boldo	The leaves of *Peumus B.*, found in Chili. It contains *boldine*, volatile oil, tannin, etc.
Cactus Grandiflora Night blooming Cereus	Cardiac stimulant. Dose of a tincture of the fresh stems (4 oz. to 1 pint), thirty minims (2 Cc.) every four hours
Chelidonium Celandine. U. S. P. 1890	The entire plant, *Chelidonium majus* Linné (Fam. *Papaveraceæ*). It contains *chelerythrine*, *chelidonine*, *chelidoxanthin*, and *chelidonic acid*. Used as a diuretic in doses of forty grains (2.6 Gm.)
Cocculus Indicus Fish berries	The fruit of *Anamirta C.*, found in the East Indies. It contains *menispermine*, *picrotoxin*, etc.
Colchici Flores Colchicum Flowers	The flowers of *Colchicum autumnale*, found in Europe. They contain a large percentage of *colchicine*
Coptis Goldthread	The plant of *C. trifolia*, found in North America. It contains a yellow crystalline alkaloid, *berberine*, and *coptine*
Coptis Teeta East Indian Goldthread	The rhizome of *C. Teeta*, found in the East Indies. It contains a very large percentage of *berberine*
Corydalis Turkey Corn	The tubers of *Dicentra canadensis*, grown in North America. It contains the alkaloid *corydaline*, which is very bitter, acrid resin, etc.
Curare Wourari	An extract made by South American Indians from plants belonging to the genus *Strychnos*. It contains an extremely poisonous alkaloid, named *curarine*
Cytisus Laburnum Laburnum	Poisonous, narcotic. It contains *cytisine* ($C_{20}H_{27}N_3O$) and *laburnine*.
Delphinium Larkspur Seed	The seed of *D. consolida*, found in Central Europe. It contains the poisonous alkaloid *delphinine*

Unofficial Drugs containing Alkaloids—*Continued*

Dita Dita Bark	From the bark of *Alstonia scholaris*, found in the Philippine Islands. It contains $\frac{1}{50}$ percent. of a bitter alkaloid, *ditamine*, and 2 percent. of *ditain*, an uncrystallizable bitter substance
Duboisia Duboisia	The leaves of *D. myoporoides*, found in Australia. It contains a very poisonous alkaloid, *duboisine*, which is colored reddish-brown by sulphuric acid
Dulcamara Bittersweet. U. S. P. 1890	The young branches of *Solanum Dulcamara* Linné (Fam. *Solanaceæ*). It contains *solanine*, an alkaloid, and *dulcamarin*, a glucoside
Ephedra Vulgaris	A cardiac stimulant and local mydriatic. It contains the alkaloid *ephedrine*
Erythrophlæum Sassy Bark	The bark of *E. guineense*, found in Africa. It contains the colorless alkaloid *erythrophleine*. Emetic, narcotic, and astringent. Dose of the extract, two-tenths to three-tenths grain (0.015 to 0.02 Gm.)
Eschscholtzia Californica Chamisso	Soporific and analgesic. It contains a glucoside and an alkaloid, said to be *morphine*. The extract has been given in doses commencing with twelve and three-tenths grain (0.8 Gm.), increasing to one hundred and eighty-five grains (12 Gm.) a day
Glaucium Horn Poppy	The plant of *G. luteum*. It contains the alkaloids *sanguinarine*, *glaucine*, and *glaucopicrine*
Gloriosa Superba	An acrid, narcotic poison. It contains two resins and a very poisonous bitter principle, *superbine*
Ignatia Bean of St. Ignatius	The seed of *Strychnos Ignatii* (Fam. *Loganiaceæ*)
Isopyrum Thalictroides	It contains two alkaloids, *isopyrine* and *pseudo-isopyrine*
Manaca	A portion of the root and stem of *Francisca uniflora*, a Brazilian plant. Antirheumatic, given in the form of fluidextract, in the dose of ten to thirty drops, three times a day
Mandragora Officinalis Mandrake	Anæsthetic. It contains an alkaloid, *mandragorine*, and another alkaloid, both of which possess mydriatic properties
Menispermum Yellow Parilla Canadian Moonseed. U. S. P. 1890	The rhizome and roots of *Menispermum canadense* Linné (Fam. *Menispermaceæ*). It contains *menispine*, *berberine*, resin, etc. It is alterative and tonic. Dose, twenty to forty grains (1.3 to 2.6 Gm.)
Muawin Bark	An ordeal poison. It contains an alkaloid, *muawinine*
Sophora Speciosa	The poisonous seeds of this tree contain a volatile liquid alkaloid, *sophorine*
Sterculia Acuminata, Cola, Kola Nut	The nuts of this tree contain *caffeine*. They are used as a cardiac stimulant
Stramonii Semen Stramonium Seed. U. S. P. 1890	The seed of *Datura Stramonium* Linné (Fam. *Solanaceæ*). Similar to the leaves in action and constituents (see page 955). It contains in addition about 25 percent. of fixed oil.
Tabacum Tobacco. U. S. P. 1890	The commercial, dried leaves of *Nicotiana Tabacum* Linné (Fam. *Solanaceæ*). It contains *nicotine*, a liquid alkaloid, very acrid and poisonous. Tobacco is sedative and emetic in doses of one to five grains (0.065 to 0.3 Gm.)
Xanthorrhiza Yellow Root	Tonic. Dose, forty grains (2.6 Gm.). It contains *berberine*

Unofficial Alkaloids and their Salts, with Allied Products

Alstonine, $C_{21}H_{20}N_2O_4$	From the bark of *Alstonia constricta*. A brownish-yellow, amorphous powder, readily soluble in alcohol
Anagyrine, $C_{14}H_{18}N_2O_2$	A yellowish, amorphous, hygroscopic, poisonous alkaloid, from *Anagyris fœtida*. Soluble in water, alcohol, and ether
Analgen (Ortho-ethoxy-anamonobenzoylamido-chinoline), $C_{18}H_{16}N_2O_2$	Antipyretic and antirheumatic. Dose, eight to fifteen grains (0.5 to 1 Gm.), repeated, if necessary, to seventy-five grains (4.86 Gm.) a day
Antispasmin (Narcein Sodium-Sodium Salicylate)	Hypnotic and analgesic. Dose, one-half to one grain (0.03 to 0.065 Gm.)
Aspidospermine, $C_{22}H_{30}N_2O_2$	From the bark of *Aspidosperma Quebracho*. It is a weak base, forming amorphous salts. The hydrochloride is given in doses of one-thirtieth to one-twentieth of a grain (0.002 to 0.003 Gm.)
Beberine, $C_{18}H_{21}NO_3$	From the bark of *Nectandra Rodiæi*. A pale yellow, amorphous powder, of a resinous aspect, inodorous, very bitter, very slightly soluble in water, inflammable, and of an alkaline reaction. *Beberine sulphate* is given in doses of two to five grains (0.125 to 0.3 Gm.)
Benzoyl Ecgonine, $C_{16}(H).H_{18}NO_4$, or $C_9H_{14}(C_7H_5O)NO_3$	Cardiac stimulant. Prepared by heating cocaine in aqueous solution to decomposition

Unofficial Alkaloids and their Salts, with Allied Products—*Continued*

Benzoyl Tropeine	Local anæsthetic
Berberine, $C_{20}H_{17}NO_4$	From the bark of the root of *Berberis vulgaris* and others. It occurs in minute yellow crystals, has a bitter taste, is soluble in 100 parts of cold water, and insoluble in ether. Its medicinal action is similar to that of quinine. Dose, one to eight grains (0.065 to 0.5 Gm.)
Betaine Trimethyl-glycoll	An alkaloid found in the juice of the sugar beet
Blennostasine	Supposed to be a derivative of a cinchona alkaloid. Used in hay fever, influenza, and colds, in doses of fifteen to sixty grains (1 to 4 Gm.)
Boldine	From the leaves of *Peumus Boldus*. It imparts to water a bitter taste, is soluble in alcohol, ether, chloroform, etc., and is colored red by nitric and sulphuric acids. The yield of alkaloid is about $\frac{1}{10}$ percent.
Buxine	From the bark of *Buxus sempervirens*. It is identical with the beberine of nectandra bark
Chelerythrine	From *Chelidonium majus*. This alkaloid is identical with *sanguinarine*. It is an acrid poison
Chinoidine (Quinoidine)	A mixture of alkaloids, mostly amorphous, obtained as a by-product in the manufacture of the crystallizable alkaloids from cinchona. Dose, five to thirty grains (0.3 to 2 Gm.)
Chinol, Chinoline mono-hypochlorite, $C_9H_6N.Cl.O$	Antipyretic and analgesic. Dose, three to five grains (0.2 to 0.3 Gm.)
Chinoline (Quinoline, Leucoline), C_9H_7N	An artificial alkaloid. A colorless, oily liquid. Sp. gr. 1.081 at 10° C. (50° F.). Antipyretic and antiseptic
Chlorogenine	Identical with *alstonine* (see above)
Cicutine	From *Cicuta virosa*. A volatile alkaloid
Cinchonidinæ Salicylas, Cinchonidine Salicylate, $C_{19}H_{22}N_2O.C_7H_6O_3$	Antirheumatic. Dose, fifteen to twenty grains (1 to 1.3 Gm.) a day
Cinchonine, $C_{19}H_{22}N_2O$. U. S. P. 1890	An alkaloid obtained from the bark of various species of Cinchona. Insoluble in water. Used in making elixirs, etc, as it is soluble in alcohol
Conhydrine, $C_8H_{17}NO$	From *Conium maculatum*. It occurs in pearly, iridescent plates, which are easily fusible; odor similar to that of coniine
Coniine, $C_8H_{17}N$	From *Conium maculatum*. A volatile alkaloid, inflammable, strong alkaline reaction, a strong odor, soluble in water, alcohol, ether, chloroform, etc. Used as an antispasmodic. Dose, one-fourth of a grain (0.015 Gm.). *Coniine hydrobromide* is given in doses of one-sixteenth of a grain (0.004 Gm.)
Corydaline	From the tubers of *Dicentra canadensis*. A white, amorphous powder; its solution has a very bitter taste
Curarine, $C_{18}H_{35}N$?	From *curare*. It occurs in colorless prisms having a very bitter taste. It is colored red by nitric acid
Cytisine, $C_{11}H_{14}N_2O$	From *Cytisus Laburnum*. It occurs in white crystals, is inodorous, and has a bitter, somewhat caustic taste, and an alkaline reaction. Soluble in water and alcohol. It is colored orange-yellow by nitric acid
Daturine	See page 955. Dose, one-sixty-fourth of a grain (0.001 Gm.)
Delphinine, $C_{22}H_{35}NO_6$	From the seed of *Delphinium Staphisagria*. It occurs in flat prisms; taste bitter, followed by persistent tingling. Nearly insoluble in water
Duboisine	From several species of *Duboisia*. It crystallizes in fine colorless needles. Used as a substitute for atropine. Dose, one sixty-fourth of a grain (0.001 Gm.)
Erythrophleine Hydrochloride	Obtained from *Erythrophlœum guineense* (Sassy bark). Used in place of cocaine. Dose, one-eighth of a grain (0.008 Gm.)
Ethyl-oxy-Caffeine	Called also Ethoxycaffeine. Given in migraine, in doses of six to eight grains (0.38 to 0.5 Gm.)
Geissospermine, $C_{19}H_{24}N_2O_2.H_2O$	From *Geissospermum læve*. It occurs in small white prisms, nearly insoluble in ether and water, and readily soluble in alcohol and dilute acids
Gelsemine, $C_{24}H_{28}N_2O_4$	From *Gelsemium sempervirens*. It occurs in an amorphous, white powder, of a very bitter taste and an alkaline reaction, slightly soluble in cold water. It is colored red, changing to purple when heated with sulphuric acid. *Gelsemine hydrochloride* has been given in doses of one-sixteenth of a grain (0.004 Gm.)
Glaucine	From *Glauceum luteum*. A white, crystalline powder
Glaucopicrine	From *Glauceum luteum*. A white, crystalline powder
Guaranine	From *Paullinia sorbilis*. Identical with caffeine
Hygrine	From the leaves of *Erythroxylon Coca*. A volatile alkaloid, of a pale yellow color and a burning taste

Unofficial Alkaloids and their Salts, with Allied Products—*Continued*

Hyoscine	Obtained from *Hyoscyamus niger* in the process for obtaining hyoscyamine, and also by boiling hyoscyamine with baryta water, when decomposition takes place, forming hyoscine and hyoscinic acid. Dose, one-sixty-fourth of a grain (0.001 Gm.)
Jervine, $C_{26}H_{37}NO_3 + 2H_2O$	From *Veratrum album.* It occurs, when pure, as a white powder, tasteless, insoluble in water and ether, but soluble in alcohol and chloroform
Kairine, $C_{10}H_{13}NO.HCl + H_2O$	The hydrochloride of an artificial alkaloid prepared from chinoline. It occurs in commerce as a grayish or yellowish crystalline powder, having a slight phenol-like odor, and a saline, bitter, somewhat aromatic taste, soluble in boiling water. Dose, fifteen grains (1 Gm.)
Kairoline, Tetrahydromethylquinoline, or Tetrahydroethylquinoline	Antipyretic. The sulphates are the commercial salts
Laurotetanine	An alkaloid found in a number of plants belonging to the Laurinæ. A powerful poison, acting like strychnine
Lobeline	From *Lobelia inflata.* It is a volatile, yellow, somewhat aromatic liquid, having an acrid taste. Soluble in alcohol, ether, and fixed oils
Lupinine, $C_{10}H_{19}NO$	From different species of *Lupinus.* It occurs in colorless, rhombic prisms having a fruity odor and a very bitter taste
Lupuline	From *Humulus Lupulus.* A liquid alkaloid which has a strong coniine-like odor and an alkaline taste
Menispermine, $C_{18}H_{24}N_2O_2$	From *Cocculus Indicus*
Muscarine, $C_5H_{15}NO_3$	From *Amanita muscaria.* A colorless, crystalline powder, deliquescent, sparingly soluble in chloroform, and insoluble in ether
Nicotine, $C_{10}H_{14}N_2$	From *Nicotiana Tabacum.* A poisonous, oily liquid. It has an unpleasant tobacco-like odor, a burning taste, and a strongly alkaline reaction
Oxyacanthine, $C_{19}H_{21}NO_3$	From *Berberis vulgaris.* It is white, turning yellow on exposure to sunlight, having a bitter taste and an alkaline reaction. Soluble in 30 parts of boiling alcohol and in 1 part of cold alcohol, insoluble in water. Sulphuric acid colors it brown-red, turning to bright red on being heated
Parthenine	From *Parthenium Hysterophorus.* Used in doses of seven to ten grains (0.4 to 0.6 Gm.) in neuralgia
Pelosine	From *Chondodendron tomentosum.* It is amorphous, insoluble in water, slightly soluble in ether
Piturine, C_6H_8N	From the leaves of *Duboisia Hopwoodii.* A colorless liquid, of a nicotine odor and an acrid taste; on exposure to light it turns yellow and brown; freely soluble in water, alcohol, etc.
Quebrachine, $C_{21}H_{26}N_2O_3$	From the bark of *Aspidosperma Quebracho.* It yields crystallizable salts, and is colored yellow by sunlight
Quinine Valerate (Quinine Valerianate). U. S. P. 1890, $C_{20}H_{24}N_2O_2.C_5H_{10}O_2 + H_2O$	The valeric acid salt of quinine. It has the same uses as quinine sulphate (see page 935)
Quinidine Sulphate, $(C_{20}H_{24}N_2O_2)_2.H_2SO_4 + 2H_2O$	Obtained from the mother-liquors after the crystallization of the quinine
Sanguinarine, $C_{20}H_{15}NO_4 + H_2O$	From *Sanguinaria canadenis.* It occurs in white crystals having a bitter, acrid taste; soluble in ether and alcohol
Solanine	From *Dulcamara* and other plants. Dose, one grain (0.065 Gm.)
Sophorine	From the seeds of *Sophora speciosa.* A poisonous alkaloid
Staphisagrine, $C_{22}H_{33}NO_5$	From *Delphinium Staphisagria.* It is amorphous, very soluble in ether and in 200 parts of water
Thalline, Tetrahydroparaquinanisol, $C_9H_6H_4N(OCH_3)$	A hæmostatic. The sulphate and tartrate are powerful antipyretics. Dose, from four to eight grains (0.26 to 0.5 Gm.)
Theine	See Caffeine (page 972)
Theobromine, $C_7H_8N_4O_2$	From *Theobroma Cacao.* It occurs in minute, colorless or white, bitter crystals, sparingly soluble in water, alcohol, and ether
Veratroidine, $C_{51}H_{78}N_2O_{16}$	From *Veratrum viride.* It is a white powder, of a bitter taste, soluble in alcohol, ether, chloroform, etc. It is colored yellow by sulphuric acid

CONDENSED CHART OF THE VEGETABLE OFFI

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Anacardiaceæ				
Mastiche	Pistacia Lentiscus	. . . . . .	Concrete resinous exudation	Mediterranean basin
Rhus Glabra	Rhus glabra	. . . . . .	Fruit	North America
Apocynaceæ				
Apocynum	A. cannabinum and allied species	Canadian Hemp	Rhizome	United States
Strophanthus	S. Kombé	. . . . . .	Ripe seed	Tropical Africa
Araceæ				
Calamus	Acorus C.	Sweet Flag	Unpeeled, dried rhizome	. . . .
Aristolochiaceæ				
Serpentaria	Aristolochia S. and A. reticulata	Virginia Snakeroot	Rhizome and roots	United States
Berberidaceæ				
Berberis	B. Aquifolium and others	Oregon Grape Root	Rhizome and roots	United States
Podophyllum	P. peltatum	Mandrake, May-Apple Root	Rhizome	North America
Betulaceæ				
Oleum Betulæ	Betula lenta	Oil of Sweet Birch	Volatile oil from bark	North America
Burseraceæ				
Myrrha	Commiphora M.	. . . . . .	Gum-resin	East Africa and Arabia
Campanulaceæ				
Lobelia	L. Inflata	. . . . . .	Leaves and tops	North America
Caprifoliaceæ				
Viburnum Opulus	V. Opulus	Cramp-Bark	Bark	United States
Viburnum Prunifolium	V. prunifolium	Black Haw, Viburnum	Bark of root	United States
Celastraceæ				
Euonymus	E. atropurpureus	Wahoo	Bark of root	United States
Chenopodiaceæ				
Oleum Chenopodii	C. Anthelminticum	Oil of American Wormseed	Volatile oil	. . . .
Saccharum	Beta vulgaris	Cane Sugar	. . . .	North America
Compositæ				
Anthemis	A. nobilis	English or Roman Chamomile, Chamomile	Flower-heads	Southern and Western Europe
Arnica	A. montana	. . . . . .	Flower-heads	Mts. of Europe
Calendula	C. officinalis	Marigold	Florets	S. Europe, cult.
Eupatorium	E. perfoliatum	Thoroughwort, Boneset	Leaves and flowering tops	North America
Grindelia	G. robusta and G. squarrosa	. . . . . .	Leaves and flowering tops	North America

CIAL DRUGS, WITH THEIR PREPARATIONS

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Mastic	Stimulant; gr. xxx (2 Gm.)	Volatile oil, mastichic acid, masticin	Pills of Aloes and Mastic
Rhus Glabra	Diuretic; gr. xv (1 Gm.)	Acid calcium and potassium malates, tannin	**Fluidextract**
Apocynum	Antiperiodic, emetic; gr. xv (1 Gm.)	Tannin, resin, apocynin, apocynein, etc.	**Fluidextract**
Strophanthus	Sedative; gr. i (0.065 Gm.)	Strophanthin, kombic acid, trigonelline	**Tincture**
Calamus	Aromatic; gr. xv (1 Gm.).	Volatile oil, acorin, bitter principle	**Fluidextract**
Serpentaria	Stimulant; gr. xv (1 Gm.)	Volatile oil, aristolochine. resin	**Fluidextract, Tincture,** Compound Tincture of Cinchona
Berberis	Alterative, laxative; gr. xxx (2 Gm.)	Berberine, berberidine, oxyacanthine	**Fluidextract**
Podophyllum	Cathartic; gr. viii (0.5 Gm.)	Resin, starch, sugar	**Fluidextract, Resin**
Oil of Betula	Flavoring, antirheumatic; ♏xv (1 Cc.)	Methyl salicylate, $CH_3C_7H_5O_3$	
Myrrh	Stimulant, tonic; gr. viii (0.5 Gm.)	Volatile oil, resin, gum, bitter principle	**Tincture,** Compound Iron Mixture, Pills of Aloes and Myrrh, Tincture of Aloes and Myrrh, Compound Pills of Rhubarb
Lobelia	Emetic; gr. viii (0.5 Gm.)	Lobeline, lobelic acid, lobelacrin, inflatin	**Fluidextract, Tincture**
Viburnum Opulus	gr. xxx (2 Gm.)	Valeric acid, viburnin	**Fluidextract**
Viburnum Prunifolium	Antidysmenorrhœic; gr. xxx (2 Gm.)	Valeric acid, viburnin, tannin	**Fluidextract**
Euonymus	Laxative; gr. viii (0.5 Gm.)	Euonymin, asparagin, resins	**Fluidextract**
Oil of Chenopodium	Anthelmintic; ♏iii (0.2 Cc.)	$C_{10}H_{16}$,—$C_{10}H_{16}O$	
Sugar	. . . .	. . . .	**Syrup, etc.**
Anthemis	Stimulant; gr. xxx (2 Gm.)	Volatile oil, resin, anthemic acid, anthemene (anthemidin)	
Arnica	Vulnerary; gr. xv (1 Gm.)	Volatile oil, arnicin	**Tincture**
Calendula	Vulnerary; gr. xv (1 Gm.)	Trace of volatile oil, calendulin, etc.	**Tincture**
Eupatorium	Tonic; gr. xxx (2 Gm.)	Eupatorin, volatile oil, tannin, resin	**Fluidextract**
Grindelia	Sedative; gr. xxx (2 Gm.)	Volatile oil, resin, grindeline, bitter principle	**Fluidextract**

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Lactucarium	Lactuca virosa	. . . . . .	Concrete milk-juice	C. and S. Europe
Lappa	Arctium L.	Burdock Root	Root	Europe, Northern Asia
Matricaria	M. Chamomilla	German Chamomile	Flower-heads	Europe
Oleum Erigerontis	Erigeron canadensis	Oil of Fleabane	Volatile oil	. . . .
Pyrethrum	Anacyclus P.	. . . . . .	Root	Mediterranean basin
Santonica	Artemisia pauciflora	Levant Wormseed	Unexpanded flower-heads	Turkestan
Taraxacum	T. officinale	Dandelion	Root	Europe, nat.
Coniferæ				
Oleum Cadinum	Juniperus Oxycedrus	Oleum Juniperi Empyreumaticum, Oil of Juniper Tar	Product of dry distillation	. . . .
Oleum Juniperi	Juniperus communis	. . . . . .	Volatile oil	. . . .
Oleum Picis Liquidæ	Pinus palustris and others	. . . . . .	Volatile oil	. . . .
Oleum Sabinæ	Juniperus Sabina	. . . . . .	Volatile oil	. . . .
Oleum Terebinthinæ	Pinus palustris and others	. . . . . .	Volatile oil	. . . .
Pix Liquida	Pinus palustris and others	. . . . . .	Empyreumatic oleoresin	United States
Resina	Pinus palustris and others	Colophony, Resin	Residue (from distilling turpentine)	United States
Sabina	Juniperus S.	. . . . . .	Tops	Europe and N. America
Terebinthina Canadensis	Abies balsamea	Canada Balsam, Balsam of Fir	Liquid oleoresin	North America
Convolvulaceæ				
Jalapa	Exogonium Purga	. . . . . .	Tuberous root	Eastern Mexico
Scammonium	Convolvulus Scammonia	. . . . . .	Gum-resin	Western Asia
Cruciferæ				
Oleum Sinapis Volatile	Sinapis nigra	. . . . . .	Volatile oil	. . . .
Sinapis Alba	Sinapis alba	. . . . . .	Seed	Asia and Southern Europe
Sinapis Nigra	Brassica nigra	. . . . . .	Seed	Asia and Southern Europe
Cucurbitaceæ				
Colocynthis	Citrullus C.	Bitter Apple	Peeled dried fruit	Southern and Western Asia
Pepo	Cucurbita P.	Pumpkin Seed	Seed	Asia and America
Cupuliferæ				
Galla	Quercus infectoria	. . . . . .	Excrescence	Levant
Quercus	Q. alba	. . . . . .	Bark	North America
Ericaceæ				
Chimaphila	C. umbellata	Pipsissewa	Leaves	Northern Continents

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Lactucarium	Sedative; gr. xv (1 Gm.)	Lactucin, lactucic acid, lactucerin	**Tincture**
Lappa	Alterative; gr. xxx (2 Gm.)	Inulin, tannin, bitter extractive	**Fluidextract**
Matricaria	Stimulant; ℥ss (16 Gm.)	Volatile oil, anthemic acid, anthemidin	
Oil of Erigeron	Stimulant; ♏xv (1 Cc.)	$C_{10}H_{16}$	
Pyrethrum	Sialagogue; gr. xxx (2 Gm.)	Resin, fixed oils, pyrethrin, inulin	**Tincture**
Santonica	Anthelmintic	Volatile oil, santonin, resin, artemisin	
Taraxacum	Cholagogue; ʒii (8 Gm.)	Inulin, taraxacin, taraxacerin	**Extract, Fluidextract**
Oil of Cade	Parasiticide; externally	Empyreumatic products	
Oil of Juniper	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$	**Spirit, Compound Spirit**
Oil of Tar	Externally and as expectorant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$	
Oil of Savin	Stimulant; ♏i (0.05 Cc.)	$C_{10}H_{16}$	
Oil of Turpentine	Stimulant	$C_{10}H_{16}$	**Liniment, Rectified Oil**
Tar	Irritant; gr. viii (0.5 Gm.)	See page 723	**Syrup, Ointment**
Rosin	Mild stimulant; gr. iv (0.25 Gm.)	Abietic anhydride	**Cerate, Compound Cerate,** Cantharides Cerate
Savin	Irritant; gr. viii (0.5 Gm.)	Volatile oil, resin, tannin	**Fluidextract**
Canada Turpentine	Stimulant	Volatile oil, bitter principle	Flexible Collodion
Jalap	Hydragogue cathartic; gr. xv (1 Gm.)	Resin, starch, gum	**Compound Powder, Resin**
Scammony	Hydragogue cathartic; gr. iv (0.25 Gm.)	Resin, gum	**Resin**
Volatile Oil of Mustard	Rubefacient; ♏⅛ (0.008 Cc.)	Allyl iso-thiocyanate	
White Mustard	Emetic; ʒii (8 Gm.)	Fixed oil, myrosin, sinalbin, mucilage	
Black Mustard	Emetic; ʒii (8 Gm.)	Fixed oil, myrosin, sinigrin, mucilage	**Mustard Paper**
Colocynth	Purgative; gr. i (0.065 Gm.)	Colocynthin, colocynthitin, pectin, etc.	**Extract,** Compound Extract (from Extract)
Pepo	Tænifuge; ℥i (30 Gm.)	Fixed oil, acrid resin, proteids, starch	
Nutgall	Astringent; gr. viii (0.5 Gm.)	Tannin, gallic acid, mucilage, resin	**Tincture, Ointment**
White Oak	Astringent; gr. xv (1 Gm.)	Tannin, pectin, resin	**Fluidextract**
Chimaphila	Astringent, diuretic; gr. xxx (2 Gm.)	Arbutin, ericolin, tannin, chimaphilin	**Fluidextract**

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Oleum Gaultheriæ	Gaultheria procumbens	Oil of Wintergreen	Volatile oil	. . . .
Uva Ursi	Arctostaphylos Uva-ursi	Bearberry	Leaves	Northern Hemisphere
Erythroxylaceæ				
Coca	Erythroxylon C., E. Truxillense	Erythroxylon	Dried leaves	South America
Euphorbiaceæ				
Elastica	Hevea	India Rubber	Milk-juice	South America
Oleum Ricini	Ricinus communis	. . . . . .	Fixed oil	India, United States
Oleum Tiglii	Croton Tiglium	. . . . . .	Fixed oil	India, cult.
Stillingia	S. sylvatica	Queen's Root	Root	Southern United States
Fagaceæ				
Creosotum	Fagus silvatica, or F. ferruginea	. . . . . .	. . . .	. . . .
Filices				
Aspidium	Dryopteris Filix-mas and D. marginalis	Male Fern	Rhizome	Europe and N. America
Gentianaceæ				
Chirata	Swertia Chirayita	. . . . . .	Entire plant	Northern India
Gentiana	G. lutea	. . . . . .	Rhizome and roots	C. and S. Europe
Geraniaceæ				
Geranium	G. maculatum	Cranesbill	Rhizome	North America
Gigartinaceæ				
Chondrus	C. crispus	Irish Moss	Dried plant	North Atlantic Coast
Gramineæ				
Amylum	Zea Mays	. . . . . .	Starch grains from fruit	. . . .
Maltum	Hordeum distichon	. . . . . .	Partially germinated and then dried grain	Europe and North America
Saccharum	S. officinarum and other species of Sorghum	Cane Sugar	. . . .	Tropics
Triticum	Agropyron repens	Couch-Grass	Rhizome	Europe, North America
Zea	Z. Mays	Corn Silk	Fresh styles and stigmas	. . . .
Guttiferæ				
Cambogia	Garcinia Hanburii	. . . . . .	Gum-resin	Anam and Siam
Hamamelidaceæ				
Hamamelidis Cortex	H. virginiana	Witchhazel Bark	Bark and twigs	North America
Hamamelidis Folia	H. virginiana	Witchhazel Leaves	Leaves	North America
Styrax	Liquidambar orientalis	. . . . . .	Balsam	Asia Minor
Hydrophyllaceæ				
Eriodictyon	E. californicum	Yerba Santa	Leaves	. . . .
Hypocreaceæ				
Ergota	Claviceps purpurea, upon Secale cereale	Ergot of Rye, Spurred Rye	Sclerotium	Europe and United States

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Oil of Gaultheria	Flavoring, antirheumatic; ♏xv (1 Cc.)	Methyl salicylate, $CH_3C_7H_5O_3$	**Spirit,** Compound Syrup of Sarsaparilla, Emulsion of Cod Liver Oil, Emulsion of Cod Liver Oil with Hypophosphites, and Antiseptic Solution
Uva Ursi	Diuretic, astringent; gr. xxx (2 Gm.)	Tannin, arbutin, gallic acid, ericolin, urson	**Fluidextract**
Coca	Nervine; gr. xxx (2 Gm.)	Cocaine, hygrine	**Fluidextract**
Rubber	. . . .	. . . .	Mustard Paper, Adhesive Plaster
Castor Oil	Cathartic; ℥ss (16 Cc.)	Ricinolein and palmitin	Flexible Collodion
Croton Oil	Purge; ♏i (0.05 Cc.)	Crotonolic acid?	
Stillingia	Alterative; gr. xxx (2 Gm.)	Resin, fixed oil, sylvacrol, starch	**Fluidextract**
Creosote	Bactericide; ♏iii (0.2 Cc.)	. . . .	**Water**
Aspidium	Tænifuge; gr. lx (4 Gm.)	Fixed oil, filicic acid, filicin, filitannic acid	**Oleoresin**
Chirata	Tonic; gr. xv (1 Gm.)	Ophelic acid, chiratin	**Fluidextract**
Gentian	Tonic; gr. xv (1 Gm.)	Gentiopicrin, gentisic acid, gentianose, pectin	**Extract, Fluidextract, Compound Tincture**
Geranium	Astringent; gr. xv (1 Gm.)	Tannin, pectin, starch	**Fluidextract**
Chondrus	Demulcent; ʒiv (15 Gm.)	Mucilaginous compounds, etc.	
Starch, Corn starch	. . . .	. . . .	**Glycerite,** Sulphurated Lime
Malt	Nutrient; gr. lx (4 Gm.)	Maltose, diastase	**Extract**
Sugar	. . . .	. . . .	**Syrup, etc.**
Triticum	Diuretic; ʒii (8 Gm.)	Glucose, triticin	**Fluidextract**
Zea	Diuretic	Maizenic acid, sugar, resin	
Gamboge	Hydragogue cathartic; gr. ii (0.13 Gm.)	Gum, resin, cambogic acid	Compound Cathartic Pills
Hamamelis Bark	Astringent, vulnerary; gr. xxx (2 Gm.)	Tannin, resin, volatile oil	**Water**
Hamamelis Leaves	Astringent, hæmostatic; gr. xxx (2 Gm.)	Tannin, bitter principle, volatile oil	**Fluidextract**
Storax	Expectorant; gr. xv (1 Gm.)	Styrol, cinnamic acid, storesin	Compound Tincture of Benzoin
Eriodictyon	Expectorant; gr. xv (1 Gm.)	Resin, volatile oil, ericolin	**Fluidextract**
Ergot	Parturient; gr. xxx (2 Gm.)	Fixed oil, sclerotic acid, ergotine, sclererythrin	**Fluidextract, Extract**

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Krameriaceæ				
Krameria	K. triandra, K. Ixina, or K. argentea	Rhatany	Root	South America
Labiatæ				
Hedeoma	H. pulegioides	Pennyroyal (American)	Leaves and flowering tops	North America
Marrubium	M. vulgare	Hoarhound (Horehound)	Leaves and flowering tops	Europe, nat.
Mentha Piperita	M. piperita	. . . . . .	Leaves and flowering tops	Europe and North America
Mentha Viridis	M. spicata (M. viridis)	. . . . . .	Leaves and flowering tops	Europe and North America
Oleum Hedeomæ	Hedeoma pulegioides	Oil of Pennyroyal	Volatile oil	. . . .
Oleum Lavandulæ Florum	Lavandula officinalis	. . . . . .	Volatile oil	. . . .
Oleum Menthæ Piperitæ	Mentha piperita	. . . . . .	Volatile oil	. . . .
Oleum Menthæ Viridis	M. spicata (M. viridis)	. . . . . .	Volatile oil	. . . .
Oleum Rosmarini	Rosmarinus officinalis	. . . . . .	Volatile oil	. . . .
Oleum Thymi	Thymus vulgaris	. . . . . .	Volatile oil	. . . .
Salvia	S. officinalis	Sage	Leaves	Southern Europe, cult.
Scutellaria	S. lateriflora	Skullcap	Dried plant	North America
Thymol	Thymus vulgaris and others	. . . . . .	Phenol	Southern Europe, cult.
Lauraceæ				
Camphora	Cinnamomum C.	. . . . . .	Stearopten	China and Japan
Cinnamomum Saigonicum	Cinnamomum ——	. . . . . .	Bark	. . . .
Cinnamomum Zeylanicum	C. zeylanicum	. . . . . .	Inner bark of shoots	. . . .
Oleum Cinnamomi	Cassia Cinnamon	. . . . . .	Volatile oil	. . . .
Oleum Sassafras	Sassafras variifolium	. . . . . .	Volatile oil	. . . .
Sassafras	S. variifolium (Syn. Sassafras Sassafras)	. . . . . .	Bark of root	North America
Sassafras Medulla	S. variifolium (Syn. Sassafras Sassafras)	. . . . . .	Pith	North America
Leguminosæ				
Acacia	A. Senegal and others	Gum Arabic	Gummy exudation	Africa

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Krameria	Astringent; gr. xv (1 Gm.)	Kramero-tannic acid, rhatanic acid	**Extract, Fluidextract, Tincture**
Hedeoma	Stimulant; ʒii (8 Gm.)	Volatile oil	
Marrubium	Expectorant; gr. xxx (2 Gm.)	Trace of volatile oil, marrubiin, tannin	
Peppermint	Stimulant; gr. lx (4 Gm.)	Volatile oil, trace of tannin	**Spirit**
Spearmint	Stimulant; gr. lx (4 Gm.)	Volatile oil, resin	**Spirit**
Oil of Hedeoma	Stimulant; ♏iii (0.2 Cc.)		
Oil of Lavender Flowers	Scent; ♏iii (0.2 Cc.)	$C_{10}H_{16}$ and esters	**Spirit, Compound Tincture,** Aromatic Spirit of Ammonia, Liniment of Soft Soap, Diachylon Ointment
Oil of Peppermint	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{18}O$—$C_{10}H_{20}O$	**Water, Spirit,** Compound Pills of Rhubarb, Vegetable Cathartic Pills, Cataplasm of Kaolin, Antiseptic Solution
Oil of Spearmint	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$—$C_{10}H_{14}O$	**Water, Spirit**
Oil of Rosemary	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$, borneol, $C_{10}H_{18}O$	Soap Liniment, Compound Tincture of Lavender
Oil of Thyme	Stimulant; ♏iii (0.2 Cc.)	Cymene, pinene, thymol	Antiseptic Solution
Salvia	Astringent; gr. xxx (2 Gm.)	Volatile oil, tannin, resin	
Scutellaria	Antispasmodic; gr. xv (1 Gm.)	Scutellarin, volatile oil	**Fluidextract**
Thymol	Antiseptic; gr. ii (0.13 Gm.)	$C_{10}H_{14}O$	Cataplasm of Kaolin, Antiseptic Solution
Camphor	Stimulant; gr. ii (0.13 Gm.)	$C_{10}H_{16}O$	**Water, Liniment, Spirit,** Cerate of Lead Subacetate, Camphorated Tincture of Opium, Belladonna Liniment, Soap Liniment, Compound Powder of Morphine
Saigon Cinnamon	Stimulant; gr. iv (0.25 Gm.)	Volatile oil, etc.	**Tincture,** Aromatic Powder, Compound Tincture of Cardamom, Compound Tincture of Gambir, Compound Tincture of Lavender, Aromatic Tincture of Rhubarb, and Wine of Opium
Ceylon Cinnamon	Stimulant; gr. iv (0.25 Gm.)	Volatile oil, etc.	
Oil of Cinnamon, Oil of Cassia	Stimulant; ♏i (0.05 Cc.)	Cinnamic aldehyde, C_9H_8O	**Water, Spirit,** Aromatic Sulphuric Acid
Oil of Sassafras	Stimulant; ♏iii (0.2 Cc.)	Safrene, $C_{10}H_{16}$, safrol, $C_{10}H_{10}O_2$	Troches of Cubeb, Compound Syrup of Sarsaparilla
Sassafras	Stimulant; gr. xxx (2 Gm.)	Volatile oil, tannin, sassafrid	Compound Fluidextract of Sarsaparilla
Sassafras Pith	Demulcent	Mucilage	**Mucilage**
Acacia	Demulcent	Gummic acid combined with calcium, magnesium, and potassium	**Mucilage, Syrup,** Emulsion of Almond, Emulsion of Cod Liver Oil, Emulsion of Cod Liver Oil with Hypophosphites, Emulsion of Oil of Turpentine, Compound Mixture of Glycyrrhiza, Pills of Ferrous Iodide, Pills of Phosphorus, Pills of Podophyllum, Belladonna, and Capsicum, Compound Chalk Powder, Troches of Cubeb, Troches of Glycyrrhiza and Opium

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Balsamum Peruvianum	Toluifera Pereiræ	. . . . . .	Balsam	Central America
Balsamum Tolutanum	Toluifera Balsamum	. . . . . .	Balsam	Venezuela
Cassia Fistula	C. Fistula	Purging Cassia	Dried fruit	Eastern India
Chrysarobinum	Vouacapoua Araroba	. . . . . .	Principle from Goa powder	Brazil
Copaiba	One or more species of Copaiba	Balsam of Copaiba, Copaiva	Oleoresin	South America
Glycyrrhiza	G. glabra, G. glandulifera	Liquorice Root	Rhizome and roots	Europe and Asia
Hæmatoxylon	H. campechianum	Logwood	Heart-wood	Central America
Kino	Pterocarpus Marsupium	. . . . . .	Inspissated juice	East Indies
Oleum Copaibæ	One or more species of Copaiba	. . . . . .	Volatile oil	. . . .
Physostigma	P. venenosum	Calabar Bean	Ripe seed	Western Africa
Santalum Rubrum	Pterocarpus santalinus	. . . . . .	Heart-wood	Madras, cult.
Scoparius	Cytisus S.	Broom	Tops	Asia and Europe
Senna	Cassia acutifolia and C. angustifolia	. . . . . .	Leaflets	Eastern and Central Africa
Tamarindus	T. indica	. . . . . .	Preserved pulp of fruit	India, West Indies
Tragacantha	Astragalus gummifer and others	. . . . . .	Gummy exudation	Western Asia
Liliaceæ				
Aloe	A. vera, A. Perryi, A. Chinensis, and others	. . . . . .	Inspissated juice	Africa
Colchici Cormus	C. autumnale	Colchicum Root	Corm	Europe
Colchici Semen	C. autumnale	. . . . . .	Seed	Europe
Convallaria	C. majalis	Lily-of-the-Valley	Rhizome and roots	Europe
Sarsaparilla	Smilax, medica, S. ornata, S. papyracea, and probably S. officinalis	. . . . . .	Root	Tropical America
Scilla	Urginea maritima	. . . . . .	Sliced bulb	Mediterranean basin

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Balsam of Peru	Expectorant; gr. xv (1 Gm.)	Cinnamein, resin, cinnamic and benzoic acids	
Balsam of Tolu	Expectorant; gr. xv (1 Gm.)	Resins, cinnamic and benzoic acids	**Tincture,** Pills of Ferrous Iodide, Pills of Phosphorus, Compound Tincture of Benzoin
Cassia Fistula	Laxative; gr. lx (4 Gm.)	Sugar, pectin	Confection of Senna
Chrysarobin	Irritant; gr. ss (0.03 Gm.)	. . . .	**Ointment**
Copaiba	Stimulant; ♏xv (1 Cc.)	Volatile oil, resins, copaivic acid	
Glycyrrhiza, Licorice Root	Expectorant; gr. xxx (2 Gm.)	Glycyrrhizin, asparagin, acrid oleoresin, sugar	**Fluidextract, Pure Extract, Ammoniated Glycyrrhizin, Compound Powder,** Compound Fluidextract of Sarsaparilla, Aromatic Fluidextract of Cascara Sagrada, Mass of Mercury, Pills of Ferrous Iodide, Compound Laxative Pills, Compound Powder of Morphine, Tincture of Aloes, Tincture of Aloes and Myrrh, and as diluent in powdered extracts
Hematoxylon	Astringent; gr. lx (4 Gm.)	Hæmatoxylin, tannin, resin	**Extract**
Kino	Astringent; gr. viii (0.5 Gm.)	Kinotannic acid, pyrocatechin	**Tincture**
Oil of Copaiba	Stimulant; ♏viii (0.5 Cc.)	$C_{15}H_{24}$	
Physostigma	Sedative; gr. iss (0.1 Gm.)	Physostigmine, calabarine, proteids	**Extract, Tincture**
Red Saunders	Coloring	Santalic acid, santal	Compound Tincture of Lavender
Scoparius	Diuretic; gr. xv (1 Gm.)	Volatile oil, scoparin, sparteine	
Senna	Cathartic; gr. lx (4 Gm.)	Chrysophanic acid, anthraglucosennin, emodin	**Fluidextract, Confection, Compound Infusion,** Compound Powder of Glycyrrhiza
Tamarind	Laxative; ℥ss (16 Gm.)	Tartaric, citric, malic, and acetic acids	Confection of Senna
Tragacanth	Demulcent	Tragacanthin, starch	**Mucilage,** Pills of Ferrous Carbonate, Troches of Tannic Acid, Troches of Ammonium Chloride, Troches of Gambir, Troches of Krameria, Troches of Potassium Chlorate, Troches of Santonin, Emulsion of Chloroform
Aloes	Laxative; gr. iv (0.25 Gm.)	Aloin, emodin, resin, little volatile oil	**Purified Aloes, Extract**
Colchicum Corm	Sedative, emetic; gr. iv (0.25 Gm.)	Colchicine, starch, resin	**Extract**
Colchicum Seed	Sedative; gr. iii (0.2 Gm.)	Colchicine, fixed oil	**Fluidextract, Tincture**
Convallaria	Cardiac sedative; gr. viii (0.5 Gm.)	Convallamarin, convallarin, resin	**Fluidextract**
Sarsaparilla	Alterative; gr. xxx (2 Gm.)	Parillin, saponin, resin	**Fluidextract, Compound Fluidextract**
Squill	Expectorant; gr. ii (0.13 Gm.)	Scillipicrin, scillitoxin, scillin, sinistrin	**Vinegar, Fluidextract, Tincture**

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Veratrum	V. viride or V. album	American Hellebore, Veratrum Viride, White Hellebore	Rhizome and roots	North America
Linaceæ				
Linum	L. usitatissimum	. . . . . .	Ripe seed	Southern Europe, cult.
Oleum Lini	L. usitatissimum	Oil of Flaxseed	Fixed oil	Southern Europe cult.
Loganiaceæ				
Gelsemium	G. sempervirens	. . . . . .	Rhizome and roots	Southern United States
Nux Vomica	Strychnos Nux-vomica	. . . . . .	Seed	India
Spigelia	S. marilandica	Pinkroot	Rhizome and roots	United States
Lycopodiaceæ				
Lycopodium	L. clavatum and others	. . . . . .	Spores	Europe and North America
Magnoliaceæ				
Oleum Anisi	(See Pimpinella Anisum) Illicium verum	. . . . . .	Volatile oil	Southwestern China
Malvaceæ				
Althæa	A. officinalis	Marshmallow	Root	Europe, nat.
Gossypii Cortex	G. herbaceum and others	. . . . . .	Bark of root	Asia, Africa, cult.
Gossypium Purificatum	G. herbaceum and others	Absorbent Cotton	Hairs of seed	Tropics
Oleum Gossypii Seminis	G. herbaceum and others	. . . . . .	Fixed oil	. . . .
Menispermaceæ				
Calumba	Jateorhiza palmata	Columbo	Root	Eastern Africa
Pareira	Chondrodendron tomentosum	Pareira Brava	Root	Brazil
Moraceæ				
Cannabis Indica	C. sativa	Indian Hemp	Flowering tops of pistillate plants	Asia
Ficus	F. Carica	. . . . . .	Partially dried fruit	Western Asia, cult.
Humulus	H. Lupulus	. . . . . .	Carefully dried strobiles	Europe and Asia
Lupulinum	H. Lupulus	. . . . . .	Glandular trichomes from fruit	Europe and Asia
Myristicaceæ				
Myristica	M. fragrans	Nutmeg	Kernel of ripe seed	Molucca Islands
Oleum Myristicæ	Myristica fragrans	Oil of Nutmeg	Volatile oil	. . . .
Myrtaceæ				
Caryophyllus	Eugenia aromatica	. . . . . .	Dried flower buds	Molucca Islands
Eucalyptus	E. Globulus	. . . . . .	Leaves	Australia
Oleum Cajuputi	Melaleuca Leucadendron	. . . . . .	Volatile oil	East Indian Islands
Oleum Caryophylli	Eugenia aromatica	. . . . . .	Volatile oil	. . . .

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Veratrum	Cardiac sedative; gr. ii (0.13 Gm.)	Jervine, veratroidine, resin	**Fluidextract, Tincture**
Linseed, Flaxseed	Demulcent; gr. lx (4 Gm.)	Fixed oil, mucilage	
Linseed Oil	Cathartic; f℥i (30 Cc.)	Linolein, palmitin, myristin	Lime Liniment, Soft Soap, Compound Rosin Cerate, Compound Solution of Cresol
Gelsemium	Antispasmodic; gr. i (0.065 Gm.)	Gelsemine, volatile oil	**Fluidextract, Tincture**
Nux Vomica	Tonic; gr. i (0.065 Gm.)	Strychnine, brucine, proteids	**Extract, Fluidextract, Tincture**
Spigelia	Anthelmintic; gr. lx (4 Gm.)	Volatile oil, bitter principle, spigeline	**Fluidextract**
Lycopodium	Used externally	Fixed oil	
Oil of Anise	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$, and anethol, $C_{10}H_{12}O$	**Water, Spirit,** Camphorated Tincture of Opium, Troches of Glycyrrhiza and Opium, Compound Spirit of Orange, Compound Syrup of Sarsaparilla
Althæa	Demulcent; gr. lx (4 Gm.)	Asparagin, starch, mucilage	Mass of Mercury, Pills of Ferrous Carbonate, Pills of Phosphorus
Cotton Root Bark	Emmenagogue; gr. xxx (2 Gm.)	Yellow resin, fixed oil, etc.	
Purified Cotton	. . . .	Cellulose, fixed oil	
Cotton Seed Oil	Demulcent; f℥ss (16 Cc.)	Olein, palmitin	Ammonia Liniment, Camphor Liniment
Calumba	Tonic; gr. xxx (2 Gm.)	Columbin, berberine, mucilage	**Fluidextract, Tincture**
Pareira	Diuretic; gr. xxx (2 Gm.)	Pelosine, tannin	**Fluidextract**
Indian Cannabis	Nervine; gr. i (0.065 Gm.)	Resin, cannabinine	**Extract, Fluidextract, Tincture**
Fig	Laxative	Cellular tissue, sugar, gum, fat, etc.	Confection of Senna
Hops	Tonic; gr. xxx (2 Gm.)	Volatile oil, resin, tannin	
Lupulin	Tonic; gr. viii (0.5 Gm.)	Volatile oil, lupuline, resin	**Fluidextract, Oleoresin**
Myristica	Stimulant; gr. viii (0.5 Gm.)	Volatile oil, fixed oil, proteids	Vinegar of Opium, Aromatic Powder, Compound Tincture of Lavender, Aromatic Tincture of Rhubarb, Troches of Sodium Bicarbonate
Oil of Myristica	Stimulant; ♏iii (0.2 Cc.)	Pinene, $C_{10}H_{16}$, and myristicol, $C_{10}H_{16}O$	Aromatic Spirit of Ammonia
Cloves	Stimulant; gr. iv (0.25 Gm.)	Volatile oil, tannin, resin	Compound Tincture of Lavender, Aromatic Tincture of Rhubarb, Wine of Opium
Eucalyptus	Febrifuge; gr. xxx (2 Gm.)	Volatile oil, tannin, resin	**Fluidextract**
Oil of Cajuput	Diaphoretic; ♏viii (0.5 Cc.)	Cajuputol, $C_{10}H_{18}O$	
Oil of Cloves	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$, and eugenol, $C_{10}H_{12}O_2$	

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Oleum Eucalypti	Eucalyptus Globulus	. . . . . .	Volatile oil	. . . .
Oleum Pimentæ	Pimenta officinalis	Oil of Allspice	Volatile oil	. . . .
Pimenta	P. officinalis	Allspice, Pimento	Nearly ripe fruit	Tropical America
Oleaceæ				
Manna	Fraxinus Ornus	. . . . . .	Concrete sacch. exudation	Mediterranean basin
Oleum Olivæ	Olea europæa	. . . . . .	Fixed oil	Southern Europe
Orchidaceæ				
Cypripedium	C. hirsutum (C. pubescens) and C. parviflorum	Lady's Slipper	Rhizome and root	North America
Vanilla	V. planifolia	. . . . . .	Cured, full grown, but unripe fruit	Eastern Mexico
Palmæ				
Sabal	Serenoa serrulata	Saw Palmetto	Partially dried ripe fruit	North America
Papaveraceæ				
Opii Pulvis	. . . .	. . . . . .	Powder	. . . .
Opium	Papaver somniferum	. . . . . .	Concrete milky exudation	Western Asia, cult.
Opium Granulatum	. . . .	. . . . . .	Coarse powder	. . . .
Sanguinaria	S. canadensis	Bloodroot	Rhizome	North America
Phytolaccaceæ				
Phytolacca	P. decandra	Poke Root	Root	North America
Pinaceæ				
Terebinthina	Pinus palustris and others	. . . . . .	Concrete oleoresin	North America
Piperaceæ				
Cubeba	Piper C.	. . . . . .	Unripe, but full grown fruit	Java, cult.
Matico	Piper angustifolium	. . . . . .	Leaves	Tropical America
Oleum Cubebæ	Piper Cubeba	. . . . . .	Volatile oil	. . . .
Piper	P. nigrum	Black Pepper	Unripe fruit	India, cult.
Polygalaceæ				
Senega	Polygala S.	Senega Snakeroot	Root	United States
Polygonaceæ				
Rheum	R. officinale, R. palmatum, and var. tanguticum or others	. . . . . .	Rhizome	Western and Central China and Thibet
Punicaceæ				
Granatum	Punica G.	. . . . . .	Bark of stem and root	Warm Climates
Ranunculaceæ				
Aconitum	A. Napellus	. . . . . .	Tuberous root	Europe, Asia
Cimicifuga	C. racemosa	Black Cohosh, Black Snakeroot	Rhizome and roots	North America
Hydrastis	H. canadensis	Golden Seal	Rhizome and roots	North America
Staphisagria	Delphinium S.	Stavesacre	Ripe seed	Europe

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Oil of Eucalyptus	Febrifuge; ♏viii (0.5 Cc.)	$C_{10}H_{14}$, $C_{10}H_{18}$, $C_{10}H_{18}O$	
Oil of Pimenta	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$, and eugenol, $C_{10}H_{12}O_2$	
Pimenta	Stimulant; gr. xv (1 Gm.)	Volatile oil, tannin, resin	
Manna	Laxative; ℥ss (16 Gm.)	Mannite, fraxin, resin, glucose	Compound Infusion of Senna
Olive Oil	Laxative; f℥i (30 Cc.)	Olein, palmitin, arachin, stearin	Diachylon Ointment, Oleate of Atropine, Oleate of Cocaine, Oleate of Veratrine
Cypripedium	Diaphoretic; gr. xv (1 Gm.)	Volatile oil, tannin, resins	**Fluidextract**
Vanilla	Stimulant; gr. xv (1 Gm.)	Vanillin, fixed oil, resin, sugar	**Tincture**
Sabal	Diuretic, tonic; gr. xv (1 Gm.)	Volatile oil, fixed oil, an alkaloid, resin	
Powdered Opium	Narcotic; gr. i (0.065 Gm.)	Morphine, narcotine, codeine, etc.	**Vinegar, Extract, Pills, Camphorated Tincture, Deodorized Opium,** Powder of Ipecac and Opium, Troches of Glycyrrhiza and Opium
Opium	Narcotic; gr. iss (0.1 Gm.)	Morphine, narcotine, codeine	**Powdered Opium, Granulated Opium**
Granulated Opium	Narcotic; gr. i (0.065 Gm.)	Morphine, narcotine, codeine	**Tincture, Tincture of Deodorized Opium, Wine**
Sanguinaria	Alterative; gr. ii (0.13 Gm.)	Sanguinarine, chelerythine, resins, starch	**Fluidextract, Tincture**
Phytolacca Root	Alterative; gr. ii (0.13 Gm.). Emetic; gr. xv (1 Gm.)	Resin, tannin, asparagin	**Fluidextract**
Turpentine	Stimulant	Volatile oil, abietic anhydride	Compound Rosin Cerate
Cubeb	Stimulant; gr. xv (1 Gm.)	Volatile oil, resin, cubebin, cubebic acid	**Fluidextract, Oleoresin**
Matico	Stimulant; gr. lx (4 Gm.)	Volatile oil, artanthic acid, resin	**Fluidextract**
Oil of Cubeb	Stimulant; ♏viii (0.5 Cc.)	$C_{10}H_{16}—C_{15}H_{24}$	
Pepper	Stimulant; gr. viii (0.5 Gm.)	Volatile oil, resin, piperine, fat	**Oleoresin**
Senega	Expectorant; gr. xv (1 Gm.)	Polygalic acid, saponin, pectin, fixed oil	**Fluidextract**
Rhubarb	Purgative, astringent; gr. xv (1 Gm.)	Chrysophanic acid, emodin, rhein, tannin and resins	**Fluidextract, Compound Pills, Compound Powder, Tincture, Aromatic Tincture**
Pomegranate	Tænifuge; gr. xxx (2 Gm.)	Pelleticrine, tannin	**Fluidextract**
Aconite	Sedative; gr. i (0.065 Gm.)	Resin, aconitic acid, aconitine	**Fluidextract, Tincture**
Cimicifuga	Alterative; gr. xv (1 Gm.)	Crystalline principle, resin, tannin	**Fluidextract, Tincture**
Hydrastis	Alterative, tonic; gr. xxx (2 Gm.)	Berberine, hydrastine, canadine	**Fluidextract, Tincture, Glycerite**
Staphisagria	Used externally	Delphinine, fixed oil	**Fluidextract**

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Rhamnaceæ				
Frangula	Rhamnus F.	Buckthorn	Bark	Western Asia, cult.
Rhamnus Purshiana	Rhamnus Purshiana	......	Bark	Western Asia, cult.
Rosaceæ				
Amygdala Amara	Prunus Amygdalus, var. amara	......	Seed	Western Asia, cult.
Amygdala Dulcis	Prunus Amygdalus, var. dulcis	......	Seed	Western Asia, cult.
Oleum Amygdalæ Amaræ	Prunus Amygdalus, var. amara	......	Volatile oil	....
Oleum Amygdalæ Expressum	Prunus Amygdalus, var. dulcis, Prunus A., var. amara	......	Fixed oil	....
Prunum	Prunus domestica	......	Partially dried ripe fruit	Western Asia, cult.
Prunus Virginiana	P. serotina (P. virginiana)	......	Bark	North America
Rubus	R. villosus, R. nigrobaccus, R. cuneifolius	Blackberry	Bark of rhizomes	North America
Cusso	Hagenia abyssinica	Brayera	Dried panicles of pistillate flowers	Abyssinia
Oleum Rosæ	Rosa damascena	......	Volatile oil	Roumelia
Quillaja	Q. Saponaria	Soap Bark	Bark	Chili and Peru
Rosa Gallica	R. gallica	......	Petals	Southern Europe, cult.
Rubiaceæ				
Cinchona	C. Ledgeriana, C. Calisaya, C. officinalis, and hybrids	Peruvian Bark	Bark	South America, cult.
Cinchona Rubra	C. succirubra	Peruvian Bark	Bark	South America, cult.
Gambir	Ourouparia G.	Pale Catechu	Extract from leaves and twigs	India
Ipecacuanha	Cephaëlis I. and Cephaëlis acuminata	......	Root	Brazil
Rutaceæ				
Aurantii Amari Cortex	Citrus vulgaris	......	Dried rind of unripe fruit	Northern India, and cult.
Aurantii Dulcis Cortex	Citrus Aurantium	......	Fresh outer rind of ripe fruit	Northern India, and cult.
Oleum Aurantii Corticis	Citrus Aurantium	......	Volatile oil	....
Limonis Cortex	Citrus Limonum	......	Fresh outer rind of ripe fruit	Northern India, and cult.
Limonis Succus	Citrus Limonum	......	Fresh juice	Northern India, and cult.
Oleum Limonis	Citrus Limonum	......	Volatile oil	....
Buchu	Barosma betulina	......	Leaves	Southern Africa
Pilocarpus	P. Jaborandi or P. microphyllus	Jaborandi	Leaflets	Brazil
Xanthoxylum	X. americanum and Fagara Clava-Herculis	Prickly Ash	Bark	North America
Santalaceæ				
Oleum Santali	Santalum album	Oil of Sandalwood	Volatile oil	....

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Frangula	Laxative; gr. xv (1 Gm.)	Frangulin, emodin, frangulic acid	**Fluidextract**
Cascara Sagrada	Laxative; gr. xv (1 Gm.)	Purgative resins, chrysophanic acid	**Extract, Fluidextract, Aromatic Fluidextract**
Bitter Almond	Demulcent	Fixed oil, proteids, amygdalin	
Sweet Almond	Demulcent	Fixed oil, proteids	**Emulsion**
Oil of Bitter Almond	Sedative; ♏ss (0.03 Cc.)	Benzaldehyde, C_7H_6O	**Water, Spirit**
Expressed Oil of Almond	Laxative; f℥i (30 Cc.)	Olein, palmitin	Ointment of Rose Water, Veratrine Ointment, Emulsion of Chloroform, and Emulsion of Oil of Turpentine
Prune	Laxative	Sugar, pectin, malic acid	Confection of Senna
Wild Cherry	Sedative; gr. xxx (2 Gm.)	Tannin, amygdalin, emulsin	**Fluidextract, Infusion, Syrup**
Rubus	Astringent; gr. xv (1 Gm.)	Tannin	**Fluidextract**
Kousso	Anthelmintic; ℥ss (16 Gm.)	Tannin, acrid resin, kosin	
Oil of Rose	Scent	Elæopten, stearopten	
Quillaja	Irritant; gr. iii (0.2 Gm.)	Saponin	**Fluidextract, Tincture**
Red Rose	Tonic	Volatile oil, quercitrin	**Fluidextract, Confection,** Pills of Aloes and Mastic
Cinchona	Tonic, antiperiodic; gr. xv (1 Gm.)	Quinine, quinidine, cinchonine, cinchonidine, etc.	**Fluidextract, Tincture**
Red Cinchona	Tonic, antiperiodic; gr. xv (1 Gm.)	See Cinchona	**Compound Tincture of Cinchona**
Gambir	Astringent; gr. xv (1 Gm.)	Catechu-tannic acid, catechin	**Troches, Compound Tincture**
Ipecac	Expectorant; gr. i (0.065 Gm.) Emetic; gr. xv (1 Gm.)	Emetine, cephaëline, ipecacuanhic acid, pectin	**Fluidextract,** Powder of Ipecac and Opium, Compound Laxative Pills
Bitter Orange Peel	Stimulant, tonic; gr. xv (1 Gm.)	Volatile oil, hesperidin, etc.	**Fluidextract, Tincture,** Compound Tincture of Cinchona, and Compound Tincture of Gentian
Sweet Orange Peel	Stimulant; gr. xv (1 Gm.)	Volatile oil, hesperidin, etc.	**Tincture**
Oil of Orange Peel	Flavoring	$C_{10}H_{16}$	**Compound Spirit**
Lemon Peel	Flavoring	Volatile oil, hesperidin	**Tincture**
Lemon Juice	Refrigerant; f℥i (30 Cc.)	Citric acid, water, etc.	
Oil of Lemon	Flavoring	. . . .	Aromatic Spirit of Ammonia, Compound Spirit of Orange
Buchu	Diuretic; gr. xxx (2 Gm.)	Volatile oil, diosphenol, resin, mucilage, rutin	**Fluidextract**
Pilocarpus	Sialagogue; gr. xxx (2 Gm.)	Volatile oil, pilocarpine, jaborine	**Fluidextract**
Xanthoxylum	Alterative; gr. xxx (2 Gm.)	Acrid green oil, resin	**Fluidextract**
Oil of Santal	Stimulant; ♏viii (0.5 Cc.)	Santalol, $C_{15}H_{26}O$	

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Sapindaceæ				
Guarana	Paullinia Cupana	. . . . . .	Dried paste from crushed seeds	Northern and Western Brazil
Scrophulariaceæ				
Digitalis	D. purpurea	Foxglove	Leaves	Europe
Leptandra	Veronica virginica	Culver's Root	Rhizome and root	North America
Simarubaceæ				
Quassia	Picrasma excelsa, or Quassia amara	Bitter Wood	Wood	Jamaica
Solanaceæ				
Belladonnæ Folia	Atropa B.	. . . . . .	Leaves	Central and Southern Europe
Belladonnæ Radix	Atropa B.	. . . . . .	Root	Central and Southern Europe
Capsicum	C. fastigiatum	Cayenne Pepper	Dried, ripe fruit	Tropical America
Hyoscyamus	H. niger	Henbane	Leaves and flowering tops	Europe and Asia
Scopola	Scopola Carniolica	. . . . . .	Rhizome	Europe and Asia
Stramonium	Datura Stramonium	. . . . . .	Leaves	Asia, nat.
Sterculiaceæ				
Oleum Theobromatis	Theobroma Cacao	Butter of Cacao, Cacao Butter	Fixed oil	South America
Styraceæ				
Benzoinum	Styrax Benzoin and other species	. . . . . .	Balsamic resin	Sumatra
Thymeleaceæ				
Mezereum	Daphne M., and others	. . . . . .	Bark	Europe
Ulmaceæ				
Ulmus	U. fulva	Slippery Elm	Inner bark	North America
Umbelliferæ				
Anisum	Pimpinella A.	. . . . . .	Fruit	Asia, cult.
Asafœtida	Ferula fœtida	. . . . . .	Gum-resin	Persia
Carum	C. Carvi	. . . . . .	Dried fruit	Central and Western Asia, cult.
Conium	C. maculatum	Poison Hemlock	Full grown, but unripe fruit	Europe, nat.
Coriandrum	C. sativum	Coriander Seed	Dried, ripe fruit	Europe, cult.
Fœniculum	F. vulgare	. . . . . .	Dried, nearly ripe fruit	Southern Europe, cult.
Oleum Anisi	Pimpinella Anisum or from Illicium Verum (Fam. Magnoliaceæ)	. . . . . .	Volatile oil	. . . .
Oleum Cari	Carum Carvi	. . . . . .	Volatile oil	. . . .
Oleum Coriandri	Coriandrum sativum	. . . . . .	Volatile oil	. . . .
Oleum Fœniculi	Fœniculum vulgare	. . . . . .	Volatile oil	. . . .
Sumbul	Undetermined	Musk-root	Rhizome and root	Asia

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Guarana	Stimulant; gr. xxx (2 Gm.)	Caffeine, saponin	**Fluidextract**
Digitalis	Cardiac stimulant; gr. i (0.065 Gm.)	Digitalin, resin, pectin	**Fluidextract, Infusion, Tincture**
Leptandra	Alterative; gr. xv (1 Gm.)	Leptandrin, resin, saponin, tannin	**Fluidextract**
Quassia	Tonic; gr. viii (0.5 Gm.)	Mucilage, resin, picrasmin	**Extract, Fluidextract, Tincture**
Belladonna Leaves	Sedative; gr. i (0.065 Gm.)	Atropine, hyoscyamine, belladonnine	**Extract, Tincture**
Belladonna Root	Sedative; gr. i (0.065 Gm.)	Atropine, hyoscyamine, belladonnine	**Fluidextract**
Capsicum	Stimulant; gr. i (0.065 Gm.)	Capsaicin, fixed oil, capsicine	**Fluidextract, Oleoresin, Tincture,** Pills of Podophyllum, Belladonna, and Capsicum
Hyoscyamus	Narcotic; gr. iv (0.25 Gm.)	Hyoscyamine, hyoscine	**Fluidextract, Tincture**
Scopola	Sedative; gr. i (0.065 Gm.)	Atropine, hyoscyamine, scopolamine	**Fluidextract**
Stramonium	Narcotic; gr. i (0.065 Gm.)	Daturine, mucilage	**Fluidextract, Tincture**
Oil of Theobroma	Emollient	Stearin, palmitin, olein	Suppositories
Benzoin	Stimulant; gr. xv (1 Gm.)	Benzoic acid, cinnamic acid	**Tincture, Compound Tincture,** Benzoinated Lard
Mezereum	Sialagogue, stimulant; gr. viii (0.5 Gm.)	Soft acrid resin, daphnin	**Fluidextract,** Compound Fluidextract of Sarsaparilla
Elm	Demulcent	Mucilage	**Mucilage**
Anise	Stimulant; gr. viii (0.5 Gm.)	Volatile oil, fixed oil, sugar	
Asafetida	Nervine; gr. iv (0.25 Gm.)	Volatile oil, gum-resin, ferulic acid	**Emulsion, Pills, Tincture**
Caraway	Stimulant; gr. xv (1 Gm.)	Volatile oil, resin, little tannin	Compound Tincture of Cardamom
Conium	Sedative; gr. iii (0.2 Gm.)	Fixed oil, coniine	**Fluidextract**
Coriander	Stimulant; gr. viii (0.5 Gm.)	Volatile oil, fat, mucilage	
Fennel	Stimulant; gr. xv (1 Gm.)	Volatile and fixed oil, sugar	Compound Infusion of Senna
Oil of Anise	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$, and anethol, $C_{10}H_{12}O$	**Water, Spirit,** Compound Spirit of Orange, Camphorated Tincture of Opium, Troches of Glycyrrhiza and Opium, Compound Syrup of Sarsaparilla
Oil of Caraway	Stimulant; ♏iii (0.2 Cc.)	Carvene, $C_{10}H_{16}$, and carvol, $C_{10}H_{14}O$	Compound Spirit of Juniper
Oil of Coriander	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{18}O$	Syrup of Senna, Compound Spirit of Orange, Confection of Senna
Oil of Fennel	Stimulant; ♏iii (0.2 Cc.)	$C_{10}H_{16}$, and anethol, $C_{10}H_{12}O$	**Water,** Compound Spirit of Juniper, Compound Powder of Glycyrrhiza
Sumbul	Stimulant; gr. xxx (2 Gm.)	Volatile oil, resin, valeric acid	**Fluidextract**

Family and Official Name	Botanical Name	Synonym	Part used, or Description	Habitat
Valerianaceæ				
Valeriana	V. officinalis	. . . . . .	Rhizome and roots	Europe, nat.
Vitaceæ				
Vinum Album	Vitis vinifera	. . . . . .	Fermented juice of grapes	. . . .
Vinum Rubrum	Vitis vinifera	. . . . . .	Fermented juice of grapes, with skins	. . . .
Zingiberaceæ				
Cardamomum	Elettaria repens	. . . . . .	Dried, nearly ripe fruit	Malabar, cult.
Zingiber	Z. officinale	. . . . . .	Dried rhizome	West Indies, India
Zygophyllaceæ				
Guaiacum	G. officinale and G. sanctum	Guaiac Resin	Resin of wood	West Indies and South America

English Name	Medical Properties, Dose	Principal Constituents	Official Preparations in heavy type; those into which the drug enters, in Roman type
Valerian	Nervine; gr. xxx (2 Gm.)	Valeric, formic, and acetic acids	**Fluidextract, Tincture, Ammoniated Tincture**
White Wine	Stimulant	Alcohol, bouquet, etc.	Wines of Antimony, Colchicum Seed, Ergot, Iron, Ipecac and Opium, and Bitter Wine of Iron
Red Wine	Stimulant	Alcohol, bouquet, etc.	Wine of Coca
Cardamom	Stimulant; gr. xv (1 Gm.)	Volatile oil, fixed oil	**Tincture, Compound Tincture,** Aromatic Powder, Tincture of Rhubarb, Compound Tincture of Gentian, Compound Extract of Colocynth
Ginger	Stimulant; gr. xv (1 Gm.)	Volatile oil, gingerol, resin	**Fluidextract, Oleoresin, Tincture,** Compound Powder of Rhubarb, Aromatic Powder
Guaiac	Antirheumatic; gr. xv (1 Gm.)	Guaiaretic acid, guaiaconic acid, guaiacic acid, guaiac yellow	**Tincture, Ammoniated Tincture**

CHAPTER LXI

PRODUCTS FROM ANIMAL SUBSTANCES

THE animal products of pharmaceutical interest are not numerous, but some of them are very important. Their chemical composition is not very well understood.

Proteids or tissue forming substances are universally found in animal and vegetable bodies,—indeed, are essential to all living organisms. In their chemical composition nitrogen is always a constituent, together with carbon, hydrogen, and oxygen, and often small quantities of sulphur, phosphorus, and iron. Very little is definitely known of the exact composition of the proteid compounds. They are usually colloids and uncrystallizable, varying in their solubilities in aqueous liquids. Some of the proteids are soluble in water, but they are nearly all insoluble in alcohol; all are insoluble in ether, chloroform, petroleum benzin, and carbon disulphide. They are decomposed by the mineral acids and strong caustic alkalies. Solutions of proteids are lævorotatory. They are generally coagulated by heat, and on exposure to air, heat, and moisture they decompose, undergoing *putrefaction*. *Ptomaines* or cadaveric alkaloids are intensely poisonous. They are produced when animal substances are subjected to putrefaction or fermentative processes. They have an alkaline reaction, forming salts like the alkaloids, and may be volatile or fixed, fluid or solid, crystalline or amorphous. Some ptomaines are tasteless and odorless, others have an intensely bitter taste and an aromatic odor. The toxic alkaloids from animal excretions have been given the name of *leucomaines;* nitrogenous poisonous substances derived from animal tissues which are not alkaloids are termed *toxalbumins* or *albumoses*.

The animal products of interest in pharmacy are grouped according to the *class* to which they belong, as follows: 1. Mammalia. 2. Pisces. 3. Aves. 4. Insecta. 5. Reptilia. 6. Annelida. There are no official products from the third, fifth, or sixth classes.

Official Products derived from the Class Mammalia

ADEPS. U.S. Lard

The prepared internal fat of the abdomen of the hog (*Sus scrofa*, var. *domesticus* Gray), purified by washing, melting, and straining. It should be kept in well-closed vessels impervious to fat, in a cool place.

Preparation.—The adipose matter adhering to the kidneys, mesentery, and omentum of the hog is the usual source of the best lard. This, after careful removal of the membranes and adhering flesh, should be cut into small pieces, malaxated with successive portions of cold water until this remains clear, and then heated *moderately*, in a tinned iron or copper vessel, over a *slow* fire, until the melted fat becomes perfectly clear and anhydrous. Lastly, it is to be strained into earthen pots, being occasionally stirred as it cools; the pots should be securely covered with waxed or varnished paper, or the lard protected from the air by pouring over it a thin layer of melted paraffin, and kept in a cool, dry cellar.

The purification of lard, by which the "odor of the pig" is separated, is attended with considerable labor. In France this is an industry by itself, large quantities of purified lard being used in making pomades (see page 804). The process usually consists in spreading the lard, which has been heated with a little powdered alum, strained, and cooled, upon an inclined slate or marble slab so arranged that a stream of water can trickle on it. While the water is running, the lard is thoroughly worked with a spatula, stirrer, or muller, so that a fresh surface is continually exposed to the action of the water. This tedious process is continued until the lard is *completely washed and deodorized.*

Official Description.—A soft, white, unctuous solid.

Odor and Taste.—Faint odor free from rancidity; bland taste.

Specific Gravity.—About 0.917 at 25° C. (77° F.), and about 0.904 at 40° C. (104° F.), water at 25° C. (77° F.) taken as the standard.

Solubility.—*Water.* Insoluble.

Alcohol. Very slightly.

Other solvents. Readily in ether, chloroform, carbon disulphide, or petroleum benzin.

Test for Identity.—It melts at 38° to 40° C. (100.4° to 104° F.) to a perfectly clear liquid, which is colorless in thin layers and from which an aqueous layer should not separate.

Impurities and Tests for Impurities.—*Alkalies.* Distilled water boiled with Lard should not acquire an alkaline reaction.

Chlorides. A portion of the water, when filtered, acidulated with nitric acid and treated with silver nitrate T.S., should not yield a white precipitate soluble in ammonia water.

Limit of free fatty acids. If 10 Gm. of Lard be dissolved in chloroform. and the solution mixed with 10 Cc. of alcohol and 1 drop of phenolphthalein T.S., it should not require more than 0.2 Cc. of normal potassium hydroxide V.S. to produce a pink tint after strongly shaking.

More than about 5 percent. of cotton seed fats. If 5 Cc. of melted and filtered Lard be, while warm, intimately mixed by agitation in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol, and adding 2 drops of nitric acid), and the mixture then heated for five minutes in a water-bath, the liquid fat should not acquire a reddish or brown color, nor should any dark color be produced at the line of contact of the hot liquids.

Cotton seed oil or of certain other fats. If 2 Cc. of the melted and filtered Lard be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, no reddish color should develop in from ten to fifteen minutes.

Lard, like most animal fats and oils, consists of stearin, palmitin, and olein, its consistence, when pure, depending largely upon the relative proportion of these principles; olein, being the liquid principle, can readily be separated from the other two by subjecting lard in cold weather to strong pressure, when the *olein* (*lard oil*) is pressed out, the solid residue (*stearin*) being used for various purposes, particularly for the manufacture of candles.

Uses.—Lard is used in pharmacy principally as a base for ointments; it needs protection from rancidity, however. (See Adeps Benzoinatus.) It is used officially in the preparation of benzoinated lard, cantharides cerate, rosin cerate, ointment of mercuric nitrate, iodoform ointment, and tar ointment.

ADEPS BENZOINATUS. U.S. Benzoinated Lard

	Metric	Old form
* **Lard**	1000 Gm.	16 oz. av.
Benzoin, in coarse powder	20 Gm.	140 grains

Add the Benzoin to the Lard and mix thoroughly; then melt the Lard by means of a water-bath, and, stirring frequently, continue the heat for two hours, covering the vessel and not allowing the temperature to rise above 60° C. (140° F.). Lastly, strain the liquid through muslin and stir occasionally while it cools.

When Benzoinated Lard is to be kept or used during warm weather, 5 percent. (or more, if necessary) of the Lard should be replaced by White Wax.

Certain balsamic substances, when digested with lard or fats, have the property of preventing or retarding rancidity; benzoin is most frequently used for this purpose. The temperature at which it is digested should not exceed 60° C. (140° F.), or the agreeable vanilla-like odor of the benzoin will be dissipated. A specially selected benzoin, called vanilla-benzoin, is preferably used, and small amounts of vanillin have sometimes been added to increase the delicacy of the odor. The method of adding tincture of benzoin to cold lard does not produce as good a product, for it is darker in color, less fragrant, and sometimes acts as an irritant when applied in certain skin diseases. Benzoinated Lard is used in the following official ointments: belladonna, chrysarobin, mercurial, iodine, potassium iodide, stramonium, veratrine, and zinc oxide.

OLEUM ADIPIS. U.S. Lard Oil

A fixed oil expressed from lard at a low temperature.

Preparation.—This oil, which consists principally of olein, is made by exposing lard to a low temperature and then pressing it powerfully in an hydraulic press.

As found in commerce, it is almost *invariably adulterated with paraffin oil.* As it is largely employed as a lubricating oil, this admixture is not particularly injurious, but if it is to be used as a vehicle for citrine ointment, as in the U. S. P. 1890, the presence of paraffin oil prevents solidification.

Official Description.—A colorless or pale yellow, oily liquid.

Odor and Taste.—Peculiar odor; bland taste.

Specific Gravity.—0.905 to 0.915 at 25° C. (77° F.).

Solubility.—*Alcohol.* Almost insoluble in cold alcohol and only slightly soluble in boiling alcohol.

Other solvents. Easily soluble in ether, chloroform, benzene, and carbon disulphide.

Tests for Identity.—At a temperature a little below 10° C. (50° F.) it usually commences to deposit a white, granular fat, and at or near 0° C. (32° F.) it forms a solid white mass.

Impurities and Tests for Impurities.—*More than about 5 percent. of cotton seed oil.* If 5 Cc. of the Oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol, and adding 2 drops of nitric acid), and the mixture heated for about five minutes on a water-bath, the Oil should remain nearly or quite colorless, not acquiring a reddish or brown color.

Mineral oils. The Oil should be completely saponifiable with alcoholic potassium hydroxide T.S. and the resulting soap should be completely soluble in water, without separation of an oily layer.

Cotton seed oil or of certain other fats. If 2 Cc. of Lard Oil be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, no reddish color should develop in from ten to fifteen minutes.

Lard Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of 195 to 197 (see U. S. P. Test No. 99, Chap. LXII).

If 0.3 Gm. of Lard Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours protected from the light, 20 Cc. of potassium iodide T.S. be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 56 nor more than 74 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Lard oil is used as an emollient and for softening cerates and ointments.

ADEPS LANÆ. U.S. Wool-Fat

The purified fat of the wool of sheep (*Ovis aries* Linné), freed from water.

Preparation.—This substance, to which the name of *anhydrous lanoline* is applied, is made by a patented process, which consists essentially of purifying the fatty matter obtained from the wool of the sheep (*suint*), by repeated treatment with diluted solution of sodium hydroxide and washing with water, in a centrifugal machine. *Wool-fat* differs from *hydrous wool-fat* in containing no water. It consists mainly of *cholesterin* and *isocholesterin*, $C_{26}H_{43}OH$, but other alcohols are present associated with esters.

Official Description.—A light-yellowish, tenacious, unctuous mass.

Odor, Taste, and Reaction.—Slight, peculiar odor.

Solubility.—*Water.* Insoluble in, but miscible with, large quantities.

Alcohol. Sparingly in cold, more soluble in hot alcohol.

Other solvents. Readily in ether and chloroform.

Tests for Identity.—Wool-Fat melts at about 40°C. (104° F.), and at a higher temperature vaporizes, the vapor igniting and burning with a luminous, sooty flame.

The solution of Wool-Fat in chloroform (1 in 50), when poured upon the surface of concentrated sulphuric acid, gradually develops a deep brownish-red color at the line of contact of the layers.

Impurities and Tests for Impurities.—*Freedom from alkalies.* When Wool-Fat is incinerated it should leave not more than 0.3 percent. of ash, which should not show an alkaline reaction to litmus paper.

Free alkalies. If 2 Gm. of Wool-Fat be dissolved in 10 Cc. of ether, and 2 drops of phenolphthalein T.S. added, a colorless liquid should be obtained.

Free fatty acids. The above liquid, on the addition of 1 drop of normal potassium hydroxide V.S., should develop a deep red color.

Chlorides. If 1 Gm. of Wool-Fat be boiled with 20 Cc. of alcohol, and the solution filtered after cooling, the filtrate should not be rendered turbid by the addition of an alcoholic solution of silver nitrate (1 in 20).

Organic nitrogenous matter. If 10 Gm. of Wool-Fat be heated with 50 Cc. of water on a bath of boiling water until completely fused, the lower aqueous layer, when filtered through a well-wetted filter, should not yield *glycerin* on evaporation, and when boiled with potassium hydroxide T.S. it should not give off vapors of ammonia.

Uses.—Wool-fat is used in the cerate of lead subacetate; hydrous wool-fat is more frequently used.

ADEPS LANÆ HYDROSUS. U.S. Hydrous Wool-Fat

The purified fat of the wool of sheep (*Ovis aries* Linné), mixed with not more than 30 percent. of water.

Preparation.—Hydrous wool-fat is made by incorporating about 30 percent. of water with anhydrous wool-fat.

Official Description.—A yellowish-white, or nearly white, ointment-like mass.

Odor and Reaction.—Slight, peculiar odor. With ether or chloroform it yields turbid solutions which are neutral to moistened litmus paper.

Solubility.—*Water.* Insoluble in water, but miscible with twice its weight of the latter, without losing its ointment-like character.

Tests for Identity.—Hydrous Wool-Fat melts at about 40° C. (104° F.), and separates into an upper oily and a lower aqueous layer. When heated on a water-bath, with stirring until it ceases to lose weight, there should remain not less than 70 percent. of a residue, which is transparent when melted, and when cold remains as a yellowish, tenacious, unctuous mass, completely soluble in ether or chloroform, and only sparingly soluble in alcohol. If Hydrous Wool-Fat be thus deprived of water, it should respond to the tests given under *Adeps Lanæ*.

Uses.—This substance is used largely as a vehicle for ointments, for which it is admirably adapted, on account of the facility with which it is absorbed by the skin. It is used officially in the preparation of mercurial plaster, and in the following ointments: belladonna, ammoniated mercury, yellow mercuric oxide, red mercuric oxide, and stramonium.

SEVUM PRÆPARATUM. U.S. Prepared Suet

[SEVUM, PHARM. 1890]

The internal fat of the abdomen of the sheep (*Ovis aries* Linné), purified by melting and straining.

Prepared Suet should be kept in well-closed vessels impervious to fat. It should not be used after it has become rancid.

Preparation.—Prepared Suet is made by a process similar to that for lard. (See Adeps.)

Official Description.—A white, solid fat.

Odor, Taste, and Reaction.—Nearly inodorous; bland taste when fresh, but becoming rancid on prolonged exposure to the air. An alcoholic solution is neutral or has only a slightly acid reaction upon litmus paper moistened with alcohol.

Solubility.—*Water.* Insoluble.

Alcohol. Insoluble in cold alcohol; soluble in 44 parts of boiling alcohol.

Other solvents. Soluble in about 60 parts of ether, and slowly in 2 parts of petroleum benzin. From its solution in the latter, when kept in a stoppered flask, it slowly separates in a crystalline form on standing.

Test for Identity.—Prepared Suet melts between 45° and 50° C. (113° and 122° F.), and congeals between 37° and 40° C. (98.6° and 104° F.).

Uses.—Prepared suet is firmer than lard, owing to its containing a larger proportion of stearin. It is used in making compound rosin cerate and mercurial ointment.

GELATINUM. U.S. Gelatin

The purified air-dried product of the hydrolysis of certain animal tissues, as skin, ligaments, and bones, by treatment with boiling water.

Preparation.—Gelatin is made by boiling animal substances in water; the strained liquid is evaporated and dried; when not purified it is termed *glue*. If, however, the solution is prepared by boiling selected, fresh animal substances, clarifying, filtering, evaporating, until a jelly is produced, then cutting this into pieces and drying it on nets, it constitutes gelatin. The sheets may be cut into thin pieces to form *shred gelatin*.

Official Description.—An amorphous, more or less transparent solid, usually shredded or in thin sheets; colorless or with a slight yellowish tint. Unalterable in the air when dry, but putrefying rapidly when moist or in solution.

Odor and Taste.—Inodorous, and having a slight, characteristic, almost insipid taste.

Solubility.—*Water.* Insoluble in cold water, but swells and softens when immersed in it, gradually absorbing from 5 to 10 times its weight of water; soluble in boiling water.

Alcohol. Insoluble.

Other solvents. Soluble in acetic acid and glycerin; insoluble in ether, chloroform, benzene, carbon disulphide, and fixed and volatile oils.

Tests for Identity.—When incinerated, Gelatin is decomposed, leaving a slight mineral residue, which should not exceed 2 percent. of the original weight.

Gelatin is insoluble in cold water, but swells and softens when immersed in it, gradually absorbing from 5 to 10 times its weight of water.

When dissolved in boiling water (1 in 50), it should solidify upon cooling, and form a transparent jelly.

An aqueous solution of Gelatin (1 in 5000) is at once rendered turbid on the addition of tannic acid T.S., the precipitate being insoluble in the presence of an excess of the reagent.

Gelatin is precipitated from its aqueous solution by mercuric chloride T.S. in excess; it is not precipitated by a solution of alum, by ferric chloride T.S., or by lead acetate T.S.

If potassium dichromate T.S. be added to a solution of Gelatin in hot water, the jelly which forms on cooling becomes insoluble in warm water after exposure to light.

Uses.—Gelatin is largely used in pharmacy to coat pills and form capsules and as a vehicle for suppositories.

Official Preparation

Gelatinum Glycerinatum Glycerinated Gelatin	Made by macerating 100 Gm. of gelatin, in enough water to cover it, during one hour, pouring off excess of water, draining, and then dissolving the gelatin in 100 Gm. of glycerin with the aid of a gentle heat, and continuing the evaporation until the product weighs 200 Gm. (See page 1244). Used as a vehicle in making suppositories.

PEPSINUM. U.S. Pepsin

A proteolytic ferment or enzyme, obtained from the glandular layer of the fresh stomach of the hog (*Sus scrofa*, var. *domesticus* Gray), and proved to be capable, when assayed by the process given below, of digesting not less than 3000 times its own weight of freshly-coagulated and disintegrated egg albumin.

If it is desired to use a diluent for reducing Pepsin of a higher digestive power to that required by the Pharmacopœia, sugar of milk should be employed for this purpose.

Preparation.—Pepsin is largely made by the following process of Prof. Scheffer. The mucous membrane of hogs' stomachs is macerated in water acidulated with hydrochloric acid for several days, with frequent stirring. The strained liquid, if not clear, is clarified by allowing it to stand for twenty-four hours, and decanting. Sodium chloride is then thoroughly mixed with it. After several hours the floating pepsin is skimmed from the surface and put on a cotton cloth to drain, and finally is submitted to strong pressure to get rid of the saline solution. This pepsin, when air-dried, is very tough, parchment-like or leathery, varying in color from a dim straw-yellow to a brownish-yellow. *Purified pepsin*, or *scale pepsin*, is made by redissolving the pepsin in acidulated water and precipitating as before, immersing the product when perfectly dry in pure water for a short time, after which it is rapidly dried, and is in the form of yellowish scales. It is sometimes prepared in smaller scales and called *granular pepsin*. When in this scaled form pepsin is very soluble, and analysis has shown the presence of as much as 12 to 14 percent. of free hydrochloric acid.

An insoluble pepsin freed from acid is also largely used for dispensing in powders and capsules, as it is not hygroscopic it can be dispensed without becoming moist.

Official Description.—Lustrous white, pale yellow or yellowish, transparent or translucent scales or grains, or a fine white or cream-colored amorphous powder. It should be not more than slightly hygroscopic.

Odor, Taste, and Reaction.—Free from any offensive odor, and having a slightly acid or saline taste. Pepsin usually has a slightly acid reaction; it may be neutral, but should never be alkaline.

Solubility.—*Water.* Soluble, or almost entirely soluble, in about 50 parts of water, the solution having more or less opalescence; more soluble in water acidulated with hydrochloric acid.

Alcohol. Insoluble.

Other solvents. Insoluble in ether or chloroform.

Tests for Identity.—Pepsin, when in solution, is incompatible with alkalies, alkaline earths, or alkali carbonates. The presence of hydrochloric acid of greater strength than 0.5 percent. inhibits and rapidly destroys its proteolytic activity. Its solution is precipitated by the salts of many heavy metals, and by tannic acid or gallic acid. Pepsin and pancreatin in solution are incompatible with one another; if the solution be neutral or alkaline, the pancreatin gradually destroys the Pepsin, and if acid the Pepsin destroys the pancreatin.

On heating a solution of Pepsin in acidulated water to 100° C. (212° F.) it becomes milky, or yields a light flocculent precipitate, and loses all proteolytic power; in a dry state it is not injured if subjected to the above temperature. The activity of Pepsin in solution is destroyed by temperatures exceeding 70° C. (158° F.).

Assay of Pepsin

Pepsin	**0.1 Gm.**
Egg Albumin, boiled and disintegrated	**10.0 Gm.**
Diluted Hydrochloric Acid,	
Distilled Water, each, a sufficient quantity	

Mix 9 Cc. of diluted hydrochloric acid with 291 Cc. of distilled water, and dissolve the Pepsin in 150 Cc. of the acid liquid. Immerse a hen's egg, which should be fresh, during fifteen minutes in boiling water; remove the pellicle and all of the yolk; rub the white, coagulated albumin through a clean No. 40 sieve. Reject the first portion that passes through the sieve, and place 10 Gm. of the succeeding portion in a wide-mouthed bottle of 100 Cc. capacity. Add 20 Cc. of the acid liquid, and with the aid of a glass rod tipped with cork or black rubber tubing, completely disintegrate the albumin; then rinse the rod with 15 Cc. more of the acid liquid and add 5 Cc. of the solution of Pepsin. Cork the bottle securely, invert it three times, and place it in a water-bath that has previously been regulated to maintain a temperature of 52° C. (125.6° F.). Keep it at this temperature for two and one-half hours, agitating every ten minutes by inverting the bottle once. Then remove it from the water-bath, add 50 Cc. of cold distilled water, transfer the mixture to a narrow graduated cylinder, and allow it to stand for half an hour. The deposit of undissolved albumin should not then measure more than 1 Cc.

The relative proteolytic power of Pepsin stronger or weaker than that just described may be determined by ascertaining through repeated trials the quantity of the above Pepsin solution required to digest, under the prescribed conditions, 10 Gm. of boiled and disintegrated egg albumin. Divide 15,000 by this quantity expressed in Cc. to ascertain how many parts of egg albumin one part of the Pepsin will digest.

Uses.—Pepsin is used to aid the digestion of food, and is given in dyspepsia, in doses of three to thirty grains (0.2 to 2 Gm.).

PANCREATINUM. U.S. Pancreatin

A mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog (*Sus scrofa*, var. *domesticus* Gray), or the ox (*Bos taurus* Linné), and consisting principally of amylopsin, myopsin, trypsin, and steapsin, and proved to be capable, when assayed by the process given below, of converting not less than 25 times its own weight of starch into substances soluble in water.

Preparation.—Pancreatin is made by cutting the fresh pancreas into small pieces, kneading thoroughly with water, straining the liquid, and then filtering; an equal volume of alcohol is added to the filtrate and the precipitate is dried and powdered. Pancreatin digests albuminoids and converts starch into glucose. It decomposes fats, converting them into fatty acids and glycerin. Prolonged contact with mineral acids renders it inert.

Official Description.—A cream-colored, amorphous powder.

Odor and Taste.—Faint, peculiar, not unpleasant odor; somewhat meat-like taste.

Solubility.—*Water.* Slowly and containing not more than 10 percent. of substances insoluble in this solvent.

Alcohol. Insoluble.

Tests for Identity.—Pancreatin digests albuminoids and converts starch into sugar, dextrin, or maltose; it exhibits its peculiar activities in neutral, faintly alkaline, and faintly acid media; more than traces of mineral acids or large amounts of alkalies render it inert. Alkali carbonates exert slight inhibitory power upon Pancreatin. The digestive power of Pancreatin is injured by contact with pepsin in solution.

If 0.28 Gm. of Pancreatin and 1.5 Gm. of sodium bicarbonate be added to 100 Cc. of tepid water contained in a flask, and if 400 Cc. of fresh cows' milk, which has been previously heated to 38° C. (100.4° F.), be then added, and the temperature of the mixture maintained at this point for thirty minutes, the milk should be so completely peptonized that, if a small portion of it be transferred to a test-tube, diluted with three times its volume of water, and mixed with some nitric acid, no coagulation should occur.

Assay of Pancreatin

Pancreatin	0.3 Gm.
Starch, dry and in fine powder	7.5 Gm.
Distilled Water,	
Tenth-normal Iodine V.S., each, a sufficient quantity	

Introduce the starch into a flask, add 200 Cc. of distilled water, and boil until a translucent mixture results. Cool the resulting paste to 40.5° C. (105° F.), and add to it the Pancreatin, previously dissolved in about 10 Cc. of distilled water at 40.5 C. (105° F.). Shake the flask well, maintaining the temperature of the mixture at 40.5° C. (105° F.) during five minutes; at the end of this time all of the starch should be converted into substances soluble in water, and a thin liquid be produced. Mix 2 drops of tenth-normal iodine V.S. with 60 Cc. of distilled water, and add to it 4 drops of the warm converted starch solution; no color should result, or, at most, a wine-red color, showing the presence of dextrin and maltose. The appearance of a blue or purple color indicates the presence of *unconverted starch* and that the Pancreatin is below the standard,—*i.e.*, that of converting not less than 25 times its own weight of starch into substances soluble in water.

Uses.—Pancreatin is used to aid digestion. It should not be given in combination with acids; weak alkalies assist its action. The dose is from five to ten grains (0.3 to 0.6 Gm.).

GLANDULÆ SUPRARENALES SICCÆ. U.S. Desiccated Suprarenal Glands

The suprarenal glands of the sheep (*Ovis aries* Linné) or ox (*Bos taurus* Linné), freed from fat, and cleaned, dried, and powdered.

Preparation.—The suprarenal glands, as the name indicates, are attached to the upper portion of the kidneys of most animals. The glands should be thoroughly cleaned before drying and powdering. The active constituent may be extracted by hot water, and the filtered solution may be preserved by the addition of a small quantity of boric acid. *Epinephrine*, $C_9H_{13}O_3N$, was discovered by Dr. John J. Abel; *adrenaline*, separated by Takamine, is said to have the composition $C_{10}H_{15}NO_3$; *suprarenine*, according to Fürth, has the composition $C_9H_{13}NO_3$. All of these principles are alkaloidal, and, if pure, crystalline. They are nearly identical in medical properties.

Official Description.—A light, yellowish-brown, amorphous powder.
Odor.—Slight, characteristic odor.
Solubility.—*Water.* Partially soluble.
Tests for Identity.—One part of Dessicated Suprarenal Glands represents approximately 6 parts of fresh glands, free from fat.

Upon incineration it should not yield more than 7 percent. of ash.

If 0.5 Gm. of Desiccated Suprarenal Glands be macerated with 25 Cc. of water for fifteen minutes, and filtered, the filtrate should give an emerald-green color upon the addition of a few drops of ferric chloride T.S. The green color disappears quite rapidly.

Uses.—Desiccated suprarenal glands in powder is used in Addison's disease, and solutions have been employed as hæmostatics. Solutions of adrenaline, epinephrine, or suprarenine, protected by an antiseptic, are largely used. Dose of the dried glands, four grains (0.25 Gm.).

GLANDULÆ THYROIDEÆ SICCÆ. U.S. Desiccated Thyroid Glands

The thyroid glands of the sheep (*Ovis aries* Linné), freed from fat, and cleaned, dried, and powdered.

Preparation.—Selected thyroid glands of the sheep are minced, dried, treated with petroleum benzin to remove fat, dried again, and powdered. The active principle is *thyroidin.*

Official Description.—A yellowish, amorphous powder, containing the active ingredient of the thyroid tissue.
Odor.—Slight, peculiar odor.
Solubility.—*Water.* Partially soluble.
Tests for Identity.—One part of Desiccated Thyroid Glands represents approximately 5 parts of the fresh glands.

Upon incineration it should yield not more than 6 percent. of ash.

If 1 Gm. of Desiccated Thyroid Glands be mixed with an equal weight of pure sodium hydroxide and carefully fused in a silver dish, and oxidized by adding potassium nitrate while fusing, until a white mass remains, and if the fused mass be dissolved in a small quantity of water, the solution treated with 2 Gm. of sodium nitrite, acidified with concentrated nitric acid, and then shaken with 5 Cc. of chloroform, a decided pink to violet coloration should be imparted to the latter (presence of *iodine compounds*). A cold extract of Desiccated Thyroid Glands treated with 2 Gm. of sodium nitrite and acidified with strong nitric acid should not give the iodine test on shaking with chloroform.

Uses.—Desiccated thyroid glands in powder is used in myxœdema, for which it may be said to be almost a specific; also in the treatment of cretinism. Dose, four grains (0.25 Gm.).

SERUM ANTIDIPHTHERICUM. U.S. Antidiphtheric Serum Diphtheria Antitoxin

A fluid separated from the coagulated blood of a horse (*Equus Caballus* Linné), immunized through the inoculation of diphtheric toxin. It should be kept in sealed glass containers, in a dark place, at temperatures between 4.5° and 15° C. (40° and 59° F.).

Preparation.—Antidiphtheric serum is made by first injecting diphtheric toxin into the blood of a healthy horse and, after recovery from the attack of diphtheria, repeating this several times until it is shown that the animal is immune,—*i.e.*, capable of resisting successfully the effects of diphtheric poison, due to the accumulation in the blood of the animal of the antitoxic principle. The jugular vein of the horse is then opened and a quantity of the blood drawn off; this is allowed to stand until the serous liquid separates from the coagulum. The serum is protected from decomposition by the use of a trace of tricresol or other antiseptic, and then standardized. The antitoxic strength of the serum is tested to determine its relative strength by a physiological assay, and the United States Public Health and Marine Hospital Service has adopted a standard of strength which is recognized by the U. S. P. (8th Rev.). The physiological test is conducted as follows: A number of guinea-pigs of known body weight are simultaneously injected with one hundred times the minimum deadly dose of toxin (the poisonous principle of diphtheria), and at at the same time with varying quantities of the antitoxin serum to be tested. From the result the strength of the antitoxin is determined. The unit strength of antitoxin is the quantity required to save the life of a guinea-pig injected with one hundred times the fatal dose of the toxin, one antitoxic unit exactly neutralizing one hundred toxic units.

Official Description.—A yellowish or yellowish-brown, transparent or slightly turbid liquid.
Odor.—Odorless, or having a slight odor due to the presence of the antiseptic used as a preservative.
Specific Gravity.—1.025 to 1.040 at 25° C. (77° F.).
Tests for Identity.—Antidiphtheric Serum gradually loses its power, the loss in one year varying between 10 percent. and 30 percent. Each container should be furnished with a label or statement, giving the strength of the Antidiphtheric Serum, expressed in antitoxic units, the name and percentage by volume of the antiseptic used for the preservation of the liquid (if such be used), the date when the Antidiphtheric Serum was last tested, and the date beyond which it will not have the strength indicated on the label or statement.
Standard of Strength.—The standard of strength, expressed in units of antitoxic power, should be that approved or established by the United States Public Health and Marine Hospital Service.

Uses.—Antidiphtheric serum is used in diphtheria by hypodermic injection. Dose, 3000 units for the diphtheric patient, and an immunizing dose of 500 units for the protection of well persons who have been subjected to the contagion.

MOSCHUS. U.S. Musk

The dried secretion from the preputial follicles of *Moschus moschiferus* Linné.

Usually in irregular, crumbly, somewhat unctuous grains, dark reddish-brown, having a peculiar, penetrating, and persistent odor and a bitterish taste.

About 10 to 12 percent. of Musk is soluble in alcohol, the solution being light brownish-yellow, and on the addition of water becoming slightly turbid; from 50 to 75 percent. is soluble in water, the solution being deep brown, faintly acid, and strongly odorous; moisture not more than 15 percent., and ash not more than 8 percent.

Musk contains cholesterin, ammonia, an acid principle, wax, fat, albuminous and gelatinous principles, and an odorous matter not yet determined. When ignited with free access of air, musk gives off a peculiar, somewhat urinous odor, and leaves behind not more than 8 percent. of a grayish ash.

Uses.—Musk is antispasmodic and stimulant. It is used in the form of suppositories as a stimulant in the exhaustion of typhoid fever. Dose, four to fifteen grains (0.25 to 1 Gm.).

Official Preparation

Tinctura Moschi Tincture of Musk	Made by macerating 5 Gm. of musk with 45 Cc. of water, during twenty-four hours, adding 45 Cc. of alcohol, macerating for six days, filtering, and adding sufficient diluted alcohol to make 100 Cc. Dose, thirty minims to two fluidrachms (2 to 8 Cc.)

ACIDUM LACTICUM. U.S. Lactic Acid

A liquid organic acid, composed of not less than 75 percent., by weight, of absolute Lactic Acid [$CH_3CHOH.COOH = 89.37$], and about 25 percent. of water.

Preparation.—Lactic acid may be made from sour milk, cheese, meat juice, lactin, and from many vegetable products. Formerly it was obtained from cheese, and owing to its frequent occurrence in the decomposition of animal products it is considered here. It is now most conveniently prepared by treating cane sugar with sulphuric acid, so as to convert it into invert sugar, then adding solution of caustic soda and heating the mixture until it ceases to precipitate Fehling's solution, showing the absence of sugar. Sulphuric acid is added, and the sodium sulphate formed is crystallized out, an addition of alcohol causing the precipitation of the remainder. The alcoholic liquid contains impure lactic acid ; one-half of it is heated and zinc carbonate added until effervescence ceases ; the other half of the alcoholic liquid is now added and the whole allowed to cool. Zinc lactate crystallizes out ; this, by treatment with hydrogen sulphide, yields zinc sulphide, lactic acid remaining in solution.

Official Description.—A colorless, syrupy liquid, absorbing moisture on exposure to damp air.
Odor, Taste, and Reaction.—Odorless ; purely acid taste ; acid reaction.
Specific Gravity.—About 1.206 at 25° C. (77° F.).
Solubility.—*Water.* Freely miscible.

Alcohol. Freely miscible.

Other solvents. Freely miscible in ether ; insoluble in chloroform, petroleum benzin, or carbon disulphide.

Tests for Identity.—Lactic Acid is not vaporized by a heat below 160° C. (320° F.) ; at a higher temperature it emits inflammable vapors, and is finally dissipated ; 5 Gm., after combustion, should not leave more than 0.05 Gm. of fixed residue.

On adding some potassium permanganate to a mixture of equal volumes of Lactic and sulphuric acids, and gently heating, the odor of aldehyde will become perceptible.

Impurities and Tests for Impurities.—*Limit of chloride.* Ten Cc. of a solution of the Acid in distilled water (1 in 100) should not be rendered opalescent by 1 Cc. of silver nitrate T.S.

Sulphate. Ten Cc. of an aqueous solution (1 in 20) should remain unaffected by the addition of 1 Cc. of barium chloride T.S.

Sarcolactic acid. By 1 Cc. of copper sulphate T.S.

Heavy metals. Nor should it respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Sugars. On adding a few drops of Lactic Acid to 10 Cc. of hot alkaline cupric tartrate V.S., no red precipitate should be formed.

Butyric and other fatty acids. On warming Lactic Acid, the odor of rancid fat should not be noticeable.

Glycerin. If a small portion of the Acid be heated on a water-bath with an excess of zinc carbonate, the mixture dried at 100° C. (212° F.), and then extracted with absolute alcohol, upon evaporation of the latter no sweet residue should remain.

More than traces of organic impurities. On carefully pouring Lactic Acid upon an equal volume of colorless, concentrated sulphuric acid contained in a clean test-tube, and keeping the temperature at or below 15° C. (59° F.), no dark-colored zone should develop at the line of contact upon standing for fifteen minutes.

Quantitative Test.—If 5 Gm. of Lactic Acid be diluted with water to measure 50 Cc., then 44.7 Cc. of this solution should require for complete neutralization at boiling temperature not less than 37.5 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 2 percent. of absolute Lactic Acid), phenolphthalein T.S. being used as indicator.

Uses.—Lactic acid is chiefly used to form the lactates, which are believed to be more easily assimilated than most salts. It is rarely prescribed alone, but may be given in doses of one-half to three fluidrachms (2 to 12 Cc.), largely diluted. It is used in preparing syrup of calcium lactophosphate.

SACCHARUM LACTIS. U.S. Sugar of Milk

$C_{12}H_{22}O_{11} + H_2O = 357.48$

A peculiar crystalline sugar obtained from the whey of cows' milk by evaporation, and purified by recrystallization.

Preparation.—Sugar of milk is prepared by the addition of diluted sulphuric acid to the whey of cow's milk, and by subsequent evaporation the albuminous matter is coagulated ; this is filtered out and the liquid set aside to crystallize. Animal charcoal is sometimes used to decolorize the solution.

Official Description.—White, hard, crystalline masses, or a white powder feeling gritty on the tongue; permanent in the air.

Odor, Taste, and Reaction.—Odorless; faintly sweet taste; neutral reaction.

Solubility.—*Water.* In 4.79 parts at 25° C. (77° F.), and in 1 part of boiling water.

Alcohol. Insoluble in absolute alcohol.

Other solvents. Insoluble in ether or chloroform.

Tests for Identity.—Its aqueous solution is dextrogyrate. On incinerating a portion, the percentage of ash remaining should not exceed 0.25 percent.

On adding to 5 Cc. of a hot, saturated aqueous solution of Sugar of Milk an equal volume of sodium hydroxide T.S., and gently warming, the liquid will turn yellow and finally brownish-red. On the further addition of a few drops of cupric sulphate T.S., a brick-red precipitate will appear.

Impurities and Tests for Impurities.—*Cane-sugar.* If 1 Gm. of Sugar of Milk be digested for half an hour with 10 Cc. of diluted alcohol, with occasional shaking, and the liquid filtered, the filtrate should remain clear after admixture with an equal volume of absolute alcohol, and this liquid, if evaporated on a water-bath, should leave not more than 0.03 Gm. of residue (absence of cane sugar).

Heavy metals. An aqueous solution of Sugar of Milk (1 in 20) mixed with a few drops of hydrochloric acid should not respond to the Time-Limit Test for *heavy metals* (see U. S. P. Test No. 121, Chap. LXII).

Starch. If 1 Gm. of powdered Sugar of Milk be boiled for five minutes with 50 Cc. of distilled water and the solution cooled, no blue coloration should be produced upon the addition of one drop of iodine T.S.

Uses.—Sugar of milk is a useful diluent, and is largely used in medicine and pharmacy. The hardness of the crystals is of great assistance in securing thorough admixture of the ingredients in compound powders, by necessitating prolonged trituration.

FEL BOVIS. U.S. Oxgall

The fresh bile of *Bos taurus* Linné.

Oxgall is of complex chemical composition, the most important constituents being the sodium salts of resinous acids, or gall acids, and coloring matters. These acids are as follows: *glycocholic acid*, $C_{26}H_{43}NO_6$, *taurocholic acid*, $C_{26}N_{45}NSO_7$, *hyoglycocholic acid*, $C_{27}H_{43}NO_5$, *hyotaurocholic acid*, $C_{27}H_{45}NSO_6$, and *chenotaurocholic acid*, $C_{29}H_{49}NSO_6$.

Official Description.—A brownish-green or dark green, somewhat viscid liquid.

Odor, Taste, and Reaction.—A peculiar, unpleasant odor, and a disagreeable, bitter taste; neutral, or faintly alkaline reaction.

Specific Gravity.—1.015 to 1.025 at 25° C. (77° F.).

Test for Identity.—A mixture of 2 drops of Oxgall and 10 Cc. of water, when treated, first, with a drop of a freshly prepared solution of 1 part of sugar in 4 parts of water, and afterwards with sulphuric acid, cautiously added, until the precipitate first formed is redissolved, gradually acquires a brownish-red color, changing, successively, to carmine, purple, and violet.

Uses.—It is used in making purified oxgall.

FEL BOVIS PURIFICATUM. U.S. Purified Oxgall

	Metric	Old form
***Oxgall**	300 Cc.	3 fl. oz.
Alcohol	100 Cc.	1 fl. oz.

Evaporate the Oxgall, in a tared porcelain dish, on a water-bath, to about 100 Gm. [old form 1 oz. av.], then add to it the Alcohol, mix the whole thoroughly, and set it aside, well covered, for three or four days. Then decant the clear solution, filter the remainder, and, having mixed the liquids and distilled off the alcohol, evaporate the residue to a pilular consistence.

The addition of alcohol is to separate mucilaginous matter.

Official Description.—A yellowish-green, soft solid.
Odor and Taste.—Peculiar odor, and a partly sweet and partly bitter taste.
Solubility.—*Water.* Very soluble.
Alcohol. Very soluble.
Tests for Identity.—A solution of 1 part of Purified Oxgall in about 100 parts of water behaves toward sugar and sulphuric acid in the same manner as the solution mentioned under *Fel Bovis.*

An aqueous solution of Purified Oxgall should be clear, and should remain transparent upon the addition of an equal volume of alcohol (evidence of proper purification).

Uses.—Oxgall is not used so extensively as it was at one time. It is administered with the intention of supplying a deficiency of bile in the intestines, in certain indications. Its usefulness is questionable. The dose is five to fifteen grains (0.3 to 1 Gm.).

CETACEUM. U.S. Spermaceti

A peculiar, concrete, fatty substance, obtained from the head of the sperm whale, *Physeter macrocephalus* Linné.

Preparation.—Spermaceti is made by the forcible expression of the oleaginous compound found in the head of the sperm whale to separate the olein. The solid fat is termed *cetin.*

Spermaceti is a mixture of various fats. When recrystallized from alcohol, *cetin* is obtained, while the alcohol on evaporation deposits an oil, *cetin elain*, which when saponified yields *cetin elaic acid*, an acid resembling, but distinct from, oleic acid. The cetin which crystallizes out of the alcohol is essentially *cetyl palmitate*, $C_{16}H_{33}(C_{16}H_{31}O_2)$. There are small amounts of fats containing *stearic acid*, $C_{18}H_{36}O_2$, *myristic acid*, $C_{14}H_{28}O$, and *lauro stearic acid*, $C_{12}H_{24}O_2$, with the alcohol radicals corresponding to these acids.

Official Description.—White, somewhat translucent, slightly unctuous masses of a scaly, crystalline fracture and a pearly lustre. It becomes yellowish and rancid on prolonged exposure to air.
Odor, Taste, and Reaction.—Very faint odor; bland, mild taste; neutral reaction in alcoholic solution.
Specific Gravity.—0.935 to 0.944 at 25° C. (77° F.); 0.842 at 100° C. (212° F.).
Solubility.—*Water.* Insoluble.
Alcohol. Nearly insoluble in cold alcohol; soluble in about 50 parts of boiling alcohol.
Other solvents. Soluble in ether, chloroform, carbon disulphide, fixed and volatile oils; only slightly in cold petroleum benzin.
Test for Identity.—Melting point: 42° to 50° C. (107.6° to 122° F.).
Impurity and Test.—*Stearic acid.* If 1 Gm. of Spermaceti be boiled with 1 Gm. of anhydrous sodium carbonate and 50 Cc. of alcohol, and the mixture cooled and filtered, the filtrate, upon being supersaturated with acetic acid, may become turbid, but it should not afford a precipitate.

Uses.—Spermaceti is one of the solid fatty substances employed to give consistency to cerates and ointments. It is used in the well known ointment of rose water.

Official Products of the Class Pisces

OLEUM MORRHUÆ. U.S. Cod Liver Oil

[Oleum Jecoris Aselli]

A fixed oil obtained from the fresh livers of *Gadus morrhua* Linné, and of other species of *Gadus.* It should be kept in a cool place, in well-stoppered bottles, which have been thoroughly dried before filling.

Preparation.—The best method of preparing cod liver oil is to heat the livers in a wooden tank by means of low pressure steam.

The resulting mass is carefully drained,—the livers themselves containing, besides oil, a considerable portion of watery fluid, which passes off with it in the form of emulsion and separates on standing. In the case of the finest varieties, the oil, which is made only in the winter months, is drawn off by taps from the bottom of the cooking tank, and then put into a cooling house to freeze. The solid frozen mass is put into canvas bags, and submitted, while at a low temperature, to severe pressure, whereby the pure oil is expressed. This constitutes the light oil of commerce.

Cod liver oil consists chiefly of olein. Palmitin and stearin are present in small proportions; minute traces of iodine, chlorine, bromine, phosphorus, and sulphur are found, but these are not in sufficient quantity to have any medicinal effect. Recent investigators assert that cod liver oil owes its virtues to the alkaloids *aselline* and *morrhuine* associated with morrhuic, formic, butyric, and phosphoric acids. Preparations are upon the market containing these substances and free from any of the oil or oily constituents. Very valuable results have been claimed for these preparations. An alcoholic extract, *morrhuol*, made by shaking cod liver oil with alcohol and concentrating the product, is reported to have active virtues.

Official Description.—A pale yellow, thin, oily liquid.
Odor and Taste.—Peculiar, slightly fishy, but not rancid odor, and a bland, fishy taste.
Specific Gravity.—0.918 to 0.922 at 25° C. (77° F.).
Solubility.—*Alcohol.* Very slightly soluble.
Other solvents. Readily soluble in ether, chloroform, or carbon disulphide; also in 2.5 parts of acetic ether.
Tests for Identity.—If 1 drop of the Oil be dissolved in 20 drops of chloroform and the solution shaken with 1 drop of sulphuric acid, the solution will acquire a violet-red tint, rapidly changing to rose-red and, finally, brownish-yellow.
If a glass rod moistened with sulphuric acid be drawn through a few drops of the Oil, on a porcelain plate, a violet color will be produced.
If 2 or 3 drops of fuming nitric acid be allowed to flow alongside of 10 or 15 drops of the Oil, contained in a watch-glass, a red color will be produced at the point of contact. On stirring the mixture with a glass rod, this color becomes bright rose-red, soon changing to lemon-yellow (distinction from *seal oil*, which shows at first no change of color, and from *other fish oils*, which become at first blue and afterwards brown and yellow.
Impurity and Test.—*Limit of free fatty acids.* Cod Liver Oil should be only very slightly acid to blue litmus paper which has been previously moistened with alcohol.
Saponification Value.—Cod Liver Oil, saponified by alcoholic potassium hydroxide T.S. should show a saponification value of 175 to 185 (see U. S. P. Test No. 99, Chap. LXII).
Iodine Absorption Value.—If 0.3 Gm. of Cod Liver Oil be dissolved in 10 Cc. of chloroform in a 250 Cc. flask or bottle, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 140 nor more than 150 should be obtained (see U. S. P. Test No. 51, Chap. LXII).

Uses.—Cod liver oil is used as a nutrient and alterative in wasting diseases, notably phthisis. Dose, one to four fluidrachms (4 to 16 Cc.).

Official Preparations

Emulsum Olei Morrhuæ Emulsion of Cod Liver Oil	Made by emulsifying 500 Cc. of cod liver oil with the aid of 125 Gm. of acacia, 100 Cc. of syrup, and enough water to make 1000 Cc.; 4 Cc. of oil of gaultheria having been added as a flavor (see page 303). Dose, two fluidrachms (8 Cc.)
Emulsum Olei Morrhuæ cum Hypophosphitibus Emulsion of Cod Liver Oil with Hypophosphites	Made by emulsifying 500 Cc. of cod liver oil with the aid of 125 Gm. of acacia, 100 Cc. of syrup and enough water, in which 10 Gm. of calcium hypophosphite and 5 Gm. each of potassium and sodium hypophosphite have been dissolved, to make 1000 Cc.; 4 Cc. of oil of gaultheria being added as a flavor (see page 303). Dose, two fluidrachms (8 Cc.)

Official Products of the Class Insecta

CANTHARIS. U.S. Cantharides

[BLISTERING FLIES SPANISH FLIES]

The beetle, *Cantharis vesicatoria* (Linné) De Geer, thoroughly dried at a temperature not exceeding 40° C. (104° F.).

From 18 to 25 Mm. long, about 6 Mm. broad; flattish-cylindrical, with filiform antennæ; black in the upper part, with two long wing-sheaths, and ample membranous, transparent, brownish wings; elsewhere of a shining coppery-green color; odor strong and disagreeable; taste slight, afterwards acrid.

The powder is grayish-brown, with shining green particles, and contains few or no hairs; ash not more than 8 percent.

Cantharides owe their blistering properties to *cantharidin*, $C_{10}H_{12}O_4$. This is a white substance, in the form of crystalline scales, of a shining micaceous appearance, inodorous, tasteless, almost insoluble in water and in cold alcohol, but soluble in ether, chloroform, benzene, formic and glacial acetic acids, the oils, and in hot alcohol, which deposits it upon cooling. It fuses at 210° C. (410° F.), is volatilizable by heat without decomposition, and its vapor condenses in acicular crystals. The subliming point of isolated cantharidin is 100° C. (212° F.), or the temperature of boiling water. Cantharidin is believed to be the anhydride of cantharidic acid. The latter forms definite salts with bases. These may be obtained by heating cantharidin with alkaline solutions. The most satisfactory test of cantharidin is its vesicating property.

Uses.—Cantharides are aphrodisiac and poisonous. When applied externally they produce vesication. Dose, one-half grain (0.03 Gm.).

Official Preparations

Ceratum Cantharidis Cantharides Cerate	320 Gm. of cantharides, 180 Gm. of yellow wax, 180 Gm. of rosin, 170 Gm. of lard, and 150 Gm. of liquid petrolatum. Mix the cantharides with the liquid petrolatum and set it aside for 48 hours, then add it to the wax, rosin, and lard, previously melted and strained through muslin, and keep the mixture in a melted state for an hour, then stir until cold. (See Cerata)
Collodium Cantharidatum Cantharidal Collodion	(See page 319)
Tinctura Cantharidis Tincture of Cantharides	Made by percolating 100 Gm. of powdered cantharides with sufficient alcohol to make 1000 Cc. (see page 347). Dose, three to ten minims (0.2 to 0.6 Cc.)

COCCUS. U.S. Cochineal

The dried female insect, *Pseudococcus cacti* (Linné) Burmeister.

About 5 Mm. long, somewhat oblong and angular in outline, flat and concave beneath, convex above; externally purplish-gray or purplish-black; transversely wrinkled; easily pulverizable, yielding a dark red powder; odor faint; taste slightly bitter.

The coloring matter is soluble in water, alcohol, or ammonia water, slightly soluble in ether, insoluble in fixed and volatile oils; alkalies change the color to purple. Ash not more than 6 percent.

Cochineal owes its red color to *carminic acid*, $C_{17}H_{18}O_{10}$. It contains mucilage, fat, inorganic salts, etc. Its only use in pharmacy is to impart a bright red color to various preparations, like compound tincture of cardamom, elixirs, etc.

CERA FLAVA. U.S. Yellow Wax

A solid substance prepared from the honey-comb of the bee, *Apis mellifera* Linné.

Preparation.—Wax is now known to be a peculiar secretion of bees. Yellow wax is obtained on the large scale by first abstracting the honey from the combs by shaving off the ends of the cells, draining, and then placing them in centrifugals. The honey is rapidly whirled out, water is added, and the wax is thoroughly and quickly cleaned ; it is then melted and strained and run into flat dishes or moulds to cool and harden.

Beeswax is a mixture of three different substances, which may be separated from one another by alcohol,—viz. : 1, *myricin*, insoluble in boiling alcohol, and consisting chiefly of myricyl palmitate, $C_{30}H_{61}(C_{16}H_{31}O_2)$, which is a compound of *palmitic acid*, $C_{16}H_{32}O_2$, and *myricyl alcohol*, $C_{30}H_{62}O$; 2, *cerotic acid*, $C_{27}H_{54}O_2$ (formerly called *cerin* when obtained only in an impure state), which is dissolved by boiling alcohol, but crystallizes out on cooling ; 3, *cerolein*, which remains dissolved in the cold alcoholic liquid. This latter is probably a mixture of fatty acids, as indicated by its acid reaction to litmus paper.

Official Description.—A yellowish to brownish-yellow solid.
Odor and Taste. Agreeable, honey-like odor ; faint balsamic taste.
Specific Gravity.—0.951 to 0.960 at 25° C. (77° F.).
Solubility.—*Water.* Insoluble.

Alcohol. Sparingly in cold alcohol ; boiling alcohol dissolves the cerotic acid and a portion of the myricin.

Other solvents. Completely in ether, chloroform, and in fixed and volatile oils ; partially in cold benzene or carbon disulphide, and completely in these liquids at a temperature of 25° to 30° C. (77° to 86° F.).

Tests for Identity.—Melting point : 62° to 64° C. (143.6° to 147.2° F.).

It is somewhat brittle when cold, and when broken presents a dull, granular, not crystalline fracture. By the heat of the hand it becomes plastic.

Impurities and Tests for Impurities.—*Fats or fatty acids, Japan wax, or rosin.* If 1 Gm. of Yellow Wax be boiled for half an hour with 35 Cc. of an aqueous solution of sodium hydroxide (1 in 7), the volume being preserved by the occasional addition of water, the Wax should separate on cooling without rendering the liquid opaque, and no precipitate should be produced in the liquid, after filtration through glass-wool or asbestos, on the addition of hydrochloric acid.

Soap. Hydrochloric acid should produce no precipitate in water which has been boiled with a portion of the Wax.

Paraffin or ceresin. If 5 Gm. of Yellow Wax be heated in a flask to 160° C. (320° F.), for fifteen minutes, with 25 Cc. of sulphuric acid, and the mixture then poured into a large excess of water, no notable amount of solid substance which cannot be decomposed by sulphuric acid on further treatment, should separate.

Saponification Value.—Yellow Wax saponified by alcoholic potassium hydroxide T.S. should show a saponification value of from 90 to 96 (see U. S. P. Test No. 99, Chap. LXII).

Uses.—Yellow wax is an ingredient in cantharides cerate, rosin cerate, compound rosin cerate, and tar ointment. Its use is chiefly to give consistence to fatty vehicles.

CERA ALBA. U.S. White Wax

Yellow Wax, bleached.

Preparation.—The color of yellow wax is discharged by exposing it with an extended surface to the combined influence of air, light, and moisture. The process of bleaching is often conducted upon a large scale. The wax, previously melted, is made to fall in streams upon a revolving cylinder kept constantly wet, upon which it concretes, forming thin layers. These, having been removed, are spread upon linen cloths stretched on frames, and exposed to the air and light, care being taken to wet and occasionally turn them. In a few days they are partially bleached ; but to deprive the wax completely of color it is necessary to repeat the whole process once, if not oftener. When sufficiently white, it is melted and cast into small circular cakes.

Official Description.—A yellowish-white solid, somewhat translucent in thin layers.
Odor and Taste.—Faint, characteristic odor; nearly tasteless.
Specific Gravity.—0.950 to 0.960 at 25° C. (77° F.).
Tests for Identity.—Melting point: 64° to 65° C. (147.2° to 149° F.).
In other respects White Wax has the characteristics of, and should respond to the reactions and tests given under, *Cera Flava*.

Uses.—Wax is used in pharmacy principally to give consistence to cerates and ointments. It is used officially in cerate, camphor cerate, ointment, and ointment of rose water.

Unofficial Animal Products and Derivatives

Class Mammalia	
Acidum Butyricum, $C_4H_8O_2$ Butyric Acid	A colorless liquid, having a disagreeable odor and a rancid taste. Density, 0.973
Ambra Grisea Ambergris	A morbid excretion from the intestines of *Physeter macrocephalus*, found floating on the sea. It is friable when cold, of a gray or brown-gray color. It contains 85 percent. of ambrein, etc. Used in perfumery
Argonin	Silver-casein. A white powder containing from 4 to 25 percent. of silver. Used as injection in 2 to 5 percent. solutions
Sanguis Blood	The arterial fluid of the ox, *Bos taurus*. It is of a red color, opaque, and has a peculiar odor. It contains 78 percent. of water, 8 percent. of albumen, 5 percent. of fibrin, etc. The red color is due to *hæmoglobin*
Butyrum Butter	From the milk of the cow, *Bos taurus*. Obtained by allowing the cream to separate from the milk, collecting and churning. A soft, yellow, neutral substance, of a pleasant, sweet odor and a bland taste. It contains 30 percent. of olein, and about 68 percent. of palmitin and stearin, etc.
Castoreum Castor	From the preputial follicles of both the male and female animals *Castor Fiber*. The follicles occur in pairs, are pyriform, of a brown or blackish color, a peculiar odor, and a bitter, acrid, and nauseous taste. It contains a volatile oil, and from 15 to 40 percent. of a bitterish, resinous substance, etc.
Civetta Civet	An odorous substance obtained from two animals of the genus *Viverra* which inhabit the East Indies. It is semi-solid, unctuous, yellowish, becoming brown and thicker by exposure to air; of a very strong, peculiar odor, and a bitterish, acrid, and nauseous taste. It contains volatile oil, and resinous and other matters. Used in perfumery
Collargolum Argentum Credé	Colloidal or soluble silver. Dose, one to two grains (0.065 to 0.13 Gm.)
Extractum Carnis Extract of Beef	Prepared by subjecting beef contained in iron cylinders heated by steam to a temperature of 220° F. for several hours, collecting, when cool, the solidified juice, and preserving it in well closed cans
Fibrin	Obtained when blood is allowed to coagulate or is whipped with a bundle of twigs. It is at first, when pure, a gelatinous mass, which changes to a white, tenacious material, consisting of minute fibrils
Hæmoglobin, from the blood of swine, $C_{600}H_{1005}N_{156}S_3FeO_{17}$ From dog's blood, $C_{638}H_{1025}N_{164}S_3FeO_{189}$	Used as a substitute for iron in the treatment of anæmia. Dose, one and one-half grains (0.09 Gm.)
Hæmogallol Hæmoglobin, (deoxidized by pyrogallol)	A combination of iron with the hæmoglobin of blood ; a compound which is easily assimilated. In the form of an insoluble and tasteless red-brown powder. Given in doses of four to eight grains (0.25 to 0.5 Gm.) for anæmia, convalescence, etc.
Hæmol	A blood preparation containing iron

Unofficial Animal Products and Derivatives—*Continued*

Hyraceum	The product of *Hyrax capensis*, an animal of Southern Africa. It is found on the rugged sides of mountains, and is supposed to be the excrement or the dried urine of the animal. It is rather hard, tenacious, of a blackish-brown color, and of a taste and smell similar to those of castor
Kefir	A peculiar fermented milk, having all the virtues of Koumys
Keratin	The organic basis of horny tissues, hair, nails, feathers, epithelium, etc. Used for coating pills so as to enable them to pass through the acid juices of the stomach and be dissolved in the alkaline intestinal fluids
Koumys Kumys Koumiss	Prepare by dissolving 4 ounces of white sugar in 1 gallon of skimmed milk and placing in bottles of the capacity of 1 quart; add 2 ounces of baker's yeast, or a cake of compressed yeast, to each bottle, cork and tie securely, then set in a warm place until fermentation is well under way; then lay the bottles on their sides in a cool cellar. In three days fermentation will have progressed sufficiently to permit the koumys to be in good condition
Lac Milk	From the mammary glands of the cow, *Bos taurus*. It is a white, opaque liquid, having a slight odor and a bland and sweet taste. Sp. gr. 1.030. It contains 85 percent. of water and about 15 percent. of solids
Milk Casein	The most abundant of the albuminoids obtained from milk by the addition of rennet
Neat's-foot Oil	Prepared by boiling the feet of cattle, deprived of their hoofs, with water, removing the oil which rises to the surface, and allowing it to remain for some time in warm water. Used for softening leather
Paraglobulin	Obtained from blood serum, lymph, chyle, etc. It is a granular substance, gradually becoming more compact
Peptones	The product of the action of gastric and pancreatic juices, or of pepsin alone, upon albuminoids during the process of digestion
Ptomaines Cadaveric alkaloids	Alkaloidal substances found in dead bodies or decomposed animal matter, as *choline*, *muscarine*, *neurine*, *gadanine*, *tetanine*, *dimethylamine*, *trimethylamine*, *triethylamine*, *putrescine*, *cadaverine*, *saprine*, *neuridine*, *collidine*, *hydrocollidine*, *parvoline*, and *tyrotoxicon* (*diabenzene*)
Ptyalin	A fermentative substance occurring in saliva, and having the power of converting starch into dextrin
Sodii Choleas Sodium Choleate	Prepared by evaporating fresh oxgall to one-half, and precipitating the slimy and coloring matters with an equal bulk of alcohol, treating the filtrate with animal charcoal, distilling off the alcohol, and washing the residue with ether. It occurs as a white, sticky mass, having a penetrating odor, and a peculiar, sweetish, afterwards bitter taste. (See Fel Bovis Purificatum)
Urea Carbamide, $CO(NH_2)_2$	A hydragogue diuretic. Dose, ten grains (0.6 Gm.) every six hours
Sperm Oil	From the cranial cavities of *Physeter macrocephalus*. It is of a yellow or brown-yellow color. Sp. gr. 0.920. On cooling, it deposits spermaceti and stearin
Whale Oil	From *Balæna mysticetus*. It has a peculiar fishy odor and unpleasant taste
Porpoise Oil	From *Delphinus Phocæna*. Prepared by heating the belly-blubber of the porpoise. It is, when fresh, of a pale yellow color
Seal Oil	From *Phoca* of various species
Dugong Oil	From *Halicore Dugong*. Habitat, waters of Eastern Australia. This oil is generally used as a substitute for cod liver oil in Australia.
Class Pisces	
Eulachon Oil	From *Thaleichthys Pacificus*, a small fish found on the Pacific coast. This oil has been proposed as a substitute for cod liver oil
Gaduol (Morrhuol)	Alcoholic extract of cod liver oil. Brownish-yellow, oily liquid of a bitter, acrid taste. Used like cod liver oil, prepared in wine or elixirs, in doses of five to thirty minims (0.3 to 2 Cc.)
Ichthyocolla Isinglass. U. S. P. 1890	The swimming bladder of *Acipenser Huso* Linné, and of other species of *Acipenser* (order *Sturiones*). Used in making isinglass or court plaster
Menhaden Oil	From *Alosa Menhaden*. Habitat, Atlantic Coast. Used in dressing leather
Shark Oil	From the liver of the shark, *Squalis Carcharias*, and other species. It is of a light yellow color, and has an acrid taste. Sp. gr. 0.870 to 0.880
Skate Oil	From the liver of *Raja Batis*. Employed largely in France and Belgium. It is of a bright yellow color. Sp. gr. 0.928
Lipanin	A mixture of 100 parts of olive oil and 6 parts of oleic acid. Used as a substitute for cod liver oil. Dose, one to four fluidrachms (4 to 16 Cc.)

Unofficial Animal Products and Derivatives—*Continued*

Class Aves	
Albumin Ovi Egg Albumin	It exists in solution, enclosed in a net-work of delicate membranes, in the white of eggs. By beating the white of eggs and spreading it upon glass plates to dry, a dessicated product may be obtained
Ferratin Ferric Acid Albuminate	A reddish-brown, odorless and tasteless powder, insoluble in water, but soluble in slightly alkaline solutions. It contains about 7 percent. of iron, and is given in eight-grain (0.5 Gm.) doses
Ingluvin	From the gizzards of *Gallus Bankiva*. Prepared by a process similar to that employed in preparing pepsin. The dried and powdered gizzards are often used as digestives
Lecithin Distearin-Glycero-Phosphoric-Cholin ester	A phosphated substance, prepared from the yolk of egg, in the form of a yellow, waxy mass, soluble in alcohol and ether. Used as a nerve tonic in doses of one to two grains (0.065 to 0.125 Gm.)
Protargol	A silver compound with albumin containing about 8 percent. of silver. It is a yellow powder, soluble in water, astringent and bactericide like silver nitrate but not caustic. Used in ¼ to 2 percent. solutions for wounds and gonorrhœa
Vitellin	It exists in the yolk of eggs. Closely resembles fibrin
Vitellus Yolk of Egg. U. S. P. 1890	The yolk of the egg of *Gallus Bankiva*, var. *domestica* Temminck (order Gallinæ). Used as an emulsifying agent chiefly
Class Insecta	
Acidum Formicum Formic Acid	Obtained by distilling the ant (*Formica rufa*). It is a colorless liquid, having a pungent odor, and produces a burning sensation when applied to the skin. Its vapor is inflammable. Used for neuralgic and rheumatic pains
Cobweb	The web of *Tegeneria domestica*. It has been recommended in phthisis and chronic intermittents, but is most useful in controlling hemorrhage by simply applying it to the bleeding surfaces
Blatta Cockroach	The insect *Blatta orientalis*, about one inch long, oblong, flat, of a reddish-black color, odor very disagreeable. It contains fetid oil, extractive antihydropin, etc. Used as a diuretic
Red Ant	The insect *Formica rufa*. It contains a volatile oil and formic acid
Class Reptilia	
Crotalus	Prepared from the venom of the rattlesnake (*Crotalus horridus*). While the snake is under chloroform the poison contained in the fang is pressed out and mixed with 9 parts of glycerin. Used in diphtheritic scarlatina
Phynin	From the glandular secretion and dried skin of the toad (*Bufo viridis* and *B. cinereus*). Similar in its effects to digitalin
Class Annelida	
Hirudo Leech	From *Sanguisuga medicinalis* and *S. officinalis*. From three to six inches long, smooth, soft, round, tapering at the ends, composed of about one hundred rings; of a blackish-green color. Used for local depletion

Condensed Chart of Official Animal Substances and Derivatives

Official Name	Part used	English Name	Official Preparation
Acidum Lacticum	. . . .	Lactic Acid	Syrup of Calcium Lactophosphate
Oleicum	. . . .	Oleic Acid	Ammonia Liniment, Oleate of Atropine, Oleate of Cocaine, Oleate of Mercury, Oleate of Quinine, Oleate of Veratrine
Adeps	Prepared internal fat from the abdomen of the hog	Lard	**Benzoinated Lard,** Cantharides Cerate, Rosin Cerate, Ointment of Mercuric Nitrate, Iodoform Ointment, and Tar Ointment
Lanæ	Purified fat of the wool of sheep	Wool-Fat	Cerate of Lead Subacetate
Lanæ Hydrosus	Purified fat of the wool of sheep, containing 30 percent. of water	Hydrous Wool-Fat	Mercurial Plaster, Belladonna Ointment, Ointment of Ammoniated Mercury, Ointment of Yellow Mercuric Oxide, Ointment of Red Mercuric Oxide, Stramonium Ointment
Cantharis	Entire beetle	Cantharides	**Cerate, Cantharidal Collodion, Tincture**
Carbo Animalis	Prepared from bone	Animal Charcoal	**Purified Animal Charcoal**
Cera Alba	Yellow wax, bleached	White Wax	Cerate, Camphor Cerate, Ointment, Ointment of Rose Water
Flava	Prepared concrete substance	Yellow Wax	Cantharides Cerate, Rosin Cerate, Compound Rosin Cerate, and Tar Ointment
Cetaceum	Concrete fatty substance	Spermaceti	Ointment of Rose Water
Fel Bovis	Fresh bile	Oxgall	**Purified Oxgall**
Gelatinum	Hydrolysis of animal tissues	Gelatin	**Glycerinated Gelatin**
Glandulæ Suprarenalis Siccæ	Glands, cleaned, dried, and powdered	Desiccated Suprarenal Glands	
Thyroideæ Siccæ	Glands, cleaned, dried, and powdered	Desiccated Thyroid Glands	
Glycerinum	. . . .	Glycerin	**Glycerin Suppositories,** and in many other preparations (see page 1245)
Mel	Saccharine secretion	Honey	**Clarified Honey**
Moschus	Dried secretion	Musk	**Tincture**
Oleum Adipis	Fixed oil	Lard Oil	
Morrhuæ	Fixed oil	Cod Liver Oil	**Emulsion and Emulsion with Hypophosphites**
Pancreatinum	Enzymes from pancreas	Pancreatin	
Pepsinum	Ferment from fresh stomach of the hog	Pepsin	
Saccharum Lactis	. . . .	Sugar of Milk	Extract of Nux Vomica, Extract of Opium, Extract of Quassia, Pills of Podophyllum, Belladonna, and Capsicum, Powder of Ipecac and Opium, Trituration of Elaterin, and Triturations
Serum Antidiphthericum	Serum from coagulated blood of the horse	Antidiphtheric Serum, Diphtheria Antitoxin	
Sevum Præparatum	Purified internal fat from the abdomen of the sheep	Prepared Suet	Compound Rosin Cerate and Mercurial Ointment

CHAPTER LXII

PHARMACEUTICAL TESTING

A KNOWLEDGE of the methods of using tests with the view of identifying or ascertaining the amount of impurities in articles of the materia medica, is now demanded of the pharmacist. The professional chemist can no longer claim the exclusive right to handle the test tube and the burette, for the principles of analysis, so far as they relate to medicinal chemicals, must be understood by the practical pharmacist. It is not within the scope of this work to enter into the minute details of the application of each test, the many excellent works on analysis which have been issued within the last five years fully supplying all needs in this direction.

The introduction of many new tests into the last Pharmacopœia, however, requiring the use of various reagents and test solutions, necessitates a brief review of the methods employed in analysis, with some definitions of common terms.

Synthesis and **Pharmacy** treat of the creation or preparation of compounds by *building them up* from their constituents. Thus, by heating together iodine and sulphur, the compound, sulphur iodide, is made.

Analysis is the opposite operation. It treats of the decomposition of the compound by *separating* its constituents. If sulphur iodide be boiled with water, the iodine will be volatilized and may be collected, while the sulphur remains with the water, and thus the compound is decomposed and its constituents are separated.

The principles of analysis are based upon the application of one chemical substance, of known properties and composition, to another, which results in some change in the color, form, or state of aggregation of one or both substances, and which is intended to lead to the identification of the substance examined, or to the determination of its quantity.

Analytical methods require the use of *reagents*, *test solutions*, or *volumetric solutions.* These may be defined as substances employed in producing the phenomena above described, or the *reactions* upon which the value of the analysis is based. A list of official reagents and test solutions is given on pages 1026 to 1058.

Two kinds of analysis, depending upon the extent of the examination, are in use: 1. Qualitative. 2. Quantitative.

In *qualitative* analysis, the aim is merely the *identity* or the *quality* of the objects sought for, in the substance examined.

In *quantitative* analysis, not only must the substance sought for be identified, but the *quantity* which is present must also be ascertained. Two methods of quantitative analysis are in use, known as Gravimetric and Volumetric.

In *gravimetric* quantitative analysis, as its name indicates, the quantities of the constituents are isolated and *weighed*, either separately or in combination.

In *volumetric* quantitative analysis, the constituents are determined, either wholly or in part, in *volume* or *measure*, by dissolving a given weight of a pure salt or body in a definite volume of water or other liquid, thus forming a *standard* or *normal solution*, and using an accurately measured quantity of such a solution to produce a given effect upon the substance which is being tested. The advantages of the volumetric method consist in the ease and rapidity with which the operations may be effected, because liquids can be measured more rapidly than they can be weighed.

It is obvious that volumetric analysis can be used only where some distinctly visible phenomenon occurs in the liquid, which enables the operator to determine accurately a point when the reaction is completed.

In volumetric analysis, accurately made solutions of definite strength are employed. In the Pharmacopœia these are termed test solutions and volumetric solutions. In general practice the term *normal solution* is used, but, unfortunately, it is applied to several kinds of volumetric solutions, which may be defined as follows:

1. A normal solution is primarily and legitimately one which contains the *molecular weight* of a *univalent* substance, expressed in grammes, dissolved in a sufficient amount of pure water to make exactly *1000 Cc.* or *one liter*. Thus, the molecular weight of sodium hydroxide is 39.76, and hence normal solution of sodium hydroxide contains 39.76 grammes of sodium hydroxide in 1000 Cc., or 1 liter, of the solution. When the substance is *bivalent*, the normal solution contains *one-half* of the molecular weight, expressed in grammes, in each liter, as in the normal volumetric solution of sulphuric acid. The molecular weight of sulphuric acid is 97.35, and the normal solution is made by dissolving 48.675 grammes of the acid in sufficient distilled water to make 1000 Cc. In the same manner, if the substance is *trivalent*, a normal solution would contain in 1000 Cc. a weight, in grammes, equivalent to *one-third* of its molecular weight; if *quadrivalent*, *one-fourth* its molecular weight; if *sexivalent*, *one-sixth*, etc. For greater accuracy or convenience, solutions either stronger or weaker than *normal solutions* are frequently used; for example, among the official volumetric solutions will be found, besides the *normal solution*, expressed as $\frac{N}{1}$, *double-normal* $\left(\frac{2N}{1}\right)$, *half-normal* $\left(\frac{N}{2}\right)$, *tenth-normal* $\left(\frac{N}{10}\right)$, *fiftieth-normal* $\left(\frac{N}{50}\right)$, and *hundredth-normal* $\left(\frac{N}{100}\right)$; they being equivalent, respectively, to twice, $\frac{1}{2}$, $\frac{1}{10}$, $\frac{1}{50}$, and $\frac{1}{100}$ the strength of the normal solution. Solutions of this kind are employed in determining the strength and purity of many substances.

2. The term normal solution is, unfortunately, applied also to a liquid of which a given volume (100 Cc.) corresponds with, or exactly saturates, a given weight (1 Gm.) of only *one* substance. These test liquids are used for technical purposes, and are of use only when employed for the single object for which they were designed. They are intended to indicate the percentage of the pure substance con-

tained in the product examined. They are often employed by manufacturing chemists.

3. Still another kind of normal solution has its strength based on a *special reaction* which takes place when the solution is used for the purpose for which it was intended, the molecular weight or saturating power having no relation to its strength.[1] Normal solution of potassium permanganate is sometimes made in this way, based on the amount of oxygen that it can transfer to the substance under examination.

Proximate analysis is a term applied to the examination of organic substances with a view of isolating or determining the proximate principles present, as the proximate analysis of cinchona bark in proving the presence or quantity of the quinine, cinchonine, kinic acid, etc.

Ultimate analysis is a term applied to the examination of organic substances to determine their ultimate elements, as in an analysis of quinine to prove the number of atoms of carbon, hydrogen, oxygen, and nitrogen in it.

Proximate and ultimate analyses require individual skill and experience and the application of methods which can be properly mastered only by special study and practical experience under competent instructors. They should never be attempted by the tyro.

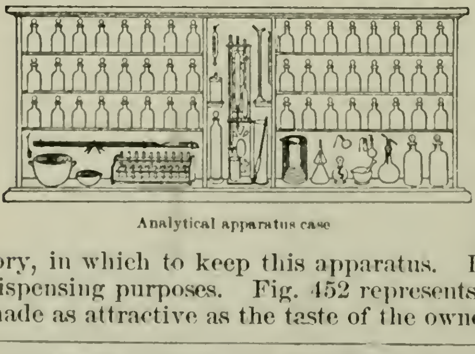
Pharmacopœial testing and volumetric analysis, on the other hand, are directly in the line of the work of the practical pharmacist, and the apparatus required is simple, while the operations to be performed are mostly those which he is called upon to perform daily upon a larger scale.

Practice and experience in analytical work will, if conscientiously followed, prove invaluable in training the pharmacist in those habits of accuracy, neatness, and thoroughness which are absolutely essential to the successful pursuit of his profession.

Apparatus used in Testing

The United States Pharmacopœia very wisely adopted the metric system in all analytical operations requiring definite weights or measures. It is admirably fitted for analytical work, and is used almost universally by chemists throughout the world. Hence the apparatus employed is always based on the metric method.

Fig. 452



Analytical apparatus case

It is well for the pharmacist to set apart a case, especially in the laboratory, in which to keep this apparatus. It should never be used for dispensing purposes. Fig. 452 represents such a case, which may be made as attractive as the taste of the owner dictates.

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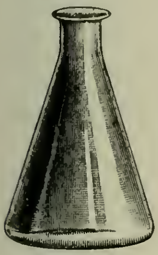
[1] It is greatly to be desired that these last two solutions shall receive some other and appropriate names, so that the term "normal solution" shall have but one signification.

Flasks.—The Erlenmeyer flask, on account of its convenient shape, is almost universally used in assay work (see Fig. 453).

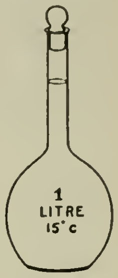
Graduated flasks are needed for making standard and normal solutions. These should be accurately stoppered, and the mark on the neck should extend all the way around, and be in the narrowest part. Liter, half-liter, and quarter-liter flasks are all useful (see Fig. 454).

Fig. 453



Erlenmeyer flask

Fig. 454



Liter flask

Graduated Jars.—A tall, cylindrical, glass stoppered jar, graduated into one hundred or one thousand equal parts, is of great service in making test solutions in smaller quantities (see Fig. 455).

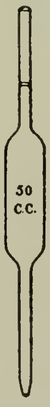
Graduated Pipette.—The pipette has already been described (see page 223). When graduated it is indispensable for analytical work. Fig. 456 shows a graduated pipette, and Fig. 457 the method of using it.

The Burette is indispensable in volumetric testing. It is a graduated glass tube, about one-half inch (12.5 Mm.) in diameter and twenty inches (50.8 Cm.) in length, having its lower end drawn to a narrow orifice, and the other flared to facilitate the pouring in of the test liquid. To the lower extremity is attached a piece of rubber tubing, the other end of the tubing being armed with a short piece of glass tube having a capillary orifice. The graduations on the tube are extended to one hundred parts or more, each part being subdivided into five or ten equal parts (see Fig. 458). The rubber tube is closed with a spring pinchcock, or, as illustrated in Fig. 459, a small piece of glass rod, A, may be inserted in the rubber tube, B, between the burette, C, and the glass tip, D, and the solution made to flow or drop, at the will of the operator, by pinching the rubber surrounding the rod.

Fig. 455

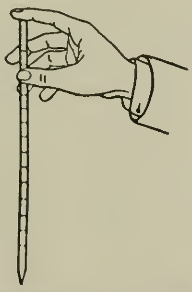
Graduated jar

Fig. 456



Graduated pipette

Fig. 457



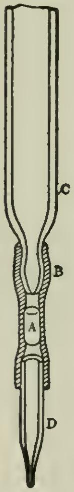
Method of using graduated pipette

Fig. 458

Burette, enlarged view of end

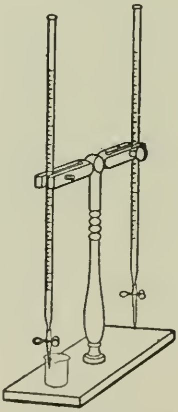
Fig. 460 represents a convenient holder for the burette while in use; the latter may be adjusted to any height to accommodate a large or a small beaker. For volumetric solutions that are decomposed by organic substances, like solution of potassium permanganate, the rubber tube is unsuitable, and *all glass* burettes must be used. These are closed with a small glass stopcock. To facilitate the reading of the divisions on the burette, Erdmann's float is employed (see Fig. 461). This is an elongated glass bulb, of slightly less diameter than the burette, loaded at one end with mercury, and having a little glass hook at the top to facilitate its being lifted out with a bent wire. A line is scratched on the bulb around the middle, and it is floated in the liquid in the burette. The actual height of the liquid is a matter of indifference, because the reading is made by comparing the line on the float with that on the burette. With practice, excellent work may be performed without the use of the float, by adopting the habit of always reading off where the lowest point of the meniscus touches the graduated mark. If the operator is compelled to work in a poor light, the reading of the line may be facilitated by placing a small card, having its lower half blackened, just behind the burette in such a position that the straight line of division between the black and the white portion is very slightly below the surface of the liquid in the burette, or one of the newer devices may be used for assisting the reading,—*i.e.*, a burette having white enamelled sides with dark blue background.

Fig. 459



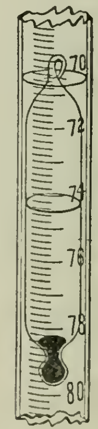
Burette

Fig. 460



Burette holder

Fig. 461



Erdmann's float

Fig. 462

Reagent bottle

The greater part of the apparatus used in such analytical work as the pharmacist is likely to be called upon to perform has been already described in Part I. and elsewhere, and the operations of making solutions, filtration, precipitation, etc., are familiar ones. Glass funnels, beakers, test tubes, stirring rods, porcelain capsules, crucibles, reagent and test solution bottles, etc., will be required.

The amber colored glass reagent bottles made by Whitall Tatum Company, of Philadelphia (see Fig. 462), are well adapted for the purpose of containing the test liquids. The bottles hold about four fluidounces, and the labels are blown in the glass, the surface of the letters being ground off so that they can be read distinctly. Paper labels are not well adapted for test liquids, because they are soon destroyed by the corrosive action of acid or alkaline vapors or the ink marks are bleached out.

TESTS, REAGENTS, TEST SOLUTIONS, AND VOLUMETRIC SOLUTIONS

United States Pharmacopœia, Eighth Decennial Revision

INTRODUCTORY

Official Substances as Reagents.—Some official substances (chemicals, chemical solutions, etc.) are sufficiently pure to be used as reagents, if they comply with the tests of purity prescribed by the Pharmacopœia. Latin official names are not used as titles in the following list, the English name being preferred. In the case of non-official substances, the presence of certain impurities, though immaterial for their use as medicines, renders their employment as reagents unsuitable. Whenever a greater degree of purity is required than is provided for by the text of the Pharmacopœia, it will be specially mentioned in the following lists.

Abbreviations and Signs Used:

T.S. = Test Solution.
V.S. = Volumetric Solution.
$\frac{N}{1}$ = Normal (see under "Volumetric Solutions," page 1041).
$\frac{N}{2}$ = Half-normal; $\frac{N}{10}$ = Tenth-normal; $\frac{N}{50}$ = Fiftieth-normal; $\frac{N}{100}$ = Hundredth-normal.
$\frac{2N}{1}$ = Double-normal (sometimes written: 2N).

Keeping of Reagents.—Reagents should be kept in bottles made of glass free from lead and arsenic, and not subject to corrosion by acids and alkalies.

The bottles should be closed by well-ground glass or rubber stoppers. Ground glass stoppers of bottles containing alkali hydroxides, ammonium sulphide, ammonia water, and other substances of alkaline reaction rapidly attacking ground glass surfaces, should be coated with a thin film of petrolatum.

Reagents easily affected by light, such as hydrogen sulphide T.S., ammonium sulphide T.S., chlorine water, silver nitrate T.S., etc., should be kept in bottles made of dark amber-colored glass.

NOTE.—As some of the following test solutions are in certain cases directed to be used in definite quantities in place of the regular volumetric solutions, it is important that they should always be prepared of the *exact strength prescribed.*

TESTS, REAGENTS, AND TEST SOLUTIONS

NOTE.—The reagents are arranged in alphabetical order. The test solutions are usually mentioned in connection with the principal chemical or other substance from which they are prepared. The volumetric solutions will be found on page 1041.

Whenever *water* is required or mentioned as a solvent in the tests given in the Pharmacopœia, or in the preparation of any reagent, it is understood that *distilled water* shall be used.

1. Absolute Alcohol.—Ethyl Alcohol, C_2H_5OH.—Use the official absolute alcohol [*Alcohol Absolutum,* U. S. P.], which should be neutral to litmus T.S.

2. Acetic Acid, $HC_2H_3O_2$.—Use the official acetic acid [*Acidum Aceticum,* U. S. P.].

3. Albumin Test Solution.—Carefully separate the white of a hen's egg (which should be fresh) from the yolk, shake it thoroughly with 100 Cc. of water, and filter. This solution should be freshly made when required.

4. Alcohol.—Ethyl Alcohol, C_2H_5OH.—Use the official alcohol [*Alcohol*, U. S. P.]. Alcohol of lower strength is prepared as follows:

Alcohol, 90 percent.—Mix 51 Cc. of alcohol [*Alcohol*, U. S. P.] with 3 Cc. of distilled water. The specific gravity of the mixture should be 0.826 at 25° C. (77° F.), corresponding to 90 percent., by volume, of absolute alcohol.

5. Alcohol, 80 percent.—Mix 45.5 Cc. of alcohol [*Alcohol*, U.S.P.] with 9.5 Cc. of distilled water. The specific gravity of the mixture should be 0.856 at 25° C. (77° F.), corresponding to 80 percent., by volume, of absolute alcohol.

6. Alcohol, 70 percent.—Mix 38.6 Cc. of alcohol [*Alcohol*, U. S. P.] with 15 Cc. of distilled water. The specific gravity of the mixture should be 0.882 at 25° C. (77° F.), corresponding to 70 percent., by volume, of absolute alcohol.

7. Ammonia Water, NH_4OH.—Use the official ammonia water [*Aqua Ammoniæ*, U. S. P.].

8. Ammonium Carbonate Test Solution.—Dissolve 20 Gm. of ammonium carbonate, $NH_4HCO_3.NH_4NH_2CO_2$ [*Ammonii Carbonas*, U. S. P.], in a mixture of 20 Cc. of ammonia water and 70 Cc. of water, and add sufficient water to measure 100 Cc.

9. Ammonium Chloride Test Solution.—Dissolve 10 Gm. of ammonium chloride, NH_4Cl [*Ammonii Chloridum*, U.S.P.], in sufficient water to measure 100 Cc.

10. Ammonium Molybdate Test Solution.—Dissolve 15 Gm. of finely powdered ammonium molybdate, $(NH_4)_6Mo_7O_{24} + 4H_2O$, in 100 Cc. of distilled water, adding sufficient ammonia water, if necessary, to effect solution. Then gradually pour the liquid into 100 Cc. of nitric acid (sp. gr. 1.403 at 25° C. [77° F.]). The resulting solution, after being subjected to gentle heat for about two hours, should be decanted from any yellow sediment which may be deposited.

Alternative Method

Solution No. 1.

Molybdic Acid, H_2MoO_4	10 Gm.
Ammonia Water (10 percent.)	42 Cc.

Solution No. 2.

Nitric Acid (sp. gr. 1.403), Water, of each	63 Cc.

Pour solution No. 1 into Solution No. 2 gradually, shaking repeatedly. After being subjected to a gentle heat for about two hours, the solution should be decanted from any yellow sediment which may be deposited.

Preserve the test solution in the dark, and, if a sediment should form in it after some days, carefully decant the clear solution from it.

11. Ammonium Oxalate Test Solution.—Dissolve 4 Gm. of pure crystallized ammonium oxalate, $(NH_4)_2C_2O_4 + H_2O$, in sufficient water to measure 100 Cc. Or, dissolve 4 Gm. of pure oxalic acid (see No. 73) in 100 Cc. of water, add 15 Cc. of ammonia water, boil to expel excess of ammonia, and dilute with water to 113 Cc.

On evaporating a portion of the test solution, and igniting the residue, it should be completely volatilized (absence of *fixed impurities*). The precipitate produced by the addition of silver nitrate T.S., or by barium chloride T.S., should dissolve without residue upon the addition of nitric acid (absence of *chlorides* and *sulphates*).

12. Ammonium Sulphate, $(NH_4)_2SO_4$.—This salt should respond to the following tests of purity: Three grammes should leave no appreciable residue upon ignition (absence of *fixed impurities*). The aqueous solution of the salt (1 in 10) should not respond to the Time-Limit Test for Heavy Metals (see No. 121). Another portion of this solution should not become turbid upon the addition of nitric acid and silver nitrate T.S. (absence of *chlorides*). Another portion of this solution should not be colored red upon the addition of 2 drops of hydrochloric acid and 1 drop of ferric chloride T.S. (absence of *sulphocyanate*). This salt may be prepared by neutralizing pure sulphuric acid, which has been diluted with an equal volume of water, with ammonia water, evaporating and crystallizing. During the evaporation, the solution should be tested from time to time with litmus paper, adding more ammonia if necessary to keep the liquid alkaline.

13. Ammonium Sulphide Test Solution.—Saturate 3 parts of pure ammonia water with hydrogen sulphide, prepared as directed (No. 47), and add to the solution (which now contains ammonium hydrogen sulphide, NH_4HS) 2 parts of ammonia water, which converts the greater portion of the ammonium hydrogen sulphide into ammonium sulphide, $(NH_4)_2S$. The solution should be perfectly clear and colorless, and should leave no residue on evaporation. It should not be rendered turbid either by magnesium sulphate T.S. (absence of *free ammonia*), or by calcium chloride T.S. (absence of *ammonium carbonate*). It should be protected against air and light by being kept in small, dark amber-colored bottles, in a cool, dark place. As soon as a notable deposit of sulphur has made its appearance in the solution, it should be rejected.

Ammonium polysulphide test solution is occasionally required. It is a yellow liquid, made by dissolving a small quantity of pure sulphur in the preceding colorless ammonium sulphide test solution

14. Amyl Alcohol, $C_5H_{11}OH$.—A colorless, oily liquid having a penetrating characteristic odor, boiling at 131° C. (267.8° F.); soluble in 40 parts of water at 25° C. (77° F.); miscible with alcohol, ether, chloroform, carbon disulphide, petroleum benzin, benzene, and fixed and volatile oils.

15. Aniline (Phenylamine), $C_6H_5NH_2$.—When freshly distilled, aniline is a colorless, strongly refractive, oily liquid having a peculiar aromatic odor and a pungent, burning taste. Upon exposure to the light and air, it rapidly assumes a reddish-brown color. Specific gravity 1.0214 at 25° C. (77° F.). Aniline should distil over completely between 183° and 184° C. (361.4° and 363.2° F.). It is soluble in alcohol, ether, and the fixed and volatile oils. With acids, it forms soluble crystalline salts. When added to a solution of calcium or sodium hypochlorite a blue or purple color is produced.

16. Arsenic Test, Bettendorf's.—To a solution of the prescribed quantity of the substance to be tested in 5 Cc. of pure concentrated hydrochloric acid contained in a clean test-tube, 5 Cc. of a saturated solution of freshly prepared stannous chloride in pure concentrated hydrochloric acid (see No. 46) are added, and, after being heated for fifteen minutes while immersed in a bath of boiling water, the tube is allowed to stand for one hour. If arsenic be present in non-permissible amount, a brownish tint will become manifest when the tube is placed over a white surface and the solution viewed from above, comparison being made with a mixture of 5 Cc. each of pure concentrated hydrochloric acid and a saturated solution of stannous chloride, prepared under like conditions.

Note.—It is absolutely necessary that the solution of stannous chloride be freshly prepared, and that sulphates, sulphites, sulphides, and salts of mercury, gold, and selenium be absent from the reagents and the chemicals being tested.

17. Arsenic Test, Modified Gutzeit's.—The efficiency of this test depends upon a strict adherence to the conditions described below.

Reagents

Zinc.—This should be in a granulated or fine mossy condition and free from arsenic, sulphur, and phosphorus, and should not contain more than 0.05 percent. of iron. It should otherwise respond to all the tests given under Zinc [*Zincum*, U. S. P.].

Hydrochloric Acid (8 percent.).—Mix 22.5 Cc. of hydrochloric acid [*Acidum Hydrochloricum*, U. S. P.] with water sufficient to measure 100 Cc.

Mercuric Chloride Test-Paper.—By means of a glass rod, transfer a drop of a saturated alcoholic solution of mercuric chloride to the centre of a piece of white filter-paper (preferably the kind used for quantitative analysis) of about 4 Cm. diameter; after drying, this paper is to be twice successively moistened with the reagent and dried. It is not necessary to moisten the paper with alcohol or the reagent while using it.

Lead Acetate Test-Gauze.—A piece of cheesecloth, about 1 decimeter square, when required for use, is thoroughly impregnated with lead acetate T.S., and the excess of fluid removed by pressure.

Test-Flask

Select a flask of the capacity of about 60 to 75 Cc., with a neck of about 5 to 6 Cm. in length, and about 1 Cm. in diameter.

PREPARATION OF THE CHEMICAL TO BE TESTED

To 5 Cc. of the aqueous solution of the chemical (1 in 10) or to a solution in 5 Cc. of water of the residue remaining after undergoing special treatment, 1 Cc. of a mixture of equal volumes of sulphuric acid and water is added, followed by 10 Cc. of a freshly prepared saturated solution of sulphurous acid. This liquid, contained in a small beaker, is heated upon a bath of boiling water until it is free from excess of sulphurous acid and has been reduced to 5 Cc. in volume.

THE TEST

Before applying this test for the presence of arsenic in chemicals, in order to establish the freedom of the reagents from arsenic, sulphur, and phosphorus, or any interfering contaminations, a preliminary blank test should be made as follows: Into the flask are introduced 2 Gm. of zinc, 20 Cc. of the hydrochloric acid (see above), and 5 Cc. of water, and into the lower end of the neck of the flask is inserted a small wad of clean dry gauze, and then the lead acetate test-gauze, pressed with sufficient firmness to retain its place. About 1 Cm. space should be allowed above the gauze; the lip of the flask, after careful cleansing, is securely covered by folding over it the mercuric chloride test-paper. The reaction is allowed to proceed until the greater portion of the zinc has dissolved, which may require from one-half to two hours, when, if no trace of a yellow to orange-colored deposit is distinguishable upon the inner surface of the test-paper cap, the reagents are proved to be sufficiently pure, and a direct test may be applied at once. If a black stain is produced, sulphur compounds are present in the zinc or reagents, and this indicates unfitness for use. While the blank test is being carried out, another flask should be charged in a like manner with 2 Gm. of zinc and 20 Cc. of the hydrochloric acid (see above), followed by the 5 Cc. of the solution of the chemical (1 in 10) to be tested, which has undergone reduction as directed (under *Preparation of the Chemical to be tested*); the wad of clean dry gauze followed by the lead acetate test-gauze is then introduced, and after cleansing the lip of the flask the mercuric chloride cap is folded over the top. After the evolution of hydrogen has continued for at least one-half hour, and most of the zinc has dissolved, the inner side of the mercuric chloride test-cap is examined to detect the presence of a yellow stain.

The presence of arsenic much in excess of the permissible limit (1 in 100,000) is manifested by the formation of a distinct yellow to orange spot, according to the quantity present. Antimony produces a dark gray to brownish-black coloration. The production of a black stain indicates the presence of sulphur compounds (as sulphurous acid or sulphides), also possibly antimony. If the former be present, a simultaneous blackening of the lead acetate gauze will be observed. If such be the case, the operation, as directed under *Preparation of the Chemical to be tested* must be repeated upon a fresh portion of the sample, using greater precautions for the complete removal of the sulphurous acid.

In testing such phosphorus compounds as hypophosphorous acid and the hypophosphites, special care should be observed to completely oxidize the sample as directed, otherwise a yellow stain, similar to that caused by arsenic, may be produced through the evolution of hydrogen phosphide.

Compounds containing antimony are tested for arsenic by Bettendorf's Test.

18. Barium Carbonate.—Purified barium carbonate, $BaCO_3$, is prepared by dissolving 12 parts of purified, crystallized barium chloride in 30 parts of boiling water, then adding 5 parts of ammonium carbonate, followed by 5 parts of ammonia water; finally washing the precipitate thoroughly and drying.

19. Barium Chloride Test Solution.—Prepared from purified, crystallized barium chloride, $BaCl_2 + 2H_2O$. The aqueous solution of the salt should be perfectly neutral and should not respond to the Time-Limit Test for Heavy Metals (see No. 121). The aqueous solution, after being precipitated by diluted sulphuric acid in slight excess, yields a filtrate which should not leave any permanent residue when evaporated and heated on platinum-foil (absence of *other fixed bases*). Diluted alcohol, after remaining in contact with it for several hours, should, upon ignition, show a pure yellowish-green flame free from red (absence of *traces of strontium*). To prepare the *test solution*, dissolve 10 Gm. of the salt in sufficient water to measure 100 Cc.

20. Barium Hydroxide Test Solution.—A saturated solution of crystallized barium hydroxide, $Ba(OH)_2 + 8H_2O$, in water. This solution rapidly absorbs carbon dioxide from the air. It should be freshly prepared when required for use.

21. Barium Nitrate Test Solution.—Prepared from pure barium nitrate, $Ba(NO_3)_2$. This salt should respond to the same tests as barium chloride (see No. 19). In addition, its aqueous solution, when slightly acidulated with nitric acid, should not be rendered turbid by silver nitrate T.S. (absence of *chloride.*) To prepare the *test solution*, dissolve 10 Gm. of the salt in sufficient water to make 100 Cc.

22. Benzin, or **Petroleum Benzin.**—Use the official purified petroleum benzin [*Benzinum Purificatum*, U. S. P.].

23. Benzene, or **Benzole.**—Benzene, C_6H_6, is a colorless, transparent liquid of a peculiar, aromatic odor, sp. gr. 0.871 at 25° C. (77° F.), congealing at 5.2° C. (41.3° F.), and boiling at 80.4° C. (176.7° F.). It is insoluble in water, but soluble in 4 parts of alcohol, and in ether. When equal volumes of benzene and concentrated sulphuric acid are mixed, the latter should not become colored. On shaking 2 Cc. of benzene with 0.5 Cc. of sulphuric acid and 1 drop of fuming nitric acid, no green or blue tint should be produced (absence of *thiophene*).

24. Brazil-Wood Test Solution.—See under *Indicators* (No. 125).

25. Bromine Test Solution (Bromine Water).—An aqueous solution of bromine, Br [*Bromum*, U. S. P.], prepared by dissolving 1 Cc. of bromine in sufficient water to measure 100 Cc.

26. Calcium Chloride Test Solution.—Dissolve 10 Gm. of crystallized calcium chloride, $CaCl_2 + 6H_2O$, in sufficient water to measure 100 Cc.

27. Calcium Hydroxide Test Solution (Lime Water), $Ca(OH)_2$.—Use the official lime water [*Liquor Calcis*, U. S. P.].

28. Calcium Sulphate Test Solution.—Introduce pulverized transparent crystals of native gypsum (selenite), $CaSO_4 + 2H_2O$, into a bottle nearly filled with water, agitate at intervals for twelve hours, and decant the clear, saturated solution when required. One part of gypsum requires, at 25° C. (77° F.), 378 parts of water for solution.

29. Carbon Disulphide, CS_2.—Use the official carbon disulphide [*Carbonei Disulphidum*, U. S. P.].

30. Chlorine Test Solution (Chlorine Water).—Use the official chlorine water [*Liquor Chlori Compositus*, U. S. P.]. Since it deteriorates by keeping, it should be freshly prepared when required for use.

31. Chloroform, $CHCl_3$.—Use the official chloroform [*Chloroformum*, U. S. P.]. It should be strictly neutral to moistened litmus paper.

32. Cobaltous Nitrate Test Solution.—The crystallized commercial salt, $Co(NO_3)_2 + 6H_2O$, is sufficiently pure, if, after it is dissolved in water, and the cobalt completely precipitated by ammonium sulphide T.S., the filtrate leaves no residue after evaporating and igniting. To prepare the *test solution*, dissolve 1 Gm. of the salt in 10 Cc. of water.

33. Cochineal Test Solution.—See under *Indicators* (No. 126).

34. Copper, Metallic, Cu, in the form of wire, foil, or turnings.

35. Cupric Ammonium Sulphate Test Solution.—A solution of cupritetrammonium sulphate, $CuSO_4 + 4NH_3 + H_2O$. To copper sulphate T.S. add ammonia water, until the precipitate first formed is nearly, but not completely, redissolved; then filter. This solution should be freshly made when required.

36. Cupric Sulphate Test Solution.—Dissolve 10 Gm. of cupric sulphate, $CuSO_4 + 5H_2O$ [*Cupri Sulphas*, U. S. P.], in sufficient water to measure 100 Cc.

37. Cupric Tartrate Test Solution.—See Volumetric Solutions (No. 133).

38. Diphenylamine Test Solution.—Prepared from diphenylamine, $(C_6H_5)_2NH$, which is in the form of grayish-white or colorless crystals, of a peculiar, aromatic odor, melting at 54° C. (129.2° F.), slightly soluble in water, more soluble in acids. It is used either in the dry state, or in solution in diluted sulphuric acid, as a test for nitric acid (in sulphuric acid, water, etc.), or for chlorine (in hydrochloric acid). To test a solution for the presence of nitric acid, a small portion of it is mixed with 1 or 2 drops of diphenylamine T.S., and then concentrated sulphuric acid, free from compounds of nitrogen, is poured in so as to form a layer beneath the solution. The presence of nitric acid is shown by a deep blue color at the zone of contact. A similar reaction is also produced by the presence of hypochlorites, chlorates, chromium trioxide, ferric salts, and similar oxidizing agents. The *test solution* is prepared by dissolving 0.1 Gm. of diphenylamine in 50 Cc. of diluted sulphuric acid. The solution should be colorless.

39. Ether, $(C_2H_5)_2O$.—Use the official ether [*Æther*, U. S. P.]. It should be strictly neutral to moistened litmus paper.

40. Ferric Ammonium Sulphate Test Solution.—Dissolve 10 Gm. of ferric ammonium sulphate, $FeNH_4(SO_4)_2 + 12H_2O$ [*Ferri et Ammonii Sulphas*, U. S. P.] in sufficient water to measure 100 Cc.

41. Ferric Chloride Test Solution.—Dissolve 10 Gm. of ferric chloride [*Ferri Chloridum*, U. S. P.] in sufficient water to measure 100 Cc.

42. Ferrous Sulphate Test Solution.—Dissolve a clear crystal of ferrous sulphate, $FeSO_4 + 7H_2O$ [*Ferri Sulphas*, U. S. P.], in about 10 parts of water which has been previously boiled to expel air. This solution should be freshly prepared immediately before use.

43. Ferrous Sulphide, FeS.—A heavy solid, in the form of black or brownish-black irregular masses, or fused into sticks, soluble in diluted sulphuric or diluted hydrochloric acid, with copious evolution of hydrogen sulphide.

44. Gelatin Test Solution.—Dissolve 1 Gm. of purified gelatin [*Gelatinum*, U. S. P.] in 50 Cc. of water, with the aid of a gentle heat, and filter if necessary. This solution should be freshly made when wanted for use.

45. Gold Chloride Test Solution.—The commercial gold chloride, usually prepared by dissolving gold in nitro-hydrochloric acid and carefully evaporating to dryness, consists chiefly of chlorauric acid, $HAuCl_4 + 4H_2O$, which is converted into neutral auric chloride, $AuCl_3$, by fusing it at a temperature not exceeding 150° C. (302° F.), moistening the residue (now consisting of auric and aurous chloride) with enough hot water to produce a syrupy liquid (whereby the aurous chloride is decomposed into auric chloride and metallic gold), and then pouring off the clear liquid from the precipitate. To prepare the *test solution*, mix the liquid finally obtained in the before-mentioned process with 20 volumes of water. Or, dissolve 1 Gm. of dry auric chloride in 30 Cc. of water.

46. Hydrochloric Acid, Pure, for Tests, HCl.—In addition to the tests prescribed for this acid [*Acidum Hydrochloricum*, U. S. P.], it is required to conform to the following more rigorous tests, before it can be employed as a reagent: The addition of 1 Cc. of barium chloride T. S. to 1 Cc. of the acid diluted with 9 Cc. of water should cause no turbidity within twenty-four hours (absence of *sulphuric acid*). A crystal of diphenylamine dropped into the acid should not turn blue (absence of *free chlorine*).

47. Hydrogen Sulphide, H_2S.—A gas generated by treating ferrous sulphide with diluted sulphuric acid, and washing the gas as directed under the Test Solution (No. 48).

48. Hydrogen Sulphide Test Solution (Hydrosulphuric Acid).—A saturated, aqueous solution of hydrogen sulphide. To prepare about 1000 Cc. of the solution, treat 20 Gm. of ferrous sulphide, in a suitable apparatus, with a mixture of 20 Cc. of sulphuric acid (U. S. P.), and 250 Cc. of water, pass the gas through a drying-tube filled with granulated calcium chloride, then from this through a tube of about 8 millimeters diameter and 40 centimeters in length, which contains about 5 Gm. of coarsely pulverized iodine mixed with spun glass (glass wool), and finally through a wash-bottle which contains a small quantity of potassium iodide T.S. The gas thus purified is conducted nearly to the bottom of a bottle of the capacity of about 1500 Cc., containing 1000 Cc. of cold water. The bottle should be shaken occasionally to facilitate the solution of the gas. When it is no longer absorbed, transfer the solution to small, dark amber-colored bottles, to be filled nearly to the top; pass a stream of hydrogen sulphide for a few minutes through each, and then at once stopper them tightly, and preserve them afterwards in a cool and dark place. Before any of the solution is used, it should be ascertained that it retains a strong odor of hydrogen sulphide, and that, when it is added to an equal volume of ferric chloride T.S., a copious precipitate of sulphur is formed at once.

49. Indicators.—See special list, page 541.

50. Indigo Test Solution.—Dissolve 1 Gm. of commercial indigo-carmine, which is the sodium or potassium salt of indigo-disulphonic acid, $H_2C_{16}H_8N_2O_2(SO_3)_2$, in 150 Cc. of water.

51. Iodine Absorption Value of Fats and Oils.—The iodine value or number of a fat or an oil is a figure which indicates the percentage of iodine absorbed under certain conditions. It is determined as follows: To a solution of 0.3

Gm.[1] of the fat or oil in 10 Cc. of chloroform contained in a glass-stoppered bottle of 250 Cc. capacity, add 25 Cc. of a mixture of equal volume of alcoholic iodine T.S., and alcoholic mercuric chloride T.S., both of which have been measured from a burette. After having been securely stoppered, the bottle is set aside in a cool place, protected from the light, for a period of four[2] hours. After this time, the mixture must still possess a brown color; if it does not, a further measured portion of the mixture of the two reagents should be added, and the mixture be again set aside. Finally, 20 Cc. of potassium iodide T.S. are added, followed by 50 Cc. of water, and tenth-normal sodium thiosulphate V.S. is then added in small successive portions, shaking thoroughly after each addition until the color of the mixture is discharged. The number of Cc. of the sodium thiosulphate V.S. consumed is noted. At the same time that this test is carried out, a blank experiment is made in which exactly the same quantities of chloroform, iodine T.S., and mercuric chloride T.S. are mixed, and after standing for four or more hours, the free iodine is estimated by titration with tenth-normal sodium thiosulphate V.S. as directed above. The number of Cc. of the thiosulphate V.S. consumed is noted, and from this is deducted the number of Cc. of the thiosulphate V.S. which was consumed in the test; the difference multiplied by 12.59, and this product divided by 3, gives the iodine value of the fat or oil.[3]

52. Iodine Test Solution.—For preparing the ordinary test solution (as a reagent for starch, alcohol by iodoform test, etc.), iodine, I, fulfilling the requirements of the Pharmacopœia [*Iodum*, U. S. P.], is sufficiently pure. Dissolve 1 Gm. of iodine and 3 Gm. of potassium iodide in 50 Cc. of water.

For use in volumetric analysis, or in other cases where the ordinary impurities present in official iodine are objectionable, *Purified Iodine* must be employed (see No. 137).

53. Iodine Test Solution, Alcoholic.—Dissolve 25 Gm. of iodine [*Iodum*, U. S. P.] in 500 Cc. of alcohol. This solution is employed in the determination of the iodine absorption value of fats and oils (No. 51).

54. Iron, Metallic, Fe.—Bright and perfectly clean iron in the form of wire, sheet, filings, or electrolytically reduced to powder, according to the uses to be made of it. For making solutions of pure iron salts, fine, thin, bright wire (so-called florist's or piano wire) should be used. For detecting copper, bright pieces of sheet iron or steel knitting-needles are used.

55. Lead Acetate Test Solution.—Dissolve 10 Gm. of clear, transparent crystals of lead acetate, $Pb(C_2H_3O_2)_2 + 3H_2O$ [*Plumbi Acetas*, U. S. P.], free from adhering lead carbonate, in sufficient water to measure 100 Cc. Preserve the solution in well-stoppered bottles.

56. Lead Acetate Test Solution, Basic.—Use the official solution of lead subacetate [*Liquor Plumbi Subacetatis*, U. S. P.].

57. Litmus Paper and **Test Solution.**—See under *Indicators* (No. 129).

58. Magnesia Mixture.—Dissolve 10 Gm. of magnesium sulphate, $MgSO_4 + 7H_2O$ [*Magnesii Sulphas*, U. S. P.], and 20 Gm. of ammonium chloride, NH_4Cl [*Ammonii Chloridum*, U. S. P.], in 80 Cc. of water, add 42 Cc. of ammonia water [*Aqua Ammoniæ*, U. S. P.], set the mixture aside for a few days in a well-stoppered vessel, and filter. If not perfectly clear, the solution should always be filtered before using.

59. Magnesium Sulphate Test Solution.—Dissolve 10 Gm. of magnesium sulphate, $MgSO_4 + 7H_2O$ [*Magnesii Sulphas*, U. S. P.], in sufficient water to measure 100 Cc.

60. Mercuric Chloride Test Solution.—Dissolve 5 Gm. of mercuric chloride, $HgCl_2$ [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in sufficient water to measure 100 Cc.

61. Mercuric Chloride Test Solution, Alcoholic.—Dissolve 30 Gm. of mercuric chloride, $HgCl_2$ [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in 500 Cc. of alcohol. This solution is employed in the determination of the iodine absorption value of fats and oils (No. 51).

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[1] 0.15 to 0.2 Gm. for linseed oil and 0.8 Gm. for oil of theobroma and similar fats.

[2] Sixteen hours are required for accuracy in the case of linseed oil.

[3] When the quantity of the fat or oil used is not 0.3 Gm., then the product is not divided by 3, but by the figure corresponding to the quantity taken; thus, for linseed oil, 0.15 Gm. would be divided by 1.5.

62. Mercuric Nitrate Test Solution, $Hg(NO_3)_2 + 4H_2O$.—Use the official solution of mercuric nitrate [*Liquor Hydrargyri Nitratis*, U. S. P.].

63. Mercuric Potassium Iodide Test Solution (*Mayer's Reagent*).—Dissolve 1.344 Gm. of mercuric chloride, $HgCl_2$ [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in 60 Cc. of water, and 5 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in 10 Cc. of water. Mix the two solutions, and then add sufficient water to make the mixture measure 100 Cc.

64. Mercuric Potassium Iodide Test Solution, Alkaline (*Nessler's Reagent*).—Dissolve 10 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in 10 Cc. of water, and add gradually, in portions, a saturated aqueous solution of mercuric chloride [*Hydrargyri Chloridum Corrosivum*, U. S. P.], with constant agitation, until a slight red precipitate remains undissolved; to this mixture add 30 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U. S. P.] and, when solution has taken place, 1 Cc. more of the saturated aqueous solution of mercuric chloride. Dilute this solution with water until it measures 200 Cc. Allow the precipitate to subside, and draw off the clear fluid.

NOTE.—2 Cc. of this reagent, when added to 50 Cc. of water containing 0.05 milligramme of ammonia, should produce at once a yellowish-brown coloration.

65. Mercurous Nitrate Test Solution.—Into a porcelain evaporating dish introduce 10 Gm. of pure mercury with 5 Cc. of pure nitric acid and 5 Cc. of distilled water, and set it aside for 24 hours in a cool, dark room. Separate and drain the crystals ($2HgNO_3 + H_2O$), and dissolve them in 100 Cc. of water. Preserve the solution in a dark, amber-colored bottle, into which a small quantity of mercury has been introduced.

66. Metals, Time-Limit Test for Heavy.—See No. 121.

67. Modified Gutzeit's Test.—See No. 17.

68. Methyl Alcohol, CH_3OH.—Rectified, purified wood-alcohol, having a specific gravity of about 0.812 at 25° C. (77° F.), and free from pyroligneous odor. Used for the identification of salicylic acid.

69. Methyl Orange Test Solution.—See under *Indicators* (No. 130).

70. Naphthylamine Acetate Test Solution.—Boil 0.1 Gm. of alpha-naphthylamine acetate ($C_{10}H_7NH_2.HC_2H_3O_2$) in 20 Cc. of distilled water, filter through cotton, and mix the filtrate with 180 Cc. of diluted acetic acid (10 per cent. absolute acid). Only freshly distilled water should be employed in preparing this reagent, which must be kept in well-stoppered bottles, protected from the light.

71. Nitric Acid, HNO_3.—Use the official nitric acid [*Acidum Nitricum*, U. S.P.].

72. Nitric Acid, Fuming.—Use the commercial red fuming acid, if it is of the specific gravity 1.437 at 25° C. (77° F.). It should be carefully kept in glass-stoppered bottles, in a cool place.

73. Oxalic Acid, Pure, $H_2C_2O_4 + 2H_2O$.—*Pure Oxalic Acid* is in the form of colorless, transparent, clino-rhombic crystals; 10 Gm. on ignition upon platinum foil should leave no residue. One part of the acid is completely soluble in 12 parts of water at 25° C. (77° F.). For the preparation of test and volumetric solutions, commercial oxalic acid should be purified as follows:

To 1 part of the Acid add 10 parts of cold water, and shake until the latter is saturated. Filter off the solution from the undissolved crystals, evaporate the filtrate to about three-fourths of its volume, and set it aside so that the fixed salts which it contains may crystallize out. Carefully decant the liquid from the crystals, concentrate it by evaporation, and set it aside to crystallize, stirring occasionally to prevent the formation of large crystals which might enclose moisture. Drain the crystals in a funnel, dry them carefully on blotting paper, and preserve them in well-stoppered bottles.

74. Oxalic Acid Test Solution.—Dissolve 10 Gm. of pure oxalic acid, $H_2C_2O_4 + 2H_2O$, in sufficient distilled water to measure 100 Cc.

75. Palladous Chloride Test Solution.—Dissolve 0.5 Gm. of palladous chloride, $PdCl_2$, in sufficient water to measure 10 Cc. Preserve in a glass-stoppered bottle.

76. Phenolphthalein Test Solution.—See under *Indicators* (No. 131).

77. Picric Acid Test Solution.—Dissolve 1 Gm of pure, distinctly crystalline picric acid (trinitro-phenol), $C_6H_2(NO_2)_3OH$, in 100 Cc. of water, cool the solution and filter, if necessary.

78. Platinic Chloride Test Solution.—Dissolve 2.6 Gm. of chloroplatinic acid, $H_2PtCl_6 + 6H_2O$, in 20 Cc. of water. On evaporating a small portion of the solution to dryness and igniting the residue, pure metallic platinum should remain, which should yield nothing soluble in nitric acid.

79. Potassio-Mercuric Iodide Test Solution.—See No. 63.

80. Potassium Bitartrate, $KHC_4H_4O_6$.—The purification of potassium bitartrate [*Potassii Bitartras*, U. S. P.], to render it suitable for standardizing volumetric solutions of potassium and sodium hydroxide, is carried out as follows: To 100 Gm. of the salt contained in a beaker, is added a mixture of 85 Cc. of water and 25 Cc. of diluted hydrochloric acid; the covered beaker is then placed upon a bath of boiling water and the mixture digested, with occasional stirring, for three hours. After quickly cooling, the solution is drained off from the precipitate, which is washed by affusion and decantation with two successive portions of 100 Cc. each of water; after collecting the precipitate upon a plain filter, the washing with cold water is continued until the filtrate, after adding a few drops of nitric acid, ceases to become opalescent upon the addition of silver nitrate T.S. The precipitate of potassium bitartrate is then dissolved in the smallest possible volume of boiling water (about 1500 Cc.), filtered, and the filtrate, while being rapidly cooled, is constantly stirred. When the mixture is cold, the crystalline precipitate is collected upon a plain filter, washed with 300 Cc. of cold water, and, after thoroughly draining, dried at 120° C. (248° F.) until of constant weight. It should be kept in dry, securely stoppered bottles.

Purified potassium bitartrate is employed for standardizing normal and tenth-normal potassium or sodium hydroxide V.S.

81. Potassium Bromate, $KBrO_3$.—White cubical crystals or granular crystalline powder, having a pungent, saline taste. Soluble in 15.5 parts of water at 25° C. (77° F.), and in 2 parts of boiling water; slightly soluble in alcohol. The aqueous solution has a neutral reaction, and upon the addition of diluted sulphuric acid no yellow color should at once be produced. When heated to 350° C. (662° F.), the salt undergoes decomposition with the evolution of oxygen. Potassium Bromate should not be triturated or heated with organic or easily oxidizable substances. The addition of nitric acid or sulphuric acid to the salt causes decomposition with the evolution of bromine. If 0.1 Gm. of Potassium Bromate, dried at 100° C. (212° F.), and 2 Gm. of potassium iodide be dissolved in about 25 Cc. of water contained in a glass-stoppered bottle (of about 100 Cc. capacity), and, after the addition of 5 Cc. of hydrochloric acid, the bottle be securely stoppered and set aside for ten minutes, not less than 36.1 Cc. of tenth-normal sodium thiosulphate V.S. should be required to discharge the color, corresponding to 99.8 per cent. of pure Potassium Bromate.

82. Potassium Carbonate Test Solution.—Dissolve 10 Gm. of anhydrous potassium carbonate, K_2CO_3, prepared by heating potassium carbonate [*Potassii Carbonas*, U. S. P.] to 130° C. (266° F.), in sufficient water to measure 100 Cc.

83. Potassium Chromate Test Solution.—Dissolve 10 Gm. of yellow potassium chromate, K_2CrO_4, in sufficient water to measure 100 Cc. On adding silver nitrate T.S. to a few drops of the solution diluted with a little distilled water, a red precipitate is produced which should be completely soluble in nitric acid (absence of *chloride*). Another portion of the solution, mixed with an equal volume of diluted hydrochloric acid, should yield no precipitate with barium chloride T.S. (absence of *sulphate*). Another portion of the solution should not become turbid upon the addition of ammonia water or ammonium oxalate T.S. (absence of *alkaline earths*). A solution of 0.1 Gm. of the salt in 20 Cc. of water should not become red upon the addition of a few drops of phenolphthalein T.S. (limit of *free alkalies*).

84. Potassium Cyanide Test Solution.—Dissolve 1 Gm. of potassium cyanide, KCN [*Potassii Cyanidum*, U. S. P.], in sufficient water to measure 10 Cc. This solution should be freshly prepared when required.

85. Potassium Dichromate, Pure, $K_2Cr_2O_7$.—In addition to the tests prescribed for this salt in the text of the Pharmacopœia, it is required to conform to more rigorous tests before it can be used in the preparation of the tenth-normal volumetric solution. In a solution of 0.5 Gm. of the salt in 10 Cc. of water rendered acid by 0.5 Cc. of nitric acid, no turbidity should be produced by barium chloride T.S. (absence of *sulphates*).

To 10 Cc. of the aqueous solution of the salt (1 in 20), the addition of 1 Cc. of ammonia water, followed by 1 Cc. of ammonium oxalate T.S., should produce no turbidity (absence of *calcium*).

If to a solution of 0.5 Gm. of the salt in 20 Cc. of water, sufficient sulphurous acid be added to impart a strong odor of the reagent, and the mixture be boiled for about three minutes and cooled, the addition of 1 Cc. of nitric acid and a few drops of silver nitrate V.S. should produce no turbidity (absence of *chlorides*).

Potassium dichromate which fails to meet all of the above requirements may be purified by recrystallization, the hot, saturated aqueous solution of the salt being rapidly cooled with agitation. The granular crystals, after being collected on a plain filter and washed with sufficient *cold* water to remove the mother liquor, are thoroughly drained and then dried at 120° C. (248° F.). This recrystallization should be repeated until the salt responds to all of the above tests for purity.

86. Potassium Dichromate Test Solution.—Dissolve 10 Gm. of pure potassium dichromate (No. 85) in sufficient water to measure 100 Cc.

87. Potassium Ferricyanide Test Solution.—Dissolve 1 part of potassium ferricyanide, $K_3Fe(CN)_6$, in about 10 parts of water. This solution should be freshly made when required, as it undergoes decomposition with formation of ferrocyanide on standing. A freshly prepared aqueous solution, when mixed with some ferric chloride T.S. which has been well diluted with water, should show a brown tint, free from turbidity or a shade of green. Potassium Ferricyanide should respond to the tests for the absence of sulphates and chlorides as described under Potassium Ferrocyanide (No. 88).

88. Potassium Ferrocyanide, $K_4Fe(CN)_6 + 3H_2O$.—In the form of large, soft, transparent, yellow, four-sided, monoclinic tabular crystals, odorless, and having a mild, saline taste. Slightly efflorescent on exposure to dry air.

Soluble in three parts of water at 25° C. (77° F.), and in 2 parts of boiling water; insoluble in alcohol. The aqueous solution is neutral to litmus paper. No effervescence should be caused by the addition of diluted sulphuric acid to a concentrated solution of the salt (absence of *carbonate*).

The aqueous solution (1 in 20), acidulated with hydrochloric acid, should, upon the addition of barium chloride T.S., remain clear (absence of *sulphate*). If a mixture of 0.5 Gm. of the salt with 1.5 Gm. of pure potassium nitrate and 0.5 Gm. of pure anhydrous sodium carbonate be heated to redness in a porcelain crucible, the residue dissolved in water, and the filtered solution supersaturated with nitric acid, no turbidity should be produced upon the addition of silver nitrate T.S. (absence of *chloride*). The precipitate produced in the aqueous solution, acidulated with nitric acid, by silver nitrate T.S. should be of a pure white color, without a tinge of red (absence of *ferricyanide*).

89. Potassium Ferrocyanide Test Solution.—Dissolve 10 Gm. of potassium ferrocyanide, $K_4Fe(CN)_6 + 3H_2O$, in sufficient water to measure 100 Cc.

90. Potassium Hydroxide Test Solution.—Use the official solution of potassium hydroxide, KOH [*Liquor Potassii Hydroxidi*, U. S. P.].

91. Potassium Hydroxide Test Solution, Alcoholic.—Use the half-normal alcoholic potassium hydroxide V.S. (Nos. 99 and 144).

92. Potassium Iodide Test Solution.—Dissolve 20 Gm. of potassium iodide, KI [*Potassii Iodidum*, U. S. P.], in sufficient water to measure 100 Cc., and keep the solution in dark amber-colored, well-stoppered bottles. The solution should be frequently renewed.

93. Potassium Nitrate, KNO_3.—The dry salt [*Potassii Nitras*, U. S. P.], responding to the tests of purity required by the Pharmacopœia. It should also be free from chlorides and sulphates.

94. Potassium Permanganate Test Solution, $KMnO_4$.—Use No. 145.

95. Potassium Sulphate Test Solution.—Dissolve 1 Gm. of potassium sulphate, K_2SO_4, in sufficient water to measure 100 Cc.

96. Potassium Sulphocyanate, KSCN.—Colorless, prismatic crystals, of cooling, saline taste, and hygroscopic in moist air. Readily soluble in less than its own weight of water; soluble in 10 parts of absolute alcohol.

The aqueous solution of the salt (1 in 20) should not become turbid within five minutes upon the addition of barium chloride T.S. (limit of *sulphate*).

The aqueous solution (1 in 20), after the addition of 1 Cc. of diluted hydrochloric acid, should remain colorless (absence of *iron*), and should not respond to the Time-Limit Test for Heavy Metals (No. 121).

97. Potassium Sulphocyanate Test Solution.—Use the tenth-normal volumetric solution (No. 146).

98. Resins, etc., Acid Number for.—Dissolve 1 Gm. of the resinous substance in alcohol, add a few drops of phenolphthalein T.S., and titrate with normal potassium hydroxide V.S.; the amount of potassium hydroxide consumed (expressed in milligrammes) is termed the Acid Number. The reaction is often more distinct if an excess of normal potassium hydroxide V.S. be used and the solution titrated back with normal acid V.S.

99. Saponification Value of Fats and Oils.—The determination of the saponification value is conducted as follows: Weigh out accurately, in a flask holding 150 to 200 Cc., 1.5 to 2 Gm. of the purified and filtered fat. Next run into the flask, with a burette, 25 Cc. of alcoholic potassium hydroxide T.S. (see No. 144). While exactly 25 Cc. is not indispensable, in comparative tests precisely the same amount must be used, allowing the burette to drain in exactly the same way in each test. Then place a small funnel in the flask and heat it on a water-bath containing boiling water, for half an hour, so that the alcohol is simmering, frequently imparting a rotatory motion to the contents of the flask. Then add 1 Cc. of phenolphthalein T.S., and titrate back the excess of potassium hydroxide with half-normal hydrochloric acid V.S. A blank test is made at the same time, using the alcoholic potassium hydroxide T.S. alone; the difference in the number of cubic centimeters of half-normal hydrochloric acid V.S. consumed by the blank test and the real test, multiplied by 27.87, and divided by the weight in grammes of the fat or oil, will give the saponification equivalent of the sample tested.

100. Silver Ammonium Nitrate Test Solution.—Dissolve 1 Gm. of silver nitrate, $AgNO_3$ [*Argenti Nitras*, U. S. P.], in 20 Cc. of water, and add ammonia water, drop by drop, until the precipitate first produced is almost, but not entirely, redissolved. Filter the solution, and preserve it in dark amber-colored and well-stoppered bottles.

101. Silver Nitrate Test Solution, $AgNO_3$.—For ordinary purposes, use the tenth-normal volumetric solution (see No. 147).

102. Silver Sulphate Test Solution.—Dissolve 1 Gm. of silver nitrate [*Argenti Nitras*, U. S. P.] in 0.5 Cc. of warm water, and add 1.5 Cc. of pure, concentrated sulphuric acid. On cooling, small transparent crystals of silver sulphate, Ag_2SO_4, separate. Carefully pour off the acid liquid, wash the crystals repeatedly, by decantation, with cold water, transfer them to a bottle, add 100 Cc. of water, and agitate so as to produce a saturated solution. For use, decant a sufficient quantity of the latter.

103. Sodium Acetate Test Solution.—Dissolve 10 Gm. of sodium acetate, $NaC_2H_3O_2 + 3H_2O$ [*Sodii Acetas*, U. S. P.], in sufficient water to measure 100 Cc.

104. Sodium Bitartrate Test Solution, $NaHC_4H_4O_6 + H_2O$.—To a solution of 3.5 Gm. of tartaric acid [*Acidum Tartaricum*, U. S. P.] in about 80 Cc. of boiling water, add gradually, in small portions, monohydrated sodium carbonate [*Sodii Carbonas Monohydratus*, U. S. P.] until the solution has a neutral reaction; to this liquid is now added 3.5 Gm. of tartaric acid, and after filtering and cooling, sufficient water is added to the solution to measure 100 Cc. This solution should be freshly prepared when required.

105. Sodium Carbonate.—The monohydrated salt, $Na_2CO_3 + H_2O$, conforming to the tests prescribed by the Pharmacopœia [*Sodii Carbonas Monohydratus*], but absolutely free from chloride and sulphate.

106. Sodium Carbonate Test Solution.—Dissolve 10 Gm. of monohydrated sodium carbonate, $Na_2CO_3 + H_2O$ [*Sodii Carbonas Monohydratus*, U. S. P.], in sufficient water to measure 100 Cc.

107. Sodium Cobaltic Nitrite Test Solution, $Co_2(NO_2)_6.6NaNO_2 + H_2O$.—Dissolve 4 Gm. of cobaltous nitrate, $Co(NO_3)_2 + 6H_2O$, and 10 Gm. of sodium nitrite, $NaNO_2$, in about 50 Cc. of water, add 2 Cc. of acetic acid [*Acidum Aceticum*, U. S. P.], and dilute with sufficient water to measure 100 Cc. A few drops of acetic acid should be added to the solution from time to time. The reagent should not be kept longer than three months.

108. Sodium Hydroxide Test Solution, NaOH.—Use the official solution of sodium hydroxide [*Liquor Sodii Hydroxidi*, U. S. P.].

109. Sodium Nitrite, $NaNO_2$.—The purest commercial salt, either granulated or in the form of sticks is sufficiently pure.

110. Sodium Nitroprusside Test Solution.—Dissolve 1 part of sodium nitroprusside, $Na_2Fe(NO)(CN)_5 + 2H_2O$, in 19 parts of water immediately before using.

111. Sodium Phosphate Test Solution.—Dissolve 10 Gm. of sodium phosphate, $Na_2HPO_4 + 12H_2O$ [*Sodii Phosphas*, U. S. P.], in sufficient water to measure 100 Cc.

112. Sodium Tartrate Test Solution, $Na_2C_4H_4O_6 + 2H_2O$.—To a solution of 6.5 Gm. of tartaric acid [*Acidum Tartaricum*, U. S. P.] in about 80 Cc. of boiling water, add gradually, in small portions, monohydrated sodium carbonate [*Sodii Carbonas Monohydratus*, U. S. P.] until the solution has a neutral reaction; after filtering and cooling, add sufficient water to measure 100 Cc. This solution should be freshly prepared when required.

113. Sodium Thiosulphate, $Na_2S_2O_3 + 5H_2O$.—In addition to the tests prescribed for this salt in the text of the Pharmacopœia [*Sodii Thiosulphas*], it is required to conform to the following more rigorous tests before it can be used in preparing the standard volumetric solution. If to a solution of the salt (1 in 20) in distilled water, iodine T.S. be added, drop by drop, until it retains a faint but permanent brown color, no turbidity should be produced upon the addition of barium chloride T.S. (absence of *sulphates* and *sulphites*). The addition of 1 drop of phenolphthalein T.S. to the aqueous solution of the salt (1 in 10) should produce not more than a very faint rose-tint (absence of *free alkalies*). The aqueous solution of the salt (1 in 20) should not become cloudy upon the addition of ammonium oxalate T.S. (absence of *calcium salts*).

114. Sodium Thiosulphate Test Solution.—Use the tenth-normal volumetric solution (No. 151).

115. Stannous Chloride Test Solution.—Heat pure tin (see No. 122), in the form of foil or granules, with concentrated hydrochloric acid, taking care that the metal be in excess. When the acid is saturated, crystals of stannous chloride, $SnCl_2 + 2H_2O$, begin to form. Remove and drain these, dissolve them in 10 parts of water, and preserve the solution in well-stoppered bottles, into each of which a fragment of pure tin, or a piece of pure tin-foil, has previously been introduced.

For Bettendorf's test (see No. 16), pure concentrated hydrochloric acid (which responds to the U. S. P. tests of purity) is saturated with the *freshly prepared* crystals.

116. Starch Test Solution.—Triturate 1 Gm. of starch [*Amylum*, U. S. P.] with 10 Cc. of cold water, and then add sufficient boiling water, with constant stirring, to make about 200 Cc. of a thin, translucent fluid. This solution should be freshly prepared and filtered when required for use.

117. Sulphanilic Acid Test Solution.—Dissolve 0.5 Gm. of sulphanilic acid, $C_6H_4(NH_2).(SO_3H)$ (para-amidobenzenesulphonic acid), in 150 Cc. of diluted acetic acid (10 percent. absolute acetic acid). Only freshly distilled water should be employed in preparing the diluted acetic acid.

This reagent should be kept in well-stoppered bottles.

118. Sulphuric Acid, Pure, for Tests, H_2SO_4.—The sulphuric acid of the Pharmacopœia, which has a specific gravity of 1.826 at 25° C. (77° F.), will answer as a reagent for most purposes, provided it is of the required degree of purity. But when "concentrated" sulphuric acid is specially directed in a test, it is intended that the strongest obtainable pure acid, of a specific gravity of not less than 1.834 at 25° C. (77° F.), be employed.

In addition to the tests prescribed for this acid in the text of the Pharmacopœia, it is required to conform to the following more rigorous tests before it can be employed as a reagent. If 1 Cc. of diphenylamine T.S. (see No. 38) be carefully poured, as a separate layer, upon 5 Cc. of sulphuric acid, contained in a test-tube, no distinct blue color should appear in the zone of contact (absence of *nitric acid*).

119. Tannic Acid Test Solution.—Dissolve 1 Gm. of tannic acid, $HC_{14}H_9O_9$ [*Acidum Tannicum*, U. S. P.], in 1 Cc. of alcohol, and add sufficient water to measure 10 Cc.

120. Tartaric Acid Test Solution.—Dissolve 1 part of tartaric acid, $H_2C_4H_4O_6$ [*Acidum Tartaricum*, U. S. P.], in 3 parts of water. Since fungous growths rapidly destroy the solution of tartaric acid, it should be prepared only as wanted.

121. Time-Limit Test for Heavy Metals.—This test is to be used to detect the presence of undesirable metallic impurities in official chemical substances or their solutions; these should not respond affirmatively within the stated time.

Ten Cc. of a solution of the substance in distilled water (1 in 20),* contained in a test-tube of about 40 Cc. capacity, is acidulated with 1 Cc. of diluted hydrochloric acid (unless otherwise directed), warmed to about 50° C. (122° F.), and an equal volume of freshly prepared hydrogen sulphide T.S. added, and the mixture allowed to stand, in the well-stoppered test-tube, in a warm place, at 35° C. (95° F.) for at least half an hour. At the end of this time any coloration or turbidity is carefully noted, ammonia water is added in excess, and the solution again examined for a coloration or turbidity. Before the addition of the ammonia water, the mixture should still possess the odor of hydrogen sulphide; if not, it should be thoroughly saturated with the gas and again set aside for half an hour.

Any change in the color of the solution which is being tested should be noted by comparison with the same volume of the hydrogen sulphide T.S. (which has been likewise acidulated), when viewed crosswise by reflected light while held against a white surface.

Antimony yields, upon the addition of hydrogen sulphide T.S. to highly diluted solutions, a pale yellow to orange color, or, to more concentrated solutions, an orange precipitate, which is soluble in test solutions of potassium hydroxide and ammonium sulphide, as well as in strong hydrochloric acid. The precipitate is insoluble in test solution of ammonium carbonate. The addition of ammonia water to the highly diluted hydrogen sulphide solution of antimony slightly intensifies the coloration.

Arsenic yields, upon the addition of hydrogen sulphide T.S. to highly diluted solutions, a pale yellow color, or, to more concentrated solutions, a yellow precipitate, which is soluble in test solutions of potassium hydroxide, ammonium sulphide, and ammonium carbonate, but is reprecipitated upon the addition of hydrochloric acid, insoluble in excess. The addition of ammonia water to the highly diluted hydrogen sulphide solution of arsenic slightly intensifies the yellow color.

Cadmium in very dilute solutions gives, with hydrogen sulphide T.S. or ammonium sulphide T.S., a pale yellow color; it yields in more concentrated solutions (not excessively acid) a yellow precipitate, which is insoluble in cold diluted hydrochloric acid, potassium hydroxide T.S., or ammonium sulphide T.S. (distinction from *arsenic*), and in solution of potassium cyanide. This precipitate is soluble in nitric and hydrochloric acids and in hot diluted hydrochloric and sulphuric acids.

Copper yields, upon the addition of hydrogen sulphide T.S. to highly diluted solutions, a pale brown color, or, to more concentrated solutions, a brownish-black precipitate, which is insoluble in diluted hydrochloric acid and test solution of potassium hydroxide, and is but very slightly soluble in test solution of ammonium sulphide. The precipitate is soluble in warm diluted nitric acid and also in solution of potassium or sodium cyanide. The addition of ammonia water to the highly diluted hydrogen sulphide solution containing copper slightly intensifies the coloration.

Iron.—Acidified solutions of ferrous iron do not react with hydrogen sulphide T.S., but yield a dark coloration or black precipitate with ammonium sulphide T.S., or upon the addition of ammonia water to the hydrogen sulphide mixture. This latter precipitate is soluble in cold diluted hydrochloric acid.

Acidified solutions of ferric iron yield a white turbidity or precipitate of sulphur upon the addition of hydrogen sulphide T.S., but a dark coloration or black precipitate with ammonium sulphide T.S., or upon the addition of ammonia water to the hydrogen sulphide mixture. This precipitate is readily soluble in acetic and inorganic acids.

Lead yields, upon the addition of hydrogen sulphide T.S. or ammonium sulphide T.S. to highly diluted solutions, a pale brown coloration, or, to more con-

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*The dilution (1 in 20) has been extended, except as stated below, by the Committee of Revision to a total dilution of 1 in 100; for iron the total dilution is extended to 1 in 300. Exception: For chemical substances to be tested for antimony, and arsenic, the dilution has not been extended, but remains at 1 to 20.

centrated solutions, a black precipitate, which is insoluble in diluted hydrochloric acid, and also in test solutions of potassium hydroxide and ammonium sulphide.

Zinc yields, with ammonium sulphide T.S., and with hydrogen sulphide T.S., either in neutral solution, or after acidulation with acetic acid (in the absence of free mineral acids), a white turbidity in highly diluted solutions, but with concentrated solutions a white precipitate soluble in hydrochloric acid and insoluble in acetic acid.

122. Tin.—Pure metallic tin, Sn, in the granulated or mossy condition. Its solution in hydrochloric acid should give no precipitate with potassium sulphate T.S. (absence of *lead*), and, when tested by the Modified Gutzeit's Test (No. 17), replacing the zinc by tin, the diluted hydrochloric acid by hydrochloric acid U. S. P., and adding 1 drop of platinic chloride T.S., the mercuric chloride cap should not become colored within the time required for the solution of the metal (absence of *arsenic*).

123. Turmeric Paper and Tincture.—See under *Indicators* (No. 132).

124. Zinc.—Pure metallic zinc, Zn [*Zincum*, U. S. P.]. See also Modified Gutzeit's Test (No. 17).

INDICATORS FOR ACIDIMETRY, ALKALIMETRY, Etc.

Note.—Each test solution used as *indicator* should be examined as soon as prepared, and afterwards from time to time, as to its neutrality. If necessary, it should be brought, by the cautious addition of highly diluted sulphuric acid, or of a very dilute solution of an alkali, to such a point that, when a few drops of it are added to 25 Cc. of water, a few drops of a hundredth-normal acid or alkali V.S., respectively, will distinctly develop the appropriate tints.

Since many of the colored test solutions are injured by exposure to light, it is best to preserve them in dark amber-colored vials. Papers prepared with them should be kept in dark bottles or paper boxes.

125. Brazil-Wood Test Solution.—Boil 50 Gm. of finely cut Brazil-wood [the heart-wood of *Peltophorum dubium* (Sprengel) Britton, Fam. *Leguminosæ*] with 100 Cc. of water during half an hour, replacing the water from time to time. Allow the mixture to cool, strain, wash the contents of the strainer with water until 100 Cc. of strained liquid are obtained, add 25 Cc. of alcohol, and filter. Care should be taken to exclude ammoniacal vapors while filtering. This solution is turned purplish-red by alkalies, and yellow by acids.

126. Cochineal Test Solution.—Macerate 1 Gm. of unbroken cochineal [*Coccus*, U. S. P.], during four days, with 20 Cc. of alcohol and 60 Cc. of water. Then filter. The color of this test solution is turned *violet* by alkalies, and *yellowish-red* by acids. Cochineal T.S. is useful in titrating alkaloids, inorganic acids, ammonia, the alkalies, and alkaline earths. The presence of salts of iron, alumina, or copper should be avoided. This indicator is useless for titrating organic acids.

127. Hematoxylin Test Solution.—Dissolve 0.2 Gm. of hematoxylin [a crystalline substance derived from *Hæmatoxylon*, U. S. P.] in 100 Cc. of alcohol. Use about 5 drops for each titration. This indicator assumes a *yellow* to *orange* color in acid solutions, and a *violet* to *purple* color in alkaline solutions. The titration is complete when the change in color remains permanent upon the addition of one drop of the volumetric solution after stirring the liquid.

128. Iodeosin Test Solution.—Dissolve 0.1 Gm. of iodeosin, $C_{20}H_8I_4O_5$ (*tetraiodofluorescein*), in 100 Cc. of alcohol. This indicator becomes *colorless* in acid solutions, changing to *pink* in alkaline solutions. Dilute the solution to be titrated in a 200 Cc. flask with distilled water to about 100 Cc., add 20 Cc. of ether and 5 drops of the iodeosin T.S., cork, and shake well. Then add the volumetric alkali solution gradually, shaking well after each addition. The titration is complete when the lower aqueous solution retains a faint *pink* color after shaking thoroughly. For assaying alkaloidal residues, dissolve the latter in a measured excess of volumetric acid solution, and transfer the acid solution to a 200 Cc. flask, washing the container well with water until the contents of the flask measure about 100 Cc. Then proceed as above.

129. Litmus Paper and Test Solution.—Exhaust powdered litmus with three separate and successive portions (representing about 4 times its weight) of boiling alcohol (which removes the undesirable color erythrolitmin), each extraction lasting for about one hour. After draining off the alcohol, digest the residue with about an equal weight of cold water and filter. (This blue solution, which contains some alkali, after being acidulated, may be used to make red litmus paper.) Finally, extract the residue with about 5 times its weight of boiling water, and, after thoroughly cooling, filter. The addition of 1 drop of tenth-normal acid or alkali V.S. to 50 Cc. of water containing 5 drops of the indicator should produce a distinct change in color. Preserve the filtrate, as *test solution*, in wide-mouthed bottles stoppered with loose plugs of cotton so as to exclude dust but admit air. The blue color of litmus test solution is changed by acids to *red*, and this red color by the addition of alkalies is restored to *blue*.

Litmus Paper, Blue.—Impregnate with the test solution just described strips of white, unsized paper, free from wood-pulp, but not too porous, and dry them by suspending them on lines of clean twine, in an atmosphere free from acid or ammoniacal vapors.

Litmus Paper, Red.—Prepare this with the same kind of paper and in the same manner as described in the preceding paragraph. Add to the test solution used to impregnate the paper just sufficient of a highly diluted solution of hydrochloric acid to impart to it a faint red tint.

Neither blue nor red litmus paper should have a very intense color.

Preserve the test-paper in bottles, so as to exclude dust and acid or ammoniacal vapors.

130. Methyl-Orange Test Solution.—Dissolve 1 Gm. of methyl-orange, $NaC_{14}H_{14}N_3SO_3$ (the sodium or ammonium salt of dimethylamidoazobenzene sulphonic acid; also known as helianthin, tropæolin D, or Poirrier's Orange 3 P), in 1000 Cc. of water. Add to it, carefully, with constant stirring, tenth-normal sulphuric acid V.S., in drops, until the liquid turns red and just ceases to be transparent. Then filter.

To distinguish methyl-orange from other orange colors of this class, which are unfit for use as indicators, it should respond to the following tests:

Methyl-orange should be completely soluble in distilled water, and the test solution should be of an orange-yellow color, free from a brownish tint. No precipitate should form in this solution upon the addition of an alkali.

The addition of hydrochloric acid to a hot, concentrated solution of methyl-orange should produce a crystalline precipitate, composed of lustrous plates having a violet reflection and free from brown tint.

The addition of calcium chloride or barium chloride T.S. should produce no precipitate.

A few drops of gold chloride T.S. should produce a red coloration, free from either a violet or green tint.

Excessive quantities of this indicator should be avoided in titrating; from 1 to 3 drops are sufficient for a volume of from 50 to 100 Cc., or just enough is added to impart a faint tint to the solution, which if neutral should change to a red or yellow respectively upon the addition of 2 drops of a tenth-normal acid or alkali V.S.

Methyl-orange is suitable for titrating inorganic acids, alkalies, alkali carbonates or bicarbonates, also certain alkaloids, as morphine and quinine. It is not to be employed in titrating organic acids, nor in alcoholic or boiling solutions.

This indicator gives a *yellow* color with alkalies and *red* with acids.

131. Phenolphthalein Test Solution.—Dissolve 1 Gm. of phenolphthalein ($C_{20}H_{14}O_4$) in 50 Cc. of alcohol and dilute to 100 Cc. with water. About 3 drops are sufficient for 50 Cc. of the solution to be titrated; it gives a *red* color with alkali hydroxides or carbonates, while acids render the solution *colorless*. Phenolphthalein may be employed in hot titrations. It is not suitable as an indicator for ammonia, but is largely used for organic acids, alkali hydroxides, and for carbonates and bicarbonates in boiling solutions.

Phenolphthalein Paper is prepared by impregnating white, unsized paper with the test solution and drying it.

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

132. Turmeric Tincture.—Digest any convenient quantity of ground turmeric root (from *Curcuma longa* Linné, Fam. *Zingiberaceæ*) repeatedly with small quantities of water and discard the liquids. Then digest the dried residue for several days with six times its weight of alcohol, and filter.

Turmeric Paper.—Impregnate white, unsized paper with the tincture, and dry it. The tincture, as well as the paper, turns *brown* with alkalies, and the original *yellow* color is restored by acids, with the exception of boric acid, which, even in the presence of hydrochloric acid, turns the color to reddish-brown, and this is changed to bluish-black by ammonia.

VOLUMETRIC SOLUTIONS

Note.—It is absolutely necessary that the measuring vessels employed in the operations of volumetric analysis, consisting of burettes, flasks, mixing cylinders, pipettes, etc., should agree among themselves accurately in their graduation at the standard temperature selected. It is immaterial what standard temperature has been selected for the graduation of the vessels.

All volumetric solutions must be prepared at the standard temperature of 25° C. (77° F.), and the solutions must be used in the titrations at a temperature not below 21° C. (69.8° F.), nor above 29° C. (84.2° F.).

All bottles in which volumetric solutions are to be kept, as well as the burettes or pipettes in which they are to be measured, should, prior to use, be thoroughly rinsed with distilled water, then with two or three small portions of the solution that they are to contain. When not in use, burettes should be kept filled with distilled water.

Normal volumetric solutions $\left(\frac{N}{1}\right)$ are those which contain in one liter, in any stated reaction, the chemical equivalent of one gramme of hydrogen. If the molecule of the reagent is univalent, one liter will contain the weight in grammes equal to the molecular weight of the reagent; if bivalent, a weight in grammes equal to one-half its molecular weight; if trivalent, a weight in grammes equal to one-third its molecular weight.

Thus, hydrochloric acid, $HCl = 36.18$, having but one H atom replaceable by a basic element, has 36.18 Gm. of absolute HCl in 1000 Cc. of the normal volumetric solution; while sulphuric acid, $H_2SO_4 = 97.35$, having two replaceable H atoms, contains only one-half this number, or 48.675 grammes of absolute H_2SO_4 in 1000 Cc. of its normal solution. Potassium hydroxide, $KOH = 55.74$, has but one K to replace one H in acids, hence its normal solution contains 55.74 grammes of pure KOH in one liter. Again, one molecule of potassium dichromate in oxidation liberates *three* atoms of oxygen which are capable of oxidizing *six* atoms of ferrous to ferric iron. Therefore, each molecule of the dichromate, yielding *three* atoms of oxygen, is equivalent to *six* atoms of hydrogen. Hence, the normal solution should contain $\frac{292.28}{6}$ or 48.713 Gm. in 1000 Cc. Two molecules of potassium permanganate, $2KMnO_4 = 313.96$, in oxidation, give off five atoms of O, which are equivalent to ten atoms of H; hence its normal solution should contain $\frac{313.96}{10}$ or 31.396 Gm. in 1000 Cc.

Solutions containing in 1000 Cc. one-tenth of the quantity of the active reagent in the normal solution are called tenth-normal $\left(\frac{N}{10}\right)$; those containing one-hundredth, hundredth-normal, $\left(\frac{N}{100}\right)$; one-fiftieth, fiftieth-normal $\left(\frac{N}{50}\right)$; those containing twice the amount, double-normal $\left(\frac{2N}{1}\right)$; half the amount, half-normal $\left(\frac{N}{2}\right)$.

Solutions containing quantities of the active reagent having *no* simple relation to the molecular weight are called empirical.

Use of Empirical Solutions.—All standard volumetric solutions deteriorate in time, some very slowly, others rapidly, especially when not properly preserved. To restore the titer of such solutions (that is, to make them exactly normal, tenth-, or hundredth-normal, as the case may be) each time they are to be used, involves an unnecessary waste of time. If one accurately standardized solution be always available, it is not necessary that the other volumetric solutions employed in conjunction with it be diluted to exactly correspond, Cc. for Cc., so long as the *exact* ratio is known.

The percentage strength of any empirical solution as compared with a standard volumetric solution is ascertained by experiment, then the number of Cc. of the empirical solution consumed in the titration of the substance is multiplied by its percentage strength, which result represents the equivalent volume of the true standard solution.

Example.—One gramme of a sample of potassium carbonate required for neutralization 22 Cc. of an empirical solution of hydrochloric acid. In a trial experiment, 16 Cc. of this weak solution were required to neutralize 10 Cc. of a standard normal potassium hydroxide V.S. The former is therefore of 62.5 percent. strength (for 16 : 10 :: 100 : x. $x = 62.5$), hence the 22 Cc. of empirical solution consumed represent 13.75 Cc. (62.5 percent. of 22) of standard normal hydrochloric acid V.S. Then if 1 Cc. of $\frac{N}{1}$ hydrochloric acid V.S. = 0.068635 Gm. of potassium carbonate, 13.75 Cc. would be equivalent to 13.75 × 0.068635, or 0.9436 + Gm. of carbonate.

133. Alkaline Cupric Tartrate Volumetric Solution

[Fehling's Solution]

A. The Copper Solution.—Dissolve 34.67 (34.6663) Gm. of carefully selected, small crystals of pure cupric sulphate [*Cupri Sulphas,* U. S. P.], showing no trace of efflorescence or of adhering moisture, in a sufficient quantity of water to make the solution measure, at 25° C. (77° F.), exactly 500 Cc.

Keep this solution in small, well-stoppered bottles.

B. The Alkaline Tartrate Solution.—Dissolve 173 Gm. of crystallized potassium and sodium tartrate [*Potassii et Sodii Tartras,* U. S. P.], and 75 Gm. of potassium hydroxide [*Potassii Hydroxidum,* U. S. P.], in a sufficient quantity of water to make the solution measure, at 25° C. (77° F.), exactly 500 Cc.

Keep the solution in small, rubber-stoppered bottles.

For use, mix exactly equal volumes of the two solutions at the time required.

One Cubic Centimeter of the mixed solution is the equivalent of:

	Gramme
Cupric Sulphate, crystallized, $CuSO_4 + 5H_2O$	0.03467
Cupric Tartrate, $CuC_4H_4O_6 + 3H_2O$	0.03688
Cane Sugar (Inverted)	0.00475
Glucose, anhydrous, $C_6H_{12}O_6$	0.00500
Milk Sugar, anhydrous, $C_{12}H_{22}O_{11}$	0.00678

134. Tenth-Normal Bromine Volumetric Solution

[Koppeschaar's Solution]

Br = 79.36 7.936 Gm. in 1000 Cc.

Dissolve 3.2 Gm. of potassium bromate (No. 81) and 50 Gm. of potassium bromide in sufficient water to measure, at or near 25° C. (77° F.), 900 Cc. Transfer 20 Cc. of this solution, by means of a pipette, into a bottle having a capacity of about 250 Cc., and provided with a glass stopper; add 75 Cc. of water and 5 Cc. of pure hydrochloric acid, and immediately insert the stopper. Shake the bottle a few times, then remove the stopper just sufficiently to quickly introduce 5 Cc. of potassium iodide T.S., taking care that no bromine vapors escape, and immediately stopper the bottle. Agitate the bottle thoroughly, remove the stopper and rinse it and the neck of the bottle with a little water so that the washings flow into the bottle, and then add from a burette tenth-normal sodium thiosulphate V.S. until the brown iodine tint is just discharged. Note the number of Cc. of the sodium thiosulphate V.S. thus consumed, and then dilute the bromine solution so that equal volumes of it and of tenth-normal sodium thiosulphate V.S. will exactly correspond to each other under the conditions mentioned above.

Example.—Assuming that the 20 Cc. of the bromine solution have required 25.2 Cc. of the sodium thiosulphate V.S. to completely discharge the iodine tint, then each 20 Cc. of the bromine solution must be diluted to 25.2 Cc. Thus, if 850 Cc. of the solution remain, it must be diluted with water to measure 1071 Cc.

After the solution is thus diluted, a new trial should be made in the manner above described, in which 25 Cc. of the tenth-normal sodium thiosulphate V.S. should just discharge the tint of the iodine liberated by the bromine set free from 25 Cc. of the standard bromine solution.

Keep the solution in dark amber-colored, glass-stoppered bottles.

One Cubic Centimeter of Tenth-Normal Bromine V.S. is the equivalent of:

	Gramme
Bromine, Br	0.007936
Phenol, C_6H_5OH	0.001556

135. Normal Hydrochloric Acid Volumetric Solution

$HCl = 36.18$ 36.18 Gm. in 1000 Cc.

Mix 130 Cc. of hydrochloric acid of specific gravity 1.158 with sufficient water to measure 1000 Cc.

Of this liquid (which is still too concentrated) carefully measure, from a burette, 10 Cc. into a flask or porcelain dish, and after diluting with about double its volume of water, add 2 drops of methyl-orange T.S., then gradually add, from a burette, a *freshly standardized* normal potassium hydroxide V.S., until the red tint of the solution changes, after vigorous shaking, to a permanent pale yellow. Note the number of Cc. of potassium hydroxide V.S. consumed, and then dilute the acid solution so that equal volumes of this and of the normal potassium hydroxide V.S. neutralize each other at 25° C. (77° F.).

Example.—Assuming that 10 Cc. of the acid solution first prepared required exactly 11 Cc. of normal potassium hydroxide V.S., each 10 Cc. of the former must be diluted to 11 Cc., or the whole of the remaining acid solution in the same proportion at 25° C. (77° F.). Thus, if 950 Cc. should remain, 95 Cc. of water must be added.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of normal potassium hydroxide V.S. If necessary, a new adjustment should then be made to render the correspondence perfect at 25° C. (77° F.).

One Cubic Centimeter of Normal Hydrochloric Acid V.S. is the equivalent of:

	Gramme
Hydrochloric Acid, absolute, HCl	0.03618

Note.—Normal hydrochloric acid is in every respect equivalent in neutralizing power to normal sulphuric acid (see No. 152), and may be employed, except in special cases, for the same purposes. However, preference is generally given to the normal sulphuric acid V.S.

136. Half-Normal Hydrochloric Acid Volumetric Solution

$HCl = 36.18$ 18.09 Gm. in 1000 Cc.

Dilute 500 Cc. of normal hydrochloric acid V.S. with sufficient distilled water to measure exactly 1000 Cc. at 25° C. (77° F.).

One Cubic Centimeter of Half-Normal Hydrochloric Acid V.S. is the equivalent of:

	Gramme
Hydrochloric Acid, absolute, HCl	0.01809
Benzaldehyde, C_7H_6O	0.0526
Cinnamic Aldehyde, C_9H_8O	0.0333
Citral, $C_{10}H_{16}O$	0.03802
Potassium Acetate, $KC_2H_3O_2$ (after ignition)	0.04872
Potassium Bicarbonate, $KHCO_3$	0.049705
Potassium Bitartrate, $KHC_4H_4O_6$ (after ignition)	0.09339
Potassium Carbonate, anhydrous, K_2CO_3	0.034318
Potassium Citrate, cryst., $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.05368
Potassium Hydroxide, KOH	0.02787
Potassium and Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.070045
Sodium Acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.06755
Sodium Benzoate, $NaC_7H_5O_2$ (after ignition)	0.071505
Sodium Bicarbonate, $NaHCO_3$	0.041715
Sodium Carbonate, anhydrous, Na_2CO_3	0.026328
Sodium Carbonate, monohydrated, $Na_2CO_3 + H_2O$	0.030798
Sodium Citrate, $2Na_3C_6H_5O_7 + 11H_2O$ (after ignition)	0.0591
Sodium Hydroxide, $NaOH$	0.01988
Sodium Salicylate, $NaC_7H_5O_3$ (after ignition)	0.079445

137. Tenth-Normal Iodine Volumetric Solution

$I = 125.9$ 12.59 Gm. in 1000 Cc.

Tenth-normal iodine V.S. may be prepared according to either of the following methods:

I. Dissolve 12.59 Gm. of pure iodine (see below) in a solution of 18 Gm. of potassium iodide in 300 Cc. of water. Then add sufficient water to make the solution measure, at 25° C. (77° F.), exactly 1000 Cc. Unless freshly prepared, its strength should always be determined anew at the time it is used. Transfer the solution to glass-stoppered vials.

Preparation of Pure Iodine.—Heat powdered iodine [*Iodum*, U. S. P.] in a porcelain dish placed over a bath of boiling water for twenty minutes, and stir it constantly with a glass rod, so that adhering moisture, cyanogen iodide, and most of the iodine bromide and iodine chloride, if present, may be vaporized. Then transfer the iodine to a porcelain or other non-metallic mortar, and triturate it with about 5 percent. of its weight of dry potassium iodide, so as to decompose any remaining iodine bromide and iodine chloride. Then return the mass to the dish, cover it with a glass funnel, and heat the dish carefully on a sand-bath. Detach the sublimed, pure iodine, and, after pulverizing and drying for twenty-four hours over calcium chloride, keep it in well-stoppered bottles, in a cool place.

II. Tenth-normal iodine V.S. may also be prepared as follows:

Dissolve about 14 Gm. of iodine [*Iodum*, U. S. P.] in a solution of 18 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in about 300 Cc. of water, diluting finally to 1000 Cc. Of this solution (which is too concentrated), carefully measure from a burette 10 Cc. into a flask, then add gradually and cautiously, from a burette, tenth-normal sodium thiosulphate V.S. (shaking constantly) until the color of the solution is discharged. Note the number of Cc. of the sodium thiosulphate V.S. consumed, and then dilute the iodine solution so that any known volume of the latter will require for decolorization exactly the same volume of the tenth-normal sodium thiosulphate V.S.

Example.—Assuming that 10 Cc. of the iodine solution required 10.8 Cc. of the tenth-normal sodium thiosulphate V.S. for decolorization, then each 10 Cc. of the former must be diluted to 10.8 Cc., or each 100 Cc. of the iodine solution to 108 Cc. at 25° C. (77° F.). After the solution is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the tenth-normal iodine V.S. should require exactly 50 Cc. of the tenth-normal sodium thiosulphate V.S. for complete decolorization. If necessary, a new adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Tenth-Normal Iodine V.S. is the equivalent of:

	Gramme
Iodine, I	0.01259
Arsenic, As	0.00372
Arsenic Trioxide (Arsenous acid), As_2O_3	0.004911
Iron, Fe	0.002775
Potassium Sulphite, crystallized, $K_2SO_3 + 2H_2O$	0.009648
Sodium Bisulphite, $NaHSO_3$	0.005168
Sodium Thiosulphate (Hyposulphite), crystals, $Na_2S_2O_3 + 5H_2O$	0.024646
Sodium Sulphite, crystallized, $Na_2SO_3 + 7H_2O$	0.012520
Sulphur Dioxide, SO_2	0.003180
Antimony and Potassium Tartrate, crystallized, $2K(SbO)C_4H_4O_6 + H_2O$	0.016495

138. Tenth-Normal Oxalic Acid Volumetric Solution

$H_2C_2O_4 + 2H_2O = 125.10$ 6.255 Gm. in 1000 Cc.

Dissolve 6.4 Gm. of pure oxalic acid (see No. 73) in sufficient water to measure 1000 Cc.

Into a flask, accurately measure, from a burette, 10 Cc. of a *freshly standardized* tenth-normal potassium hydroxide V.S., dilute with about 20 Cc. of water, add 3 to 5 drops of phenolphthalein T.S. and heat to boiling. From a burette gradually add the oxalic acid solution (which is still too concentrated) until the red tint of the alkali solution fails to reappear after vigorous shaking and boiling. Note the number of Cc. of the oxalic acid solution consumed, and then dilute it so that equal volumes of this and of the tenth-normal potassium hydroxide V.S. neutralize each other at 25° C. (77° F.). It deteriorates on standing.

Example.—Assuming that the 10 Cc. of the tenth-normal potassium hydroxide V.S. required exactly 9.5 Cc. of the oxalic acid solution, then each 9.5 Cc. of the latter must be diluted to 10 Cc., or the whole of the remaining acid solution in the same proportion at 25° C. (77° F.). Thus, if 950 Cc. of the oxalic acid solution should remain, 50 Cc. of water must be added.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of tenth-normal potassium hydroxide V.S. should require for neutralization exactly 50 Cc. of the oxalic acid solution at 25° C. (77° F.). If necessary, a new adjustment should then be made to render the correspondence perfect.

Note.—Tenth-normal oxalic acid V.S. is in every respect equivalent in neutralizing power to any other tenth-normal acid V.S. with either litmus or phenolphthalein T.S. as indicator. Its most important use is in standardizing tenth-normal potassium permanganate V.S.

One Cubic Centimeter of Tenth-Normal Oxalic Acid V.S. is the equivalent of:

	Gramme
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006255
Ammonia Gas, NH_3	0.001693
Calcium Hydroxide, $Ca(OH)_2$	0.003678
Lead Subacetate, $Pb_2O(C_2H_3O_2)_2$	0.0135935
Manganese Dioxide, precipitated, MnO_2	0.004318
Potassium Hydroxide, KOH	0.005574
Potassium Permanganate, $KMnO_4$	0.0031396
Sodium Hydroxide, NaOH	0.003976

139. Tenth-Normal Potassium Dichromate Volumetric Solution

$K_2Cr_2O_7 = 292.28$ 4.8713 Gm. in 1000 Cc.

Dissolve 4.8713 Gm. of pure potassium dichromate, which has been pulverized and dried at 120° C. (248° F.) (see Reagent No. 85), in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

When used with phenolphthalein as indicator, to neutralize alkalies, the volumetric solution of potassium dichromate is tenth-normal when it contains 14.614 Gm. in 1000 Cc. It is then the exact equivalent of any tenth-normal acid V.S., each Cc. being equivalent to the amounts of alkalies quoted under such acids.

When used as an oxidizing agent to convert ferrous into ferric salts, or to liberate iodine from potassium iodide, the solution just mentioned (containing 14.614 Gm. in 1000 Cc.) has the effect of a $\frac{3N}{10}$ volumetric solution, and a solution of one-third of this strength, containing 4.8713 Gm. in 1000 Cc., has the value of a tenth-normal solution, and is the equivalent of an equal volume of tenth-normal potassium permanganate V.S., or, in the case of iodine liberated from potassium iodide, it is the equivalent of an equal volume of tenth-normal sodium thiosulphate V.S. For titrating iron in *ferrous* compounds, it is used in the following manner. Introduce the aqueous solution of the ferrous salt into a flask, and, if it is not already acid, render it so with sulphuric acid. Now add, gradually, tenth-normal potassium dichromate V.S. from a burette, with agitation, until a drop taken out upon a white surface no longer becomes blue when mixed with a drop of freshly prepared potassium ferricyanide T.S.

Tenth-normal potassium dichromate V.S. may also be used, in conjunction with potassium iodide (from which it liberates iodine) and sulphuric acid, for adjusting the titer of sodium thiosulphate V.S. and thus that of the iodine V.S.

One Cubic Centimeter of Tenth-Normal Potassium Dichromate V.S. is the equivalent of:

	Gramme
Potassium Dichromate, $K_2Cr_2O_7$	0.0048713
Iron, Fe, in ferrous compounds	0.00555
Ferrous Carbonate, $FeCO_3$	0.011505
Ferrous Sulphate, anhydrous, $FeSO_4$	0.015085
Ferrous Sulphate, crystallized, $FeSO_4 + 7H_2O$	0.027601
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.017767
Sodium Thiosulphate, $Na_2S_2O_3 + 5H_2O$	0.024646

140. Normal Potassium Hydroxide Volumetric Solution

$KOH = 55.74$ 55.74 Gm. in 1000 Cc.

Dissolve 75 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U. S. P.], in sufficient water to measure about 1050 Cc., and fill a burette with a portion of this liquid.

Into a flask of the capacity of about 300 Cc., introduce 9.339 Gm. of potassium bitartrate, which has been purified and dried as directed under No. 80, and 160 Cc. of distilled water. Boil the liquid until solution has taken place, add from 3 to 5 drops of phenolphthalein T.S., followed by the cautious addition, from a burette, of the potassium hydroxide solution, frequently agitating the flask, boiling, and, toward the end of the operation, reducing the flow to drops until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the potassium hydroxide solution consumed, and then dilute the remainder of the solution so that exactly 50 Cc. of the diluted liquid at 25° C. (77° F.) shall be required to neutralize the 9.339 Gm. of potassium bitartrate used.

Example.—Assuming that 40 Cc. of the stronger solution of potassium hydroxide first prepared had been consumed in the trial, then each 40 Cc. must be diluted to 50 Cc., or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 1000 Cc. should be still remaining, this must be diluted with water to 1250 Cc.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the diluted solution should exactly neutralize 9.339 Gm. of potassium bitartrate at 25° C. (77° F.). If necessary, a new adjustment should then be made to render the correspondence perfect.

Note.—Solutions of caustic alkalies absorb carbon dioxide from the atmosphere, and thereby change their titer when used with litmus T.S., or phenolphthalein T.S., as indicator (methyl-orange T.S. is not affected by the presence of carbonic acid). Hence the volumetric solutions should be preserved in bottles provided with well-fitting rubber stoppers, or, better still, these should be provided with tubes filled with soda-lime (a mixture of caustic soda and lime) ; the tubes pass through a perforation in the rubber stoppers, and thus absorb the carbon dioxide and prevent its access to the solution. If the solution is kept in a burette for any length of time, the same provision with a soda-lime tube should be observed.

In place of potassium hydroxide V.S., sodium hydroxide V.S. (see No. 150) may be used, in the same manner and in the same quantity. Potassium hydroxide V.S., however, is preferable, since it foams less, and attacks glass more slowly.

One Cubic Centimeter of Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme
Potassium Hydroxide, KOH	0.05574
Acetic Acid, absolute, $HC_2H_3O_2$	0.05958
Ammonia Gas, NH_3	0.01693
Ammonium Chloride, NH_4Cl	0.05311
Boric Acid, H_3BO_3	0.06154
Citric Acid, crystallized, $H_3C_6H_5O_7 + H_2O$	0.06950
Hydriodic Acid, absolute, HI	0.12690
Hydrobromic Acid, absolute, HBr	0.08036
Hydrochloric Acid, absolute, HCl	0.03618
Hypophosphorous Acid, HPH_2O_2	0.06553
Lactic Acid, absolute, $HC_3H_5O_3$	0.08937
Nitric Acid, absolute, HNO_3	0.06257
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.06255
Phosphoric Acid, H_3PO_4 (to form K_2HPO_4 ; with phenolphthalein)	0.048645
Potassium Dichromate, $K_2Cr_2O_7$	0.14614
Sodium Hydroxide, NaOH	0.03976
Sulphuric Acid, absolute, H_2SO_4	0.048675
Tartaric Acid, crystallized, $H_2C_4H_4O_6$	0.07446
Trichloracetic Acid, CCl_3COOH	0.16212

141. Tenth-Normal Potassium Hydroxide Volumetric Solution

KOH = 55.74 5.574 Gm. in 1000 Cc.

Dilute 100 Cc. of freshly standardized normal potassium hydroxide V.S. with sufficient distilled water to measure, at 25° C. (77° F.), exactly 1000 Cc.

This solution may also be prepared and standardized directly with potassium bitartrate, as directed under normal potassium hydroxide V.S., employing for this purpose 0.9339 Gm. of the former and a solution of about 7.5 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U.S. P.] in 1000 Cc. of distilled water. Fifty Cc. of the prepared tenth-normal solution at 25° C. (77° F.) should exactly neutralize 0.9339 Gm. of potassium bitartrate (No. 80).

Note.—The same precautions should be taken for protecting this solution from carbon dioxide of the air as are directed under normal potassium hydroxide V.S.

One Cubic Centimeter of Tenth-Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme
Potassium Hydroxide, KOH	0.005574
Sulphuric Acid, absolute, H_2SO_4	0.0048675

142. Fiftieth-Normal Potassium Hydroxide Volumetric Solution

KOH = 55.74 1.1148 Gm. in 1000 Cc.

Dilute 20 Cc. of a freshly standardized normal or 200 Cc. of tenth-normal potassium hydroxide V.S. with sufficient distilled water to measure, at 25° C. (77° F.), exactly 1000 Cc. This standard solution is employed in conjunction with the tenth-normal sulphuric acid V.S. in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin T.S. as indicators.

Note.—The same precautions should be taken for protecting this solution from carbon dioxide of the air as are directed under normal potassium hydroxide V.S. It should be renewed at frequent intervals.

One Cubic Centimeter of Fiftieth-Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme
Potassium Hydroxide, KOH	0.0011148
Sulphuric Acid, absolute, H_2SO_4	0.0009735
Aconitine, $C_{34}H_{47}NO_{11}$	0.012811
Atropine, $C_{17}H_{23}NO_3$	0.005741
Cinchonidine, $C_{19}H_{22}N_2O$	0.005841
Cinchonine, $C_{19}H_{22}N_2O$	0.005841
Combined Alkaloids of Cinchona bark	0.006139
Combined Alkaloids of Ipecac	0.004768
Cocaine, $C_{17}H_{21}NO_4$	0.006018
Coniine, $C_8H_{17}N$	0.002524
Hydrastine, $C_{21}H_{21}NO_6$	0.007606
Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.006018
Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.005661
Physostigmine, $C_{15}H_{21}N_3O_2$	0.005464
Pilocarpine, $C_{11}H_{16}N_2O_2$	0.004133
Quinine, $C_{20}H_{24}N_2O_2$	0.006436
Strychnine, $C_{21}H_{22}N_2O_2$	0.006635

143. Hundredth-Normal Potassium Hydroxide Volumetric Solution

KOH = 55.74 0.5574 Gm. in 1000 Cc.

Dilute 10 Cc. of normal or 100 Cc. of tenth-normal potassium hydroxide V.S. with sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc. The solution must be frequently renewed.

One Cubic Centimeter of Hundredth-Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme
Potassium Hydroxide, KOH	0.0005574
Sulphuric Acid, absolute, H_2SO_4	0.00048675

144. Half-Normal Alcoholic Potassium Hydroxide Volumetric Solution

KOH = 55.74 27.87 Gm. in 1000 Cc.

Dissolve about 40 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U.S.P.], which has been broken into small pieces, in about 20 Cc. of water, and add sufficient alcohol [*Alcohol*, U.S.P.], to measure 1000 Cc. After setting aside in a well-stoppered bottle for one day, the clear supernatant solution should be quickly decanted into a bottle provided with a well-fitted rubber stopper.

Into a flask of the capacity of about 300 Cc., introduce 1.8678 Gm. of potassium bitartrate, which has been purified and dried, as directed under No. 80, and about 100 Cc. of distilled water. Heat the solution to the boiling point, add 5 drops of phenolphthalein T.S., followed by the cautious addition, from a burette, of the potassium hydroxide solution, frequently agitating the flask, boiling, and, toward the end of the operation, reducing the flow to drops until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the alcoholic potassium hydroxide solution consumed, and then dilute the remainder of the solution with alcohol so that exactly 20 Cc. of the diluted liquid shall be required to neutralize the 1.8678 Gm. of potassium bitartrate used.

Example.—Assuming that 12.5 Cc. of the stronger alcoholic solution of potassium hydroxide first prepared had been consumed in the trial, then each 12.5 Cc. must be diluted with alcohol to 20 Cc., or the whole of the remaining solution in the same proportion at 25° C. (77° F.) Thus, if 980 Cc. should remain, this must be diluted with alcohol to measure 1568 Cc.

Half-Normal Alcoholic Potassium Hydroxide V.S. may also be prepared as follows: Of the above described concentrated alcoholic potassium hydroxide solution, carefully measure, from a burette, 20 Cc. into a flask, and, after diluting with about 50 Cc. of water, add about 5 drops of phenolphthalein T.S., heat to a boiling temperature, and add, from a burette, half-normal hydrochloric acid V.S., frequently agitating the flask, and, toward the end of the operation, reducing the flow to drops until the red color is just discharged. Note the number of Cc. of the half-normal hydrochloric acid V.S. consumed, and then dilute the remainder of the solution with alcohol so that equal volumes of this and of the half-normal hydrochloric acid V.S. neutralize each other at 25° C. (77° F.).

Should half-normal hydrochloric acid V.S. not be available, standardization can be carried out in the same manner with *normal* hydrochloric acid V.S., two volumes of the alcoholic potassium hydroxide being made to correspond with one volume of the standard acid.

Note.—This solution should be kept in bottles provided with a well-fitted rubber stopper and protected from the light. Owing to the readiness with which this standard solution loses its titer, blank tests should be performed whenever it is employed in titrations.

One Cubic Centimeter of Half-Normal Alcoholic Potassium Hydroxide V.S. is the equivalent of:

	Gramme
Potassium Hydroxide, KOH	0.02787
Borneol, $C_{10}H_{18}O$	0.07649
Bornyl Acetate, $C_{10}H_{17}O.C_2H_3O$	0.09734
Menthol, $C_{10}H_{20}O$	0.07749
Menthyl Acetate, $C_{10}H_{19}O.C_2H_3O$	0.09834
Santalol, $C_{15}H_{26}O$	0.11026

145. Tenth-Normal Potassium Permanganate Volumetric Solution

$2KMnO_4 = 313.96$ 3.1396 Gm.[1] in 1000 Cc.

Introduce about 3.3 Gm. of pure, crystallized potassium permanganate [*Potassii Permanganas*, U. S. P.] into a flask, add 1000 Cc. of distilled water, and boil for about five minutes. Close the flask with a plug of absorbent cotton, and set aside for at least two days, so that suspended matter may deposit. After the lapse of this time, pour off the clear portion of the solution into a glass-stoppered bottle.

The water to be employed for diluting this solution (which is still too concentrated) should be prepared as directed under Distilled Water [*Aqua Destillata*, U. S. P.], adding, however, about 1 Gm. of potassium permanganate to the water in the retort before beginning the distillation.

I. Introduce into a flask 10 Cc. of an accurately standardized tenth-normal oxalic acid V.S., add 1 Cc. of pure, concentrated sulphuric acid, and before this mixture cools, gradually add, from a burette provided with a glass stop-cock, small quantities of the permanganate solution to be standardized, shaking the flask after each addition and reducing the flow to drops toward the end of the operation. When the last drop of the permanganate solution added is no longer decolorized, but imparts a pinkish tint to the liquid, which remains permanent for one-half minute, note the number of Cc. consumed, and then dilute the trial permanganate

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[1] The exact quantity is never weighed, but the solution is adjusted directly by oxalic acid or indirectly with sodium thiosulphate.

solution with the specially prepared distilled water so that it will correspond, volume for volume, at 25° C. (77° F.), with the tenth-normal oxalic acid V.S. (note example under II.).

II. Tenth-normal potassium permanganate V.S. may also be standardized as follows:

To a solution of about 1 Gm. of potassium iodide [*Potassii Iodidum*, U.S.P.], in 10 Cc. of diluted sulphuric acid, contained in a flask, add, from a burette provided with a glass stop-cock, 20 Cc. of the potassium permanganate solution to be standardized; then dilute the mixture at once with about 200 Cc. of distilled water. An accurately standardized tenth-normal sodium thiosulphate V.S. is then slowly added from a burette, while the mixture is vigorously shaken, until the color is discharged. Note the number of Cc. of the latter consumed, then dilute the permanganate solution so that equal volumes of the two solutions correspond to each other under the same conditions at 25° C. (77° F.).

Example.—Assuming that 25 Cc. of the tenth-normal sodium thiosulphate V.S. were required to decolorize the liberated iodine of the mixture, then each 20 Cc. of the potassium permanganate solution must be diluted with the specially prepared distilled water to 25 Cc., or the whole of the remaining solution in the same proportion. Thus, if 920 Cc. remain, it should be diluted to measure 1150 Cc. at 25° C. (77° F.).

After the potassium permanganate solution is thus diluted, a new trial should be made in the manner above described, in which 20 Cc. of this solution should require exactly 20 Cc. of the tenth-normal sodium thiosulphate V.S. to decolorize the mixture. If necessary, a new adjustment should be made to render the correspondence perfect.

Note.—When potassium permanganate V.S. is to be prepared for immediate use, this may be done as follows: Dissolve about 3.3 Gm. of pure, crystallized potassium permanganate in 1000 Cc. of recently boiled and cooled pure water. This is then standardized by either of the above methods and diluted accordingly with recently boiled and cooled pure water. Potassium permanganate V.S. made by this method without the preliminary boiling and standing deteriorates readily, hence should be verified each time it is used.

Potassium permanganate V.S. should be kept in well-closed glass-stoppered bottles, and only burettes provided with glass stop-cocks should be employed in titrating with it. Even when properly prepared and preserved, this solution should be restandardized frequently.

One Cubic Centimeter of Tenth-Normal Potassium Permanganate V.S. is the equivalent of:

	Gramme
Potassium Permanganate, $KMnO_4$	0.0031396
Calcium Oxide, CaO (as oxalate)	0.002784
Iron, Fe, in ferrous compounds	0.005550
Ferrous Carbonate, $FeCO_3$	0.011505
Ferrous Oxide, FeO	0.007138
Ferrous Sulphate, anhydrous, $FeSO_4$	0.015085
Ferrous Sulphate, crystals, $FeSO_4 + 7H_2O$	0.027601
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.017767
Hydrogen Dioxide, H_2O_2	0.001688
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006255
Oxygen, O	0.000794
Sodium Nitrite, $NaNO_2$	0.0034285

146. Tenth-Normal Potassium Sulphocyanate Volumetric Solution

[Volhard's Solution]

KSCN = 96.53 9.653 Gm. in 1000 Cc.

Dissolve 10 Gm. of crystals of pure potassium sulphocyanate (No. 96) in 1000 Cc. of water.

This solution is too concentrated, and has to be adjusted so as to correspond in strength exactly with tenth-normal silver nitrate V.S. For this purpose, introduce into a flask 10 Cc. of tenth-normal silver nitrate V.S., 3 Cc. of ferric ammonium sulphate T.S., and 3 Cc. of nitric acid (free from nitrous compounds), and dilute the liquid with about 100 Cc. of distilled water. To this mixture add, from a burette, in small portions at a time, the sulphocyanate solution. At first, a white precipitate of silver sulphocyanate appears, then, every drop falling from the burette is surrounded by a deep brownish-red color produced by ferric sulphocyanate, which disappears on vigorous shaking of the flask as long as any of the silver nitrate remains unchanged. When all the silver has been converted into sulphocyanate, a single additional drop of the potassium sulphocyanate solution produces a brownish-red color which no longer disappears on shaking, but communicates a perceptible pale reddish-brown tint to the contents of the flask. Note the number of Cc. of the potassium sulphocyanate solution used, and dilute the whole of the remaining solution so that equal volumes of this and of the tenth-normal silver nitrate V.S., at 25° C. (77° F.), will be required to produce the permanent reddish-brown tint. (The same depth of pale reddish brown tint to which the volumetric solution is adjusted must be attained when the solution is used for volumetric assays).

After the dilution, a new trial should be made, in which 50 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of ferric ammonium sulphate T.S., 5 Cc. of nitric acid, and 200 Cc. of water are used, and there should be required exactly 50 Cc. of the potassium sulphocyanate solution, at 25° C. (77° F.), to produce the same depth of a permanent pale reddish-brown tint.

If necessary, a new adjustment should be made, to render the correspondence perfect.

One Cubic Centimeter of Tenth-Normal Potassium Sulphocyanate V.S. is the equivalent of:

	Gramme
Potassium Sulphocyanate, KSCN	0.009653
Silver, Ag	0.010712
Silver Nitrate, $AgNO_3$	0.016869

147. Tenth-Normal Silver Nitrate Volumetric Solution

$AgNO_3 = 168.69$ 16.869 Gm. in 1000 Cc.

Dissolve 16.869 Gm. of silver nitrate [*Argenti Nitras*, U. S. P.] which, previous to weighing, has been pulverized and dried in a covered porcelain crucible in an air-bath at 130° C. (266° F.) for one hour, in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

Keep the solution in dark amber-colored, glass-stoppered vials, carefully protected from dust and sunlight.

Note.—Titration by tenth-normal silver nitrate V.S. may be conducted in various ways, adapted to the special preparation to be tested:

a. The titration of soluble chlorides and bromides.—To the solution of an accurately weighed quantity of the salt, contained in either a porcelain dish or a flask placed on a white surface, sufficient potassium chromate T.S. is added to impart a yellow tint, then the tenth-normal silver nitrate V.S. is slowly added from a burette, stirring or agitating constantly until the mixture acquires a permanent red tint, due to the formation of red silver chromate. This method is only suitable for *neutral* solutions.

b. The titration of free hydrobromic, hydrochloric, and hydriodic acids or their salts in acid solution, known as the Volhard or Thiocyanate (Sulphocyanate) method of residual titration.—An accurately measured excess of tenth-normal silver nitrate V.S. is added to the solution of the halogen acid or its salt, and then acidified with pure nitric acid, and the indicator (ferric ammonium sulphate T.S.) added; then the uncombined excess of the silver nitrate V.S. is determined by titrating back with tenth-normal potassium sulphocyanate V.S., the end-reaction being the formation of a permanent pale reddish-brown tint (due to ferric sulphocyanate). The volume of the silver nitrate V.S. originally added, less that of the potassium sulphocyanate V.S. consumed, will give the number of Cc. of the former which were required for the precipitation of the halogen. The quantity of nitric acid added should be sufficient to remove the yellow color produced by the addition of the indicator.

c. Titration till the first appearance of a permanent precipitate.—This method is applicable in the estimation of the alkali cyanides and hydrocyanic acid. When the solution is used by this method it is fifth-normal instead of tenth-normal solution.

One Cubic Centimeter of Tenth-Normal Silver Nitrate V.S. is the equivalent of:

	Gramme
Silver Nitrate, $AgNO_3$	0.016869
Allyl Iso-thiocyanate, $CS.NC_3H_5$	0.00492
Ammonium Bromide, NH_4Br	0.009729
Ammonium Chloride, NH_4Cl	0.005311
Ammonium Iodide, NH_4I	0.014383
Bromine, Br	0.007936
Calcium Bromide, $CaBr_2$	0.009926
Chlorine, Cl	0.003518
Ferrous Bromide, anhydrous, $FeBr_2$	0.010711
Ferrous Iodide, FeI_2	0.015365
Hydriodic Acid, HI	0.012690
Hydrobromic Acid, HBr	0.008036
Hydrochloric Acid, HCl	0.003618
Hydrocyanic Acid, HCN, to first formation of precipitate	0.005368
Hydrocyanic Acid, HCN, potassium chromate as indicator	0.002684
Iodine, I	0.012590
Lithium Bromide, LiBr	0.008634
Potassium Bromide, KBr	0.011822
Potassium Chloride, KCl	0.007404
Potassium Cyanide, KCN, to first formation of precipitate	0.012940
Potassium Iodide, KI	0.016476
Potassium Sulphocyanate, KSCN	0.009653
Sodium Bromide, NaBr	0.010224
Sodium Chloride, NaCl	0.005806
Sodium Iodide, NaI	0.014878
Strontium Bromide, $SrBr_2 + 6H_2O$	0.017647
Strontium Iodide, $SrI_2 + 6H_2O$	0.022301
Zinc Bromide, $ZnBr_2$	0.011181
Zinc Chloride, $ZnCl_2$	0.006763
Zinc Iodide, ZnI_2	0.015835

148. Tenth-Normal Sodium Chloride Volumetric Solution

NaCl = 58.06 5.806 Gm. in 1000 Cc.

Dissolve 5.806 Gm. of pure sodium chloride (see below) in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

Pure Sodium Chloride may be prepared by passing a current of dry hydrochloric acid gas into a saturated aqueous solution of the purest commercial sodium chloride, collecting the crystalline precipitate on a filter, washing with a little pure concentrated hydrochloric acid, draining, pulverizing, and igniting it gently in a crucible heated to low redness, to expel all traces of free acid. Care should be taken to avoid fusion.

One Cubic Centimeter of Tenth-Normal Sodium Chloride V.S. is the equivalent of:

	Gramme
Sodium Chloride, NaCl	0.005806
Silver, Ag	0.010712
Silver Nitrate, $AgNO_3$	0.016869
Silver Oxide, Ag_2O	0.011506

149. Double-Normal Sodium Hydroxide Volumetric Solution

NaOH = 39.76 79.52 Gm. in 1000 Cc.

Dissolve 90 Gm. of sodium hydroxide [*Sodii Hydroxidum*, U. S. P.] in sufficient water to measure about 1000 Cc.

For the standardization of this approximate solution of sodium hydroxide proceed as directed under normal potassium hydroxide V.S. (see No. 140); 25 Cc. of the volumetric solution, at 25° C. (77° F.), should exactly neutralize 9.339 Gm. of pure potassium bitartrate (see No. 80).

Note.—The same precautions should be taken for protecting this solution from the carbon dioxide of the air as are prescribed for normal potassium hydroxide V.S. (see No. 140).

150. Normal Sodium Hydroxide Volumetric Solution

$NaOH = 39.76$ 39.76 Gm. in 1000 Cc.

Dissolve 54 Gm. of sodium hydroxide [*Sodii Hydroxidum*, U. S. P.] in sufficient water to measure about 1050 Cc., and fill a burette with a portion of this liquid.

For the standardization of this approximate solution of sodium hydroxide, proceed as directed under normal potassium hydroxide V.S. (see No. 140); 50 Cc. of the volumetric solution, at 25° C. (77° F.), must exactly neutralize 9.339 Gm. of pure potassium bitartrate.

Note.—The same precautions should be taken for protecting this solution from the carbon dioxide of the air as are prescribed for normal potassium hydroxide V.S. (see No. 140).

This solution may be employed in place of the normal potassium hydroxide V.S. (see No. 140), volume for volume.

One Cubic Centimeter of Normal Sodium Hydroxide V.S. is the equivalent of:

	Gramme
Sodium Hydroxide, $NaOH$	0.03976
Boric Acid, H_3BO_3	0.06154
Formaldehyde, CH_2O	0.02979
Trichloracetic Acid, $HC_2Cl_3O_2$	0.16212

151. Tenth-Normal Sodium Thiosulphate Volumetric Solution

$Na_2S_2O_3 + 5H_2O = 246.46$ 24.646 Gm. in 1000 Cc.

Dissolve 30 Gm. of sodium thiosulphate (see No. 113) in sufficient distilled water to measure 1000 Cc. This trial solution, which is too concentrated, is standardized as follows:

To a solution of about 1 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in 10 Cc. of diluted sulphuric acid contained in a flask of about 500 Cc. capacity, add slowly, from a burette, 20 Cc. of tenth-normal potassium dichromate V.S., shaking after each addition. Place a watch-glass on the mouth of the flask and allow it to stand for five minutes, then dilute the solution with about 250 Cc. of distilled water, add some starch T.S., and then, from a burette, the trial solution of sodium thiosulphate, in small portions at a time, shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the blue color of the mixture changes to a light green; note the number of Cc. of the trial sodium thiosulphate solution consumed. Then dilute the sodium thiosulphate solution so that equal volumes of it and the tenth-normal potassium dichromate V.S. will exactly correspond to each other under the above conditions, at 25° C. (77° F.).

Example.—Assuming that 16 Cc. of the trial sodium thiosulphate solution were required to decolorize the liberated iodine of the mixture, then each 16 Cc. of this solution must be diluted to 20 Cc. so that it will correspond in volume to the tenth-normal potassium dichromate V.S. added, or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 984 Cc. of the sodium thiosulphate solution are remaining, this should be diluted to measure 1230 Cc. After the sodium thiosulphate solution is thus diluted, a new trial should be made in the manner above described, in which exactly 20 Cc. of this solution should be required to decolorize the iodine liberated by 20 Cc. of the tenth-normal dichromate V.S. If necessary, a new adjustment should be made to render the correspondence perfect.

Keep the solution in glass-stoppered bottles, carefully protected from dust.

Note.—When this solution is to be used, fill a burette with it, place the liquid to be tested either for the free iodine it already contains, or for that which it liberates from an excess of potassium iodide added to it, in a flask, and gradually add small portions of the solution from the burette, shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the color is discharged.

One Cubic Centimeter of Tenth-Normal Sodium Thiosulphate V.S. is the equivalent of:

	Gramme
Sodium Thiosulphate (Hyposulphite), $Na_2S_2O_3 + 5H_2O$	0.024646
Bromine, Br	0.007936
Chlorine, Cl	0.003518
Chromium Trioxide, CrO_3	0.003311

	Gramme
Iodine, I	0.01259
Iron, Fe, in ferric salts	0.00555
Potassium Bromate, $KBrO_3$	0.002764

152. Normal Sulphuric Acid Volumetric Solution

$H_2SO_4 = 97.35$ 48.675 Gm. in 1000 Cc.

Carefully mix 30 Cc. of pure, concentrated sulphuric acid, of specific gravity 1.826 at 25° C. (77° F.), with sufficient water to measure about 1050 Cc., and allow the liquid to cool to 25° C. (77° F.). Measure from a burette 10 Cc. of this liquid (which is yet too concentrated) into a flask, add 2 drops of methyl-orange T.S., and afterwards, from a burette, a freshly standardized normal potassium hydroxide V.S., shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the red tint of the solution changes to a permanent pale yellow after thorough shaking. Note the number of Cc. of normal potassium hydroxide V.S. consumed. Then dilute the sulphuric acid solution so that equal volumes of this and of normal potassium hydroxide V.S., at 25° C. (77° F.), exactly neutralize each other.

Example.—Assuming that 10 Cc. of the acid solution first prepared had required exactly 11.2 Cc. of normal potassium hydroxide V.S., each 10 Cc. of the former must be diluted to 11.2 Cc., or each 1000 Cc. to 1120 Cc.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of normal potassium hydroxide V.S., at 25° C. (77° F.). If necessary, a new adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme
Sulphuric Acid, absolute, H_2SO_4	0.048675
Ammonia Gas, NH_3	0.01693
Ammonium Carbonate, $(NH_4)_2CO_3$	0.047705
Ammonium Carbonate [U. S. P.], $NH_4HCO_3.NH_4NH_2CO_2$	0.052003
Calcium Hydroxide, $Ca(OH)_2$	0.03678
Lead Acetate, crystallized, $Pb(C_2H_3O_2)_2 + 3H_2O$	0.188075
Lead Subacetate, assumed as $Pb_2O(C_2H_3O_2)_2$	0.135935
Lithium Carbonate, Li_2CO_3	0.036755
Magnesium Carbonate, $(MgCO_3)_4(MgOH)_2 + 5H_2O$	0.048226
Magnesium Oxide, MgO	0.02003
Potassium Acetate, $KC_2H_3O_2$ (after ignition)	0.09744
Potassium Bicarbonate, $KHCO_3$	0.09941
Potassium Bitartrate, $KHC_4H_4O_6$ (after ignition)	0.18678
Potassium Carbonate, anhydrous, K_2CO_3	0.068635
Potassium Citrate, crystallized, $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.10736
Potassium Hydroxide, KOH	0.05574
Potassium and Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.14009
Sodium Acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.13510
Sodium Benzoate, $NaC_7H_5O_2$ (after ignition)	0.14301
Sodium Bicarbonate, $NaHCO_3$	0.08343
Sodium Borate, crystallized, $Na_2B_4O_7 + 10H_2O$	0.18966
Sodium Hydroxide, $NaOH$	0.03976
Sodium Salicylate, $NaC_7H_5O_3$ (after ignition)	0.15889
Zinc Oxide, ZnO	0.04039

153. Half-Normal Sulphuric Acid Volumetric Solution

$H_2SO_4 = 97.35$ 24.3375 Gm. in 1000 Cc.

Dilute 500 Cc. of normal sulphuric acid with sufficient water to measure 1000 Cc. at 25° Cc. (77° F.).

This standard solution is chiefly employed in the titration of the organic salts of sodium and potassium in conjunction with methyl-orange as indicator. For this purpose a special experiment should be made in which an accurately measured volume of 10 Cc. of normal potassium hydroxide V.S. should, after adding 2 drops of methyl-orange T.S., require exactly 20 Cc. of the half-normal sulphuric acid V.S. for neutralization.

If necessary, an adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Half-Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme
Sulphuric Acid, absolute, H_2SO_4	0.0243375
Ammonia Gas, NH_3 (Spirit of Ammonia)	0.008465
Potassium Acetate, $KC_2H_3O_2$ (after ignition)	0.04872
Potassium Bicarbonate, $KHCO_3$	0.049705
Potassium Bitartrate, $KHC_4H_4O_6$ (after ignition)	0.09339
Potassium Citrate, anhydrous, $K_3C_6H_5O_7$ (after ignition)	0.0507
Potassium Citrate, crystallized, $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.05368
Potassium and Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.070045
Sodium Acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.06755
Sodium Benzoate, $NaC_7H_5O_2$ (after ignition)	0.07150
Sodium Carbonate, anhydrous, Na_2CO_3	0.026327
Sodium Carbonate, monohydrated, $Na_2CO_3 + H_2O$	0.030797
Sodium Citrate, $2Na_3C_6H_5O_7 + 11H_2O$ (after ignition)	0.0591
Sodium Salicylate, $NaC_7H_5O_3$ (after ignition)	0.079445

154. Tenth-Normal Sulphuric Acid Volumetric Solution

$H_2SO_4 = 97.35$ 4.8675 Gm. in 1000 Cc.

Dilute 100 Cc. of normal sulphuric acid with sufficient water to measure 1000 Cc. at 25° C. (77° F.).

This standard solution is employed in conjunction with the fiftieth-normal potassium hydroxide V.S. in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin T.S. as an indicator. For this purpose a special experiment should be made, in which an accurately measured volume of 10 Cc. of the tenth-normal sulphuric acid, after adding 1 Cc. of hematoxylin T.S. (or a sufficient quantity of the indicator to be employed), should require 50 Cc. of the fiftieth-normal potassium hydroxide V.S. for complete neutralization, at 25° C. (77° F.). If necessary, an adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Tenth-Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme
Sulphuric Acid, absolute, H_2SO_4	0.0048675
Potassium Hydroxide, KOH	0.005574
Aconitine, $C_{34}H_{47}NO_{11}$	0.06406
Atropine, $C_{17}H_{23}NO_3$	0.02870
Brucine, $C_{23}H_{26}N_2O_4$	0.03913
Calcium Hydroxide, $Ca(OH)_2$	0.003678
Cephaëline, $C_{14}H_{19}NO_2$	0.02314
Cinchonidine, $C_{19}H_{22}N_2O$	0.02920
Cinchonine, $C_{19}H_{22}N_2O$	0.02920
Combined Alkaloids of Cinchona	0.03069
Combined Alkaloids of Ipecac	0.02384
Cocaine, $C_{17}H_{21}NO_4$	0.03009
Coniine, $C_8H_{17}N$	0.01262
Emetine, $C_{15}H_{21}NO_2$	0.02453
Hydrastine, $C_{21}H_{21}NO_6$	0.03803
Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.03009
Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.02830
Physostigmine, $C_{15}H_{21}N_3O_2$	0.02732
Pilocarpine, $C_{11}H_{16}N_2O_2$	0.02066
Quinine, $C_{20}H_{24}N_2O_2$	0.03218
Strychnine, $C_{21}H_{22}N_2O_2$	0.03317

155. Fiftieth-Normal Sulphuric Acid Volumetric Solution

$H_2SO_4 = 97.35$ 0.9735 Gm. in 1000 Cc.

Dilute 20 Cc. of normal sulphuric acid V.S., or 200 Cc. of tenth-normal sulphuric acid V.S., with sufficient distilled water to measure, at 25° C. (77° F.), 1000 Cc. This standard solution may be employed in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin T.S. as an indicator.

One Cubic Centimeter of Fiftieth-Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme
Sulphuric Acid, absolute, H_2SO_4	0.0009735
Aconitine, $C_{34}H_{47}NO_{11}$	0.012811
Atropine, $C_{17}H_{23}NO_3$	0.005741
Cinchonidine, $C_{19}H_{22}N_2O$	0.005841
Cinchonine, $C_{19}H_{22}N_2O$	0.005841
Combined Alkaloids of Cinchona	0.006139
Combined Alkaloids of Ipecac	0.004768
Cocaine, $C_{17}H_{21}NO_4$	0.006018
Coniine, $C_8H_{17}N$	0.002524
Hydrastine, $C_{21}H_{21}NO_6$	0.007606
Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.006018
Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.005661
Physostigmine, $C_{15}H_{21}N_3O_2$	0.005464
Pilocarpine, $C_{11}H_{16}N_2O_2$	0.004133
Quinine, $C_{20}H_{24}N_2O_2$	0.006436
Strychnine, $C_{21}H_{22}N_2O_2$	0.006635

GASOMETRIC ESTIMATIONS

In certain cases the United States Pharmacopœia (8th Rev.) directs the strength of a product or chemical substance to be determined by the volume of gas (nitrogen dioxide) given off during a definite reaction. This volume is to be determined by the nitrometer in the following manner:

Arrange a nitrometer consisting of a measuring tube (graduated for at least 50 Cc.) connected by stout rubber tubing with an open equilibrium tube (both tubes, preferably, provided with a globular expansion near the lower end) in such a manner, by suitable clamps attached to a stand, that either tube may be readily and quickly clamped at a higher or lower level. The stop-cock of the measuring tube having been opened, and the open equilibrium tube having been raised to a higher level, pour into the latter a saturated aqueous solution of sodium chloride, until the measuring tube, including the bore of the stop-cock, is completely filled. Then close the latter and fix the equilibrium tube at a low level. Having ascertained that the stop-cock is closed air-tight, and having, if necessary, wiped out the graduated tube of the nitrometer, introduce into it the prescribed quantity of the liquid to be tested, and allow this to flow slowly into the measuring tube, being careful not to admit any air. Follow it by the prescribed quantities of the several reagents (potassium iodide T.S., and normal sulphuric acid V.S.). When the reaction, which takes place at once, moderates, remove the measuring tube from its clamp, and, being careful to hold it constantly so that the liquid contained in it stands at a higher level than that in the equilibrium tube, shake its contents, without permitting any gas to pass into the open tube. When the reaction has completely ceased, restore the tube to its fastening, and allow the apparatus and contents to acquire the ordinary temperature of the room, which is assumed to be at or about 25° C. (77° F.). Then adjust the two tubes so that the liquid columns are at exactly the same level, and read off the volume of gas in the measuring tube. Multiply this figure by the weight of the substance, which is the equivalent of 1 Cc. of nitrogen dioxide (see No. 156, page 1056). The result will be the weight of the pure substance (nitrite) contained in the amount taken for the assay.

For pharmacopœial purposes the determination will be sufficiently exact if the evolved gas be measured at or near 25° C. (77° F.).

Since temperature and barometric pressure materially affect the volume of the gas, the following correction factors must be used to obtain reasonably exact results when the temperature and pressure are not nearly normal. The barometer correction is important at any locality more than 250 meters above sea-level:

Factors for Temperature Corrections

(Normal Temperature, 25° C.)

Temperature	Factor	Temperature	Factor	Temperature	Factor
15° C.	1.035	22° C.	1.010	29° C.	0.987
16° C.	1.031	23° C.	1.007	30° C.	0.983
17° C.	1.028	24° C.	1.003	31° C.	0.980
18° C.	1.024	25° C.	1.000	32° C.	0.977
19° C.	1.021	26° C.	0.997	33° C.	0.974
20° C.	1.017	27° C.	0.993	34° C.	0.971
21° C.	1.014	28° C.	0.990	35° C.	0.968

Example.—Assuming that the volume of gas read off was 44.5 Cc. at 32° C. (89.6° F.), and it is desired to ascertain the corresponding volume at 25° C. (77° F.), barometric pressure not being taken into consideration, then the 44.5 Cc. must be reduced in the proportion of 1 to 0.977 (see temperature correction factors above), or 44.5 must be multiplied by 0.977. The result will be 43.48 (43.4765) Cc. as the equivalent volume of gas at 25° C. (77° F.).

Factors for Correction for Barometric Pressure

(Normal Barometer, 760 Mm.)

Barometer Reading		Factor	Barometer Reading		Factor
Mm.	Inches		Mm.	Inches	
790	31.10	1.039	660	25.98	0.868
780	30.71	1.026	650	25.59	0.855
770	30.31	1.013	640	25.20	0.842
760	29.92	1.000	630	24.80	0.829
750	29.53	0.987	620	24.41	0.816
740	29.13	0.974	610	24.02	0.803
730	28.74	0.961	600	23.62	0.789
720	28.35	0.947	590	23.23	0.776
710	27.95	0.934	580	22.83	0.763
700	27.56	0.921	570	22.44	0.750
690	27.17	0.907	560	22.05	0.737
680	26.77	0.895	550	21.65	0.724
670	26.38	0.882			

Example.—Assuming that the volume of gas read off was 43.48 (43.4765) Cc. at 590 Mm. barometric pressure, and it is desired to ascertain the corresponding volume at normal barometric pressure (760 Mm.), temperature not being taken into consideration, then the 43.48 Cc. must be reduced in the proportion of 1 to 0.776 (see barometric correction factors above), or 43.48 must be multiplied by 0.776. The result will be 33.74 Cc. as the equivalent volume of gas at normal barometric pressure.

156. Estimation of Nitrogen Dioxide

$$\text{NO} = 29.81\ ;\ 1\ \text{Liter}\begin{cases}\text{at } 0^\circ\text{ C. and 760 Mm.} = 1.3396\text{ Gm.}\\ \text{at } 25^\circ\text{ C. and 760 Mm.} = 1.2272\text{ Gm.}\end{cases}$$

One Cubic Centimeter of Nitrogen Dioxide is the equivalent of:

	At 0° C. and 760 Mm. Gramme	At 25° C. and 760 Mm. Gramme
Nitrogen Dioxide, NO = 29.81	0.0013396	0.0012272
Amyl Nitrite, $C_5H_{11}NO_2$ = 116.24 . . .	0.0052234	0.0047851
Ethyl Nitrite, $C_2H_5NO_2$ = 74.51	0.0033482	0.0030673
Sodium Nitrite, $NaNO_2$ = 68.57	0.0030813	0.0028227

ALKALOIDAL ASSAY BY IMMISCIBLE SOLVENTS

(U. S. P. 8TH REV.)

Nearly all alkaloids are practically insoluble in water, but they are soluble in alcohol, chloroform, ether, amyl alcohol, benzene, petroleum benzin, or mixtures of several of these. The salts of these alkaloids, however, are soluble in water, but practically insoluble in the above-mentioned solvents. The process of assay by immiscible solvents, which is generally known as the "shaking out" process, is based on this property of alkaloids, and it is carried out by treating liquid extracts that have been freed from alcohol, with an immiscible solvent in the presence of an excess of alkali. This liberates the alkaloid, and, on becoming free, if not so previously, it is dissolved by the immiscible solvent. This solution is then separated, transferred to another container, and shaken with an excess of acid largely diluted with water. The acid combining with the free alkaloid forms a salt, which now leaves the immiscible solvent and is found in the aqueous solution. This process is sometimes repeated, in case the alkaloidal solution is still colored. The apparatus used in this operation of shaking out is termed a "separator," and consists of an oval or pear-shaped glass vessel, with an opening at the top supplied with a well-ground glass stopper, and an outlet tube at the bottom, provided with an accurately fitting glass stopcock. The solvents directed to be used in the U. S. P. (8th Rev.) are alcohol, chloroform, ether, and various mixtures of both containing at least 75 parts of ether in 100 parts of solvent by volume. In the case of chloroform, the solvent will collect at the bottom of the separator, and can be drawn off, but the ethereal or ether-choroform mixture will form the upper portion of the liquid in the separator, and the aqueous layer must first be drawn off into a suitable vessel, and the ethereal layer then transferred to another vessel. It is not necessary or desirable to shake the mixture of immiscible solvent and water violently, for a rotation of the separator or a gentle shaking for about a minute will answer all purposes. At times, an emulsion of the water and the solvent is formed, especially if the shaking is too violent, and in order to separate this, it is advisable to proceed as follows: If the solvent is heavier than the water, add more of the former, a little water, and a slight amount of alcohol; if the solvent is lighter than the water, add sufficient saturated sodium chloride solution or crystals of sodium chloride. A safe procedure to avoid the forming of emulsions is to invert the separator several times, and then to at once begin rotating to keep the solvents well mixed. To insure a complete extraction of the alkaloid, it is desirable to treat the liquid three times with the immiscible solvent,* and this is to be followed by a rinsing of the empty separator with repeated small portions of the same solvent. The separator should not be filled to more than two-thirds of its capacity at any time, and if its contents should become heated by the neutralization of acid by alkali, or *vice versa*, it should be cooled to the temperature of the room, before opening the stopper, by immersing it in running water. The final operation must always be the collection of the free alkaloid by the use of a portion of the immiscible solvent, drawing this off into a beaker, rinsing with small portions of the solvent to prevent possible loss. The beaker is then placed on a water-bath and gently heated, to remove the solvent by evaporation, leaving the alkaloids in the beaker in the dry form, and usually in the condition of a resinous or varnish-like mass. It is then either weighed as such or dissolved in volumetric acid solution, delivered in measured quantity from a burette, and the excess of the acid titrated with volumetric alkali solution with the use of an indicator. Should the final residual alkaloids still be slightly colored, it is preferable to employ iodeosin as the indicator, as the alkaloidal solution contains ether and the ethereal layer retains in solution coloring matter or impurity which may be present. If the alkaloids are not strongly colored, either hematoxylin or cochineal may safely be used.

The quantity of alkaloid is found by multiplying the number of cubic centimeters of volumetric acid consumed by a constant factor, depending upon the molecular weight of the individual alkaloid. These factors will be found on page 1054, under Tenth-Normal Sulphuric Acid V.S. (No. 154), and are used throughout the text without explanation. The factor in each case represents the weight in grammes of the alkaloid required to neutralize 1 Cc. of volumetric acid.

DETERMINATION OF THE OPTICAL ROTATION OF ORGANIC SUBSTANCES

(U. S. P. 8TH REV.)

Many organic substances either liquid by nature or in solution in suitable solvents, when examined in a specially constructed polarizing apparatus or polari-

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*If extraction is incomplete, the processes must be repeated with additional solvent. The completion of the "shaking out" processes may be tested by evaporating a small portion of the solution, dissolving the residue in acidulated water and adding mercuric potassium iodide T.S., when the absence of turbidity indicates exhaustion.

strobometer, exhibit the property of circular polarization, or, in other words, are capable of rotating the plane of polarization of a ray of light either to the right or to the left. Such substances are termed "optically active," and when rotating to the right are designated as "dextrorotatory" or "dextrogyrate," and when rotating to the left, as "lævorotatory" or "lævogyrate." Substances which do not possess this property of optical rotation are termed "optically inactive."

Among the substances recognized by the U. S. P. (8th Rev.), there are several, particularly certain essential or volatile oils, and related bodies, for which the determination of the angle of rotation of a ray of polarized light, or, in some cases, the proof of their optical inactivity, affords the most simple and positive evidence of their identity or purity.

The instruments used for this purpose vary somewhat in their construction. Those which are most generally adapted for the examination of the substances mentioned above are the Polaristrobometer of Wild, in which the optical activity of the substance is manifested by the appearance or disappearance of dark, parallel stripes, or the so-called "half-shadow" instrument of Laurent, in which the two sides of the field of vision are capable of becoming unequally illuminated. Both of the instruments permit the angle of rotation to be read off in degrees or fractions of a degree of a circle.

These optical determinations are best made in a dark room, and by means of homogeneous or monochromatic light, the latter being obtained by introducing into a non-luminous flame, on a loop of platinum wire, a small bead of fused sodium chloride. The light thus radiated corresponds with the line D of the solar spectrum.

Since the deviation of the plane of polarization either to the right or to the left of the zero point is directly proportional to the length of the column of liquid, it is important that the observations should be made with tubes of a definite length, such as 100, 50, or 25 Mm. The selection of the length of the tube to be employed is, however, usually dependent upon the depth of color of the liquid and the extent of its optical rotation.

The rotatory power of an optically active, liquid substance, observed with sodium light, and referred to the ideal density 1, and in a tube having a length of 1 decimeter (100 Mm.), is designated as its *specific rotatory power*. This is usually expressed by the term $[a]_D$. Since, however, not only the density of an optically active liquid, but also its rotation, is influenced by the temperature, the specific rotation varies with the latter. In stating the specific rotation it is, therefore, necessary to indicate at what temperature the rotation and the density of the liquid have been determined. But for the same temperature the specific rotation of a pure, optically active liquid is always a constant number. The temperature used in the text of the U. S. P. (8th Rev.) is 25° C. (77° F.).

For calculating the specific rotatory power of an optically active liquid substance, or solution of an optically active solid, the following formulas are of general application:

I. For liquid substances $$[a]_D = \frac{100 \times a}{L \times d}$$

II. For solutions of solids $$\left\{ \begin{array}{l} [a]_D = \dfrac{10000 \times a}{L \times p \times d} \\ \text{or} \quad [a]_D = \dfrac{10000 \times a}{L \times c} \end{array} \right.$$

For calculating these formulas the determination of the following factors is necessary:

a = the angle of rotation of the liquid or solid observed with sodium light.
L = the length of the tube in millimeters.
d = the density or specific gravity of the active liquid.
p = the amount of active substance in 100 parts by weight of the solution.
c = the number of grammes of active substance in 100 cubic centimeters of the solution.

PART V

MAGISTRAL PHARMACY[1]

UNDER the head of Magistral or Extemporaneous Pharmacy will be considered the preparation and dispensing of medicines intended *to meet the occasion* and which are to be compounded at once. The subject of official or galenical pharmacy has been considered in the previous pages, the distinction being that in the latter the preparations are intended to be permanent, and are generally made in advance and kept on hand ready for use, while those which are magistral are mostly intended to last during the occasion which calls them into existence.

There are several classes of official medicines in which both permanent and extemporaneous preparations are embraced. It has been deemed most practical to consider such under the above head. Examples are found in plasters, powders, ointments, etc. Some of these are generally kept on hand ready for use. If they are not called for soon, they become stale or deteriorated, and experience soon demonstrates that the best plan is rapidly to improve the apparatus and facilities of the store to the highest point, so that all extemporaneous preparations may be quickly and skilfully compounded on call, and thus a reputation is soon acquired for always dispensing those which are fresh. For this reason, most ointments should not be made in larger quantities than are necessary to supply the demand of the moment.

Magistral Pharmacy is unquestionably the most important division of the whole subject. It embraces the principal amount of the labor in the store, and calls for the exercise of more tact, knowledge, and ability than any other branch. Owing to the fact that the ability to successfully practise extemporaneous pharmacy depends largely upon the personal qualities of the pharmacist, very little can be written upon the subject which would be generally useful. Good training under the watchful eye of a skilled preceptor and practical experience will alone give the confidence and knowledge of details that assure success. All that will be attempted under this head will be to collect and arrange such points as the author has found useful in his own experience, in the hope that at least some of them may be of service to others. A chapter on the arrangement of the store, with a description of the facilities for practising extemporaneous pharmacy, will properly introduce the subject.

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[1] The word magistral is derived from *magister*, a master, and is defined as "a term applied to medicines prescribed for the occasion, by a competent person, in distinction from such as are official, or kept prepared in the shops. As the latter are prepared according to a certain formula, an intelligent apprentice is generally equal to the task; but the knowledge of a master is needed to give directions for an original preparation."—*Thomas.*

CHAPTER LXIII

DISPENSING

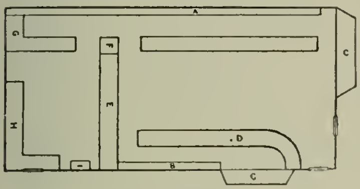
Arrangement of the Store, Laboratory, and Cellar

Selecting a Location for a Dispensing Store.—The selection of a proper location for establishing a pharmacy is in some respects the most important and responsible of all the duties of the pharmacist. As it is largely a question depending upon the personal qualifications, attainments, and financial ability of the individual or firm, it would be useless to offer anything more than a general observation upon this subject. Every pharmacist should select the location in which he will be most likely to achieve the greatest amount of *success*. The foregoing sentence will probably be construed by most readers to mean the field which will yield the largest pecuniary return; yet he is wisest whose expectations are tempered with moderation, and who looks for his reward to the happiness and satisfaction derived from a life filled with those daily deeds of service to his fellowmen, which from long custom or lack of appreciation fail to be classed as merchantable commodities. The general practice in America is to select a prominent place for a pharmacy at the intersection of principal streets, and the "corner drug store" is a well known phrase. Aside from the business view concerned in this selection, there is a great advantage derived from the presence of better light and ventilation in a corner location. At the same time, there are the disadvantages of double the amount of dust and exposure from the streets, with the necessary depreciation of the stock, as well as others of minor importance.

Apportioning Space.—The room should be at least twice as long as it is broad, in order that a suitable division of the space may be secured, so that about two-thirds may be devoted to dispensing and one-third to compounding. A high ceiling is a great desideratum. The doors should be ample, with movable transoms to secure ventilation and permit the escape of the heated air and vapors which accumulate from the lights at night and from other sources. The transoms may be suspended in the middle, and during the day, even in winter, if they are kept partly opened, the condensation of moisture upon the glass bulk windows, due to evaporating operations going on in the store or laboratory, will be largely avoided. If a chimney breast is available in the room, it will be found to be a desirable acquisition in aiding in ventilation and the escape of noxious vapors arising from chemical operations. The dispensing department is used principally for displaying the stock and for conducting the business with the customers, the prescription department for compounding prescriptions and making preparations. Much diversity of opinion exists among good pharmacists with regard to the proper method of division between these two departments. Some hold that they should be entirely separated from each other, the prescriptions being compounded in a separate room ; others, that nothing but a low counter should mark the dividing line. Probably the most satisfactory arrangement to adopt is to place across the store a prescription counter having a large glass plate in the centre, which will permit the customer to see into the prescription department if he desires to, but which will not be a standing invitation to inquisitive persons to walk in and annoy by conversation those who are engaged in compounding prescriptions.

Fig. 466 shows the plan of a corner pharmacy adapted for a moderate business. It provides for two bulk windows, C C, and two doors. A and B represent the space devoted to upright fixtures and shelving,—A, the former, for the bottles, drawers, cans, drawer cans, etc. ; B, closets for holding finished packages ready for sale. In front of A the long main counter is shown, while D represents the second counter. The spaces E and F are apportioned for the prescription counter, and the adjoining desks, G and H, show spaces devoted to working counters for pharmaceutical operations, while I represents the sink.[1] The prescription counter should be well lighted. If it is impossible to have a window in the position of the one over the counter, H, one of the "prism lights," now largely used for reflecting light from the outside into dark corners, may be used.

Fig. 466



Plan of store

Window Fixtures.—Plate glass, although expensive, is now so generally in use, and so satisfactory, that it is usually true economy to select it for bulk windows.

The principle adornments of the pharmacist's window are those ancient emblems of his art,—the show bottles. These should never be exhibited if they cannot be made to present a creditable appearance. They need not be of elaborately cut glass, but the colored liquids should be bright and transparent and the bottles clean and free from dirt and dust. (Formulas for show bottle colors are given in Part VI.)

Arrangement of Objects.—One of the most difficult subjects to treat is the proper arrangement of a pharmacist's window. In the general stores of our large cities, window dressing, as it is termed, is in the hands of trained men, who earn a comfortable livelihood by the "profession." It is far easier to note the objects which should not be exposed than to indicate those which are suitable. *Legitimate and proper objects are always found in the products of the pharmacist's own skill and labor.* Many chemical salts can be crystallized in thin glass dishes, and these, if the salt is colorless or white, can be shown to advantage on a background of black velvet ; if the salt is dark colored, like chrome alum, a white background should be chosen. Masses of crystals of various colors, alum, copper sulphate, potassium ferrocyanide, etc., form attractive objects, if they are novelties. These may be obtained from the manufacturing chemists. Chemical or pharmaceutical apparatus, tastefully displayed, rarely fails to excite the admiration of the passers by, while if some simple pharmaceu-

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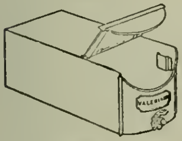
[1] Estimates, plans with illustrations, etc., are now freely furnished by druggists' outfitters. (See advertisements in the pharmaceutical journals.)

tical process is shown in automatic operation, such as the distillation of water or colored liquids in glass retorts, with a glass Liebig condenser, two objects are gained,—a supply of the distillate is secured, and the reason for possessing the window is legitimately realized. Growing plants of the materia medica can often be obtained by applying to conservatories, or, with the exercise of a little patience and care, some of these may be grown at home. If these plants be rare, or of foreign origin, the interest will be greatly enhanced. This point, however, should always be kept in view—the objects should have some connection with pharmacy. Appropriate labels should accompany the objects exhibited, or the annoyance of having to answer trivial questions many times in the day will be experienced. An instructive *series* of pharmaceutical exhibitions may be devised, the series to extend through many months. To illustrate : an empty ceroon which has held cinchona bark should be obtained, and a reproduction made, through the aid of some friend clever with the pencil, of some of the prints to be found in the books, of natives gathering cinchona bark, and also of the cinchona tree. Some large, handsome pieces of the bark should be selected, showing the different grades and qualities. Then there should be exhibited, in appropriate bottles, a series of all the *home made* pharmaceutical preparations of cinchona bark, and, for the centre piece, choice specimens of all the cinchona alkaloids ; then the pharmaceutical preparations of the alkaloids in the background, etc. A clearly written statement should be shown in the window, giving interesting details of each object. When the interest in this subject has waned, the same method may be applied to nux vomica, coca, rhubarb, opium, eucalyptus, senna, etc., and other similar subjects. It will be readily seen that the purpose of exhibitions of this character is to impress the community with the fact that the proprietor of the store is not only a merchant and dealer in the products of the skill of others, but is also a manufacturer himself.

Exhibitions of a more elaborate and valuable character will readily suggest themselves to the minds of many, but want of space prevents any further hints on our part. It must be clear, however, that displays of the above character are more in keeping with the professional status of the pharmacist in the community than the heterogeneous and often vulgar exhibitions of objects usually seen in druggists' show windows.

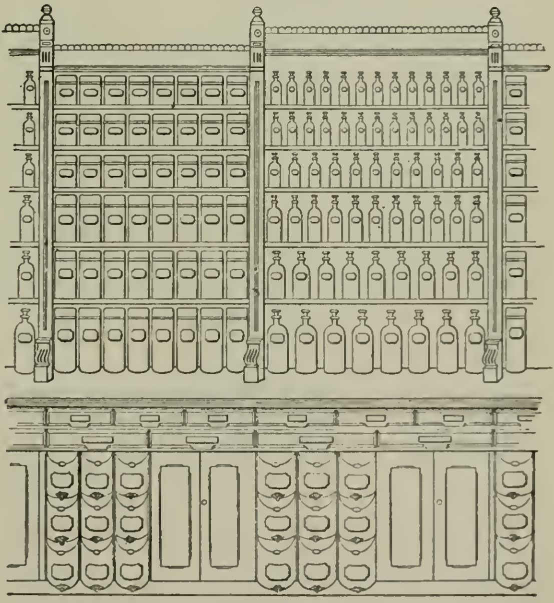
Shelving and Wall Fixtures.—The character of the permanent fixtures of the store has much to do with the comfort and convenience of conducting a pharmacy. The selection of the kind of wood to be used will depend upon the amount of light in the store, the location, and the climate. *Hard wood* is always the cheapest in the end, although the most expensive at first. If the room is exposed to a great deal of light, black walnut is to be preferred, because it shows discolorations less than any other hard wood ; but if the tone of the room is dark, a more cheerful appearance must be given to the store, and oak, ash, cherry, or mahogany will be preferable. Oak and ash, however, are not so serviceable as the others, because of their tendency to show stains. The wall fixtures generally consist of a long row of drawers four feet high, with shelves above for holding the shop bottles, cans, etc., on one side, and of a series of closets below, with shelves having glass fronts above, for the other side. Most crude drugs and chemicals, herbs, etc., are kept in wooden drawers arranged in sections. The objections to wooden drawers for this purpose are several. If the drug is odorous, like valerian, sassafras, asafetida, etc., it will surely communicate its peculiarities to its less pronounced neighbors, like arrowroot, sodium bicarbonate, etc. Again, rats and mice have strong likings for some of the articles of the materia medica, and a wooden drawer offers no impediment to their sharp teeth. Japanned and lacquered tin or tinned copper cans appropriately labelled have come into use as substitutes, and when properly made are perfectly satisfactory. Fig. 467 shows a can which is intended to take the place of a drawer. The lid is so arranged that the drawer must be pulled out nearly half way before it can be raised,—the advantage being that the bad habit of leaving the drawers partly open, thus permitting the admission of foreign substances, vermin, etc., is obviated, there being but two possible positions for this drawer can,—one with the lid raised and the mouth of the can wide open, the other with the lid down close. A label case in the corner of the can is the suggestion of Charles A. Heinitsh, of Lancaster. It has the merit of keeping the label for each drug in its appropriate container. Instead of the unbroken and monotonous array of drawers so frequently seen, a more convenient arrangement, presenting a better appearance, will be found to consist in alternating the sections of drawers or drawer cans with closets, as shown in Fig. 468. These closets should be used for packages and articles which are generally in active demand and which must be dispensed quickly. In this connection it may be stated that a stock of small packages of regular articles of the materia medica, like flowers of sulphur, cream of tartar, sodium bicarbonate, in the quantities frequently demanded

FIG. 467



Drawer can

FIG. 468

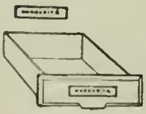


Section of wall fixtures

by customers, should be kept in a box or compartment of the drawers or drawer cans. This plan greatly facilitates quick dispensing, economizes time and labor, and leads the assistant to make neat packages, by training him in that duty thoroughly at times when he is not otherwise engaged. If there is not room in the proper receptacle for these labelled packages, they may be kept in glass furniture jars in some accessible place.

Fig. 468 also illustrates the arrangement of two sections of fixtures, one for bottles and the other for cans. Each section should be independent, or joined to its neighbor with dowelpins, so that at any time they may be separated, rearranged, if necessary, or taken down entirely. The design shown is unpretentious, and intended for a store doing a moderate business. If the fixtures are made of mahogany, oak, or walnut, the effect is much better than if soft wood, painted or stained, is used. It will be observed that the proportionate height of the fixtures is such that a short ladder is necessary to reach the top row of bottles and cans. This arrangement is a matter of necessity in stores located in large cities and towns, where space is very valuable; but whenever it can be avoided it is desirable that it should be, and if the shelves are carried to just such a height as will permit the bottles to be reached without using a ladder, much inconvenience will be obviated. The careless habit of pulling out a drawer as a step to reach a bottle on an upper shelf is broken up by the use of the drawer cans and closets, as shown in the illustration. The shallow drawers above these are not intended for holding drugs, but serve to contain small articles in constant demand, like camel's hair pencils, gelatin pearls, seidlitz powders, etc. There should be sufficient difference between the depth of the shelves for the bottles and cans and that of the closets below to permit a counter top eight inches wide to be made above the closets. This will be almost indispensable, as affording a place for retaining packages to be sent out and of temporary lodgement for articles received. This counter should be cleared and all articles distributed every morning before the busy hours arrive.

Fig. 469



Shallow drawer

Fig. 469 shows one of these shallow drawers. The label is the principal feature. It was devised by the author some years ago, to replace the labelled drawer pulls furnished by the dealers in druggists' furniture, which were in use at that time and were objectionable in several respects. The simplicity and durability of this label are its prominent advantages. It is made of plate glass, with bevelled edges; the background is of pure gold leaf, and the letters are black and in plain Egyptian style, or black letter, without shading. They are painted upon the back of the glass, and covered with a coat of varnish. The glass label is let into the front of the door by chiselling out a depression, as deep as the glass is thick, slightly larger than the label. The back of the glass label is then covered with a thick paste of red lead in boiled linseed oil and pressed into place, the edges being finished with colored putty. The lower edge of the drawer has a projection which serves as a pull.

Dispensing Counter.—The arrangement of the dispensing counter will depend upon whether it is to serve also as a prescription counter.

A combination counter should always be avoided, if possible, as the operations involved in compounding prescriptions require the closest attention, and should always be performed where the greatest freedom from interruption can be secured. This can never be had behind the dispensing counter. The plans shown on page 1069 do not, therefore, embrace a combined dispensing and prescription counter; but, if one is absolutely necessary, the main features of each can be easily merged into one. The top of the dispensing counter should be of marble or hard wood. Where space is valuable, the top of the front of the counter may overhang four inches, and room thus be obtained for a row of shelving covered with glass doors. These are shown also in front of the prescription counter (see Fig. 479). If the shelves are filled with attractive objects, particularly with special preparations made by the proprietor, they serve the excellent purpose of keeping them continually before the eye of those who frequent the store, and they may justly be called "silent salesmen." If a triangular base four inches high is placed at the bottom, no danger need be apprehended of customers breaking the glass. The case which was in the author's possession was in daily use for ten years without a single fracture occurring through the carelessness of a customer. The glass should be one-eighth-inch plate. If space is not particularly valuable, the counter front may be embellished with pilasters or panels, according to the taste of the owner, and the preparations shown in glass cases. A hardwood counter will, however, prove to be much the cheaper in the end, as the front is subjected to a great deal of wear and tear, and will require frequent painting if made of soft wood; the top of the counter may be sometimes filled with melted paraffin and rubbed, this will give a more durable surface than paint. The back of the counter should be utilized for containing drawers for heavy, unsightly goods, supplies of paper, corks, twine, sponges, glue, sand paper, plaster, labels for articles to be dispensed, etc. A sink at one end will often prove a convenience. It will, indeed, be necessary if soda water is dispensed at this counter.

Store Furniture.—This term generally denotes the containers used to hold the medicinal substances which are to be dispensed. The furniture may consist of wide mouth or salt mouth bottles, wooden drawers, drawer cans, and cans or counter urns, for the solid articles of the materia medica, while the liquids are universally dispensed from bottles and cans. The furniture other than that made from glass has been already considered under the head of fixtures. The subject of the selection of the glassware in such sizes and shapes as shall be adapted to the wants of the store is an important one. Very little assistance, however, can be rendered in a work of this kind, because a list suitable for a store in one location would be useless for one differently situated. Practice has been materially modified of late years, particularly in arranging the *sizes* of the shop bottles for liquids. Formerly, when tinctures were made by maceration, gallon, two gallon, and even three gallon bottles were to be seen upon the lowest shelf, but now it is rare to see larger than half gallon bottles; indeed, there seems to be very little necessity for bottles larger than quart. The stock of liquid preparations being generally kept in the cellar, the shop bottles are easily replenished from time to time as need arises. In selecting the sizes for the containers, whether of glass, tinned iron, or wood, the space to be devoted to them should first be decided upon, and then the number of bottles, cans, or drawers to occupy the space is easily determined. Having ascertained the number required of each, the selection of the proper sized receptacle for each article should next claim attention. The following points may serve as a guide in selecting the kind of container:

1. Solid substances which are subject *to injury by exposure to light* should not be placed in glass, like salts of the alkaloids, scaled iron salts, powdered savin, digitalis leaves, etc. 2. Odorous drugs, like hedeoma, asafetida, valerian, serpentaria, etc., should not be placed in wooden drawers, but should be put into the shop cans. 3. Volatile oils should not be placed in the pharmacist's shop furniture at all. Small quantities only are dispensed, and the oils should be kept in small amber glass bottles, away from exposure to light, preferably in a close closet. 4. Corrosive or deliquescent salts should not be placed in tinned iron cans. Glass vessels are properly used for these.

Glass Furniture.—Shop bottles are generally of four kinds,—*wide mouth* or *salt mouth*, *tincture* or *narrow mouth*, *syrup*, and *oil* bottles.

FIG 470

Wide mouth furniture bottle

FIG. 471

Narrow mouth furniture bottle

FIG. 472

Oil bottle

FIG. 473

Syrup bottle

Amber and blue glass are sometimes used,—the former for substances which are injured by light, the latter for very active poisons. Figs. 470 and 471 show cuts of the wide mouth and narrow mouth shop bottles supplied by the Whitall Tatum Company, of Philadelphia. A difference of opinion exists among pharmacists as to the advantage of fitting out with bottles of extra heavy glass or with those of ordinary weight. A certain number have to be replaced every year through breakage from careless handling, but it would seem to be most economical to select the extra heavy bottles for liquids, notwithstanding that the percentage of loss is greater with these when the practice of suddenly pouring hot liquids into them is indulged in.

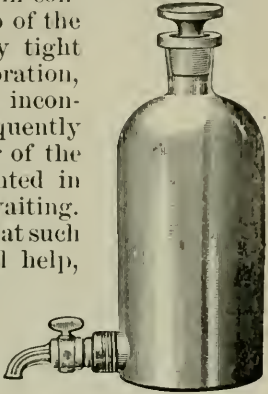
The *oil bottle* (see Fig. 472) has a cap, which protects the liquid from dust; the neck of the bottle is stoppered by a tube which has a lip, while the base of the tube is grooved on one side, to permit the oil adhering to it to flow back into the bottle.

The *syrup bottle* (see Fig. 473) does not have a ground, close fitting stopper as do the other bottles holding liquids, but the stopper is purposely made to enter the neck loosely; the flat lower surface of the stopper lies in contact with the upper surface of the lip of the bottle, and this forms a sufficiently tight connection to prevent loss by evaporation, exclude dust, and obviate the great inconvenience and loss of time which frequently occur when the ground glass stopper of the syrup bottle is found tightly cemented in the neck and a restive customer is waiting. The loose stoppered syrup bottle may at such times be justly regarded as a moral help, leaving no excuse for the use of smothered, but none the less intense, expressions of internal feeling. In dispensing the liquid, care should be taken to pour from the bottle with the label uppermost, so as to avoid soiling the label. The habit should be cultivated of catching the last drop from the lip on the end of the stopper, to prevent its trickling down the side of the bottle. If this is not done, a syrup bottle may present the appearance shown in Fig. 474.

Fig. 474

Last drop effect

Fig. 475



Tubulated bottle

Fig. 475 is a tubulated or aspirator bottle. It has a glass tap joined to the bottle by grinding. This is held in its place securely by a metal screw collar. The contents come only into contact with glass, and thus contamination is prevented. It may be used for holding infusions after sterilization, the glass stopper in this case being replaced by a tuft of purified cotton (see page 329). It may also be used in connection with the rapid filtering apparatus (see Fig. 323).

In placing the bottles upon the shelves, an alphabetical arrangement is undoubtedly the best. It is well, however, to group the strong acids in one place, and the very poisonous liquids in another. The labelling should be distinct and easily read, and the abbreviations not so short as to allow of any misunderstanding. There should be no shading of the letters. The plain black Egyptian letter on a plain gold ground is the best on this account, while the combined effect in a row of bottles so labelled is richer than where some obscure or composite style of label is adopted. The glass or mica label is universally used now for bottles.—being cemented on with a mixture consisting of three parts of rosin and one part of wax,—paper labels having almost gone out of use. These glass labels are subject to the disadvantage of being easily cracked and chipped, but they can be replaced so cheaply that this cannot be considered a serious objection. The recessed label has an advantage in this respect, the octagonal depression in the bottle enabling the glass label to be

Fig. 476

Recessed label furniture bottle

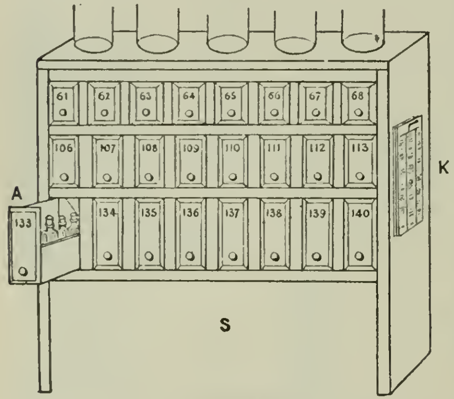
cemented in its place without exposing the edges, thus giving it protection. Fig. 476 shows a profile view of this label, and Fig. 471 a front view of an oblong label similarly recessed.

The following directions for attaching the glass labels are furnished by the Whitall Tatum Company:

Cement.—To one part of best yellow wax add three parts of rosin; melt together in an open pan or kettle, with a gentle heat, to the consistence of syrup.

Directions.—Place the bottle on a table in a nearly horizontal position in front of you; the bottle must be perfectly free from moisture. Pour the cement on the hollow side of the label with a spoon; then apply the label to the bottle with a gentle pressure. While the cement is soft, run the point of a knife around the label, so as to form a groove in the cement. This will save labor in chipping off the cement. The cement will harden in about ten minutes, when, with a putty knife such as glaziers use, the surplus is to be removed. Clean the bottle and label with a little kerosene oil, and wipe off with a damp towel.

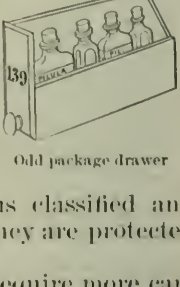
Fig. 477



Odd package case

Fig. 477 shows a method of systematically storing little odd packages which are troublesome to place. This is a modification of the plan first seen by the author in Samuel A. D. Sheppard's store in Boston. A section back of the prescription counter is chosen, and a number of small drawers are arranged to hold five or six bottles in an upright position. Fig. 478 shows an enlarged view of one of these drawers. A portion of one of the sides and of the back is cut away, to facilitate the handling of the bottles. The fronts of the drawers are of hard wood, and the drawers are numbered distinctly and consecutively. Upon the side of the section an index to the contents of the drawers is placed. This consists of a complete alphabetical list of all the odd packages in the section, and opposite each article is placed the number of the drawer in which it is contained. In practice, the bottles which are in frequent request are easily found, after once being located, without referring to the index. The advantages of this method are plain. Pill bottles, rare chemical salts, odd sized packages which cannot be easily disposed of, are thus classified and arranged so that they can be quickly found, while they are protected from the effects of light, dust, and air.

Fig. 478

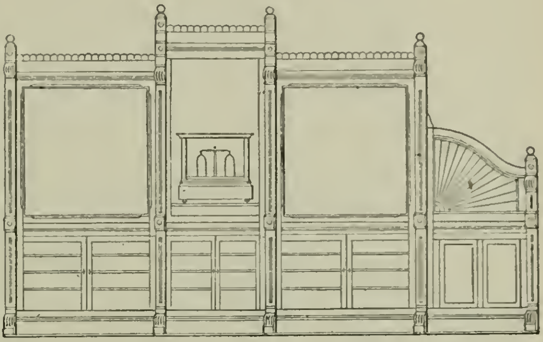


Odd package drawer

The Prescription Counter.—This will probably require more care and thought to secure the most advantageous arrangement than any other feature of the store. Good light and a convenient water supply are absolute essentials. A corner location will generally afford a side window, from which plenty of light from the side and back may be had, while the sink should be close at hand. The counter should be of the same material—hard wood—as the fixtures; or, if hard wood has not been used for the fixtures, the counter top at least should be of walnut, mahogany, oak, ash, or cherry.

Fig. 479 shows the front of a prescription counter formerly used by the author. The upper portion is divided into three spaces, the middle one of which is covered with a single sheet of plate glass, while the other two are occupied by plate mirrors; the lower portion is divided into closets, which are protected by glass doors, and suitable articles are displayed on the shelves in the closets; these, like the closets under the dispensing counter, are very useful as receptacles for many small articles which are attractive to persons who are waiting for prescriptions.

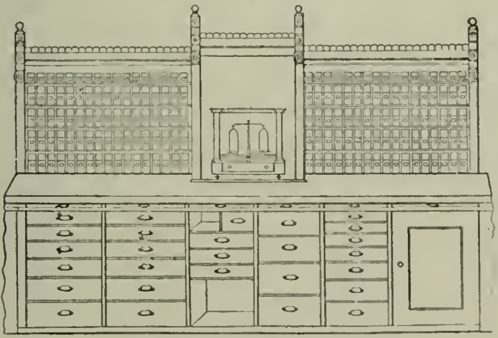
FIG. 479



Prescription counter, front view

The arrangement of the back of the prescription counter is probably of more importance than that of any other part of the fixtures. The fact that the customer rarely sees this part of the store is one of the reasons why it should *not* be neglected. The best reason for devoting thought and care to planning the arrangement of the prescription counter is that here, more than in any other place, the fate of a human life is often decided. Hence system, order, and cleanliness should be the guiding rule. Fig. 480 shows the back view of the prescription counter. The upper portion presents a series of open shelves, containing rows of japanned tin cans, uniform in color and in style of label with the shop cans. The lower shelf, in each section, is devoted to the volatile oils. These are contained in glass stoppered bottles, which are placed in the cans; or, if preferred, the original bottles in which the oils are bought are placed

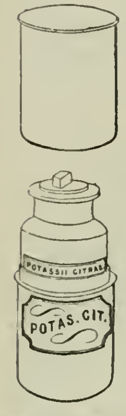
FIG. 480



Prescription counter, back view

in the cans. The oils are thus protected from light, air, and dust, and in the latter case the label of the dealer is constantly before the dispenser, and the quality of the oil under surveillance. The second, third, and fourth rows are used to hold the chemicals and dry pharmaceutical non-poisonous products which are constantly in use. In compounding prescriptions, some of these cans are filled directly from the larger shop bottles, and the substance, if without action on the tin, is not first put into smaller bottles, but is placed at once in the can. Substances like sodium bromide, hydrated chloral, potassium citrate, etc., are placed in bottles, and these then put into the proper tin cans. Fig. 481 shows one of these cans. The upper row is devoted to extracts, these being contained in jars, as shown in Fig. 482. The cans should be thoroughly japanned, and the label may be painted in large, black, distinct letters upon a gold ground. The substances should be arranged alphabetically, so that they can be readily found when wanted. This arrangement enables the dispenser to exclude the light, air, and dust from the substances, and to use the original bottles in which the manufacturer has sold the chemical, thus enabling their product to be at once identified, besides lessening the danger of errors; while another advantage is that the unsightly display of bottles of all sizes and shapes containing chemicals, with the labels more or less worn, soiled, and fly specked, is avoided. The poisons, alkaloids, and very powerful substances should be kept in a separate closet, and the bottles marked with a poison mark; for, although the pharmacist should early learn to place no absolute dependence upon any *special system* of preventing errors, but always to realize that constant, unremitting vigilance is the only safeguard, the adoption of some expedient which will aid in calling attention to poisonous compounds serves to impress upon all, particularly the junior assistants, the fact that safety can be secured only at the expense of the most scrupulous care. Fig. 483 shows Holbe's poison closet. The arrangement shows three closets in one. To each is assigned separate apparatus with lock and key.

Fig. 481

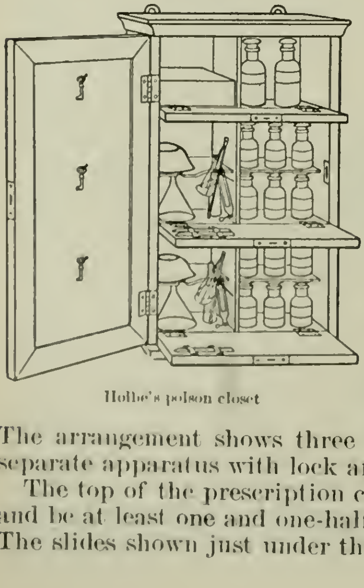


Can for prescription counter

Fig. 482

Extract can for prescription counter

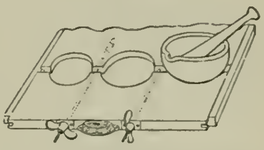
Fig. 483



Holbe's poison closet

The top of the prescription counter should be made of hard wood, and be at least one and one-half inches thick if durability is desired. The slides shown just under the edge of the counter are very convenient. They can be relied upon, when they are pulled out, in an emergency, to double the capacity of the counter. One of the slides may have a sheet of ground glass set into it by chiselling out sufficient of the wood on the face to allow the glass to be set in flush with the surface of the slide upon a bed of label cement (three parts rosin and one part yellow wax). This forms a convenient ointment slab, particularly for making up a rather large quantity of ointment. It is easily cleaned and kept in order. Two of the slides should be appropriated to folding powders and kept exclusively for this purpose, and one reserved for holding the pill machine when in use, while one may have three circular bevelled holes of different diameters cut through upon the front of the slide. If a strip equal in width to one-half the diameter of these holes is sawed out, as shown in Fig. 484, and then connected by two screw bolts which project entirely through the strip, it will be possible, by attaching thumb screws to the ends of the bolts, to clamp the mortar securely. The holes should be wider in diameter at the bottom than at the top, so that the "bite" of the clamp will be stronger when the mortar is securely clamped. It is useful in working tough pill masses, or in making emulsions quickly. The drawers in the counter are appropriated to various purposes. Those on the left are partitioned off, and contain pill, powder, and suppository boxes, each in its proper division. Ointment jars of various sizes occupy another set in the next row; the top drawer and the one immediately below it contain the pill machines; lozenge cutters, cachet machines, suppository moulds, etc., are in another drawer, spatulas, stirring rods, etc., in still another. Prescription bottles of all sizes (cleaned and dried, and, if preferred, corked) are in the next section, while cut labels, capping paper, scissors, and corks, in partitioned drawers, find places in the succeeding row. One of the upper drawers in the middle of the counter should be set apart for towels, while the open space below is convenient for holding the box to collect the scraps of paper and light waste which accumulate during the day. The closets hold the mortars and pestles, ointment slabs, etc.

FIG. 484



Device for holding mortars

Arrangement of Laboratory and Cellar.—The suggestions that are to be made upon the above subject must necessarily be of a very general character, as the circumstances of pharmacists vary greatly. The apparatus employed in the making of the various preparations has been already considered under the heads devoted to the subjects, hence the general arrangement must now receive attention.

The Laboratory.—This very important room in the pharmacy should be fitted with every facility for carrying on the various operations required, with ease, rapidity, and comfort. In most establishments but one room is available for this purpose, and this directly in the rear of the dipensing room. The manufacturing pharmacist, who makes preparations on the large scale, is compelled to devote much time and thought to the most advantageous arrangement of space, and he generally selects a location in an unfrequented portion of the town or city, or in the suburbs, where property is cheaper and railway facilities are abundant, while the retail pharmacist is fortunate indeed if he can set apart a special room on the first floor adjoining the dispensing room for a laboratory. The essential features of this room are a good light, an unfailing supply of cold and hot water, a good flue for carrying off vapors, and sufficient room for counters, closets, shelving, etc.

If steam can be introduced, so that steam kettles, evaporators, etc., can be used, it will be a great convenience. The boiler may be most suitably located upon the first floor or in the cellar. In those cases where the space for a permanent boiler cannot be spared, Prof. Patch's small steam boiler may be used. This will permit the use of steam without requiring much room, and, when an operation is concluded, the expense of keeping up the fire, as is the case in the use of coal, will be saved. A drying closet (Fig. 219) for desiccating drugs, herbs, lozenges, etc., on trays, is preferably located here, while furnaces, gas stoves, etc., must be suitably placed. Closets, arranged to hold stills, condensers, dishes, kettles, funnels, measures, etc., must be provided, while working counters, having either wooden tops covered with sheet lead, or slate tops, must be arranged so as to obtain the greatest number of advantages. Care should be exercised to have the floor, whether of stone or of brick, laid in cement, and slant gradually, so that when it is washed the water will naturally run toward the waste pipe, which should be located in one corner. If a stone or brick floor is inadmissible, an ordinary board floor, covered with sheet zinc in those portions likely to become wet, can be made to answer. The following illustrations will serve to give some idea of the general plan of a pharmacist's small working laboratory. The special apparatus is, of course, not figured, as it would interfere with the view of the general arrangement of the counters, etc. For a

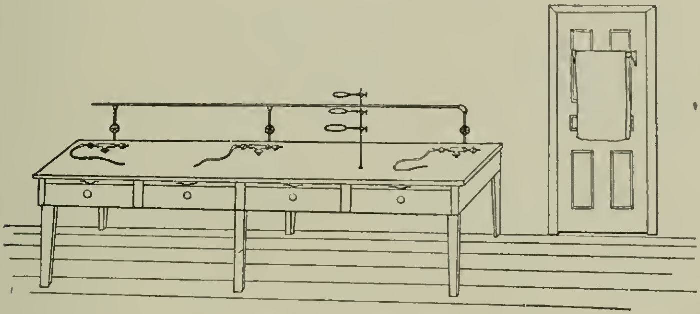
Fig. 485

Laboratory, northern side

detailed description of the apparatus the reader is referred to the illustrations in the previous chapters and to the descriptions of the various processes of operative pharmacy.

The illustrations represent the counter and apparatus for the four sides of the room. Fig. 485 represents the northern side. This is devoted to the larger operations of evaporation, distillation, etc. The steam boiler, copper kettles, still, sink, etc., being here, a steam pipe from the boiler may be run into the store for heating purposes or to supply steam for small kettles, water baths, etc., there. Fig. 486 represents the eastern side, the most prominent object being a work table, with gas and steam attachments. The retort stand, shown in Fig. 187 may be used in either of the three holes in the counter, or it may be unscrewed and put away in pieces. Four large drawers and slides are seen in this counter. An adjustable vise might occupy space at one end, and at least one of the drawers should be set apart for tools of general utility, as hatchet, hammer, saw, plane, chisel, etc. The other drawers may contain corks, bladder, twine, spatulas, scoops, glass tubing, cork cutters, etc., and other articles employed in flask operations, small distillations, etc., since this counter will be used for purposes of this kind. Fig. 487 is the counter, with a sheet lead top, used for chemical work, testing, etc. It should be on the south side, so that the northern light shall fall directly upon it. A small sink at one end will be a convenience. Appropriate drawers, slides, and a closet for holding chemical apparatus are also provided. Fig. 488 represents the pharmaceutical counter, with the percolating stand (see Fig. 415) above it; two large closets to hold the percolators when not in use, and six drawers, with slides, will complete the arrangement of this counter.

Fig. 486



Laboratory, eastern side

The Cellar.—This usually neglected locality should receive as much attention as the more favored portions of the store. It should be placed in charge of one or more of the assistants, and the responsibility for keeping it in good order definitely fixed. Good light is generally difficult to obtain, and care is necessary in the use of gas lights, lanterns, etc. The floor should be of cement, stone, or brick, and, above all, the cellar should be thoroughly drained. Good facilities for lowering and hauling heavy boxes, barrels, and packages should be provided, while the stock of prescription bottles should be kept in covered bins arranged on deep shelves, the doors being hinged from below, and each bin being distinctly labelled with the size of the bottles contained in it. In most stores the heating apparatus, whether it be a furnace or a portable heater, is located in the cellar; and the position of the heater in the cellar will largely determine the proper arrangement of the stock which is kept there. Undoubtedly the most useful feature about the cellar of a pharmacy is the fact that it affords a suitable place for keeping surplus stock, heavy or bulky articles, and those which are perishable if exposed to heat, light, or the too dry atmosphere of the upper rooms.

Fig. 487

Laboratory, southern side

The stock of mineral waters, or of liquids which are capable of freezing, should be kept near enough to the heater to prevent an accident arising from too low a temperature in winter, while ointments, cerates, volatile oils, ethereal and alcoholic liquids, etc., should be placed in the cooler portions of the cellar. If a fire proof vault made of stone or brick can be provided, it will be found a great convenience for keeping the latter class of preparations. The capabilities of the cellar should be made an object of study, and a particularly cool spot should be selected in which to keep the ointments. If this should happen to be in an inconvenient place, or too far away from the steps leading from the store, one of the stock closets in the store may be converted into a dumb waiter and lowered into a pit dug in the cellar. When an ointment is needed, the dumb waiter can be easily hauled up, secured, and, after the object is accomplished, lowered into the cooler atmosphere.

The carboys containing acids, etc., are generally regarded as cumbersome and unwieldy objects. They may be stored on skids in the least valuable portion of the cellar. The method of pouring from a carboy is by the use of Stevenson's carboy rocker (see Fig. 441).

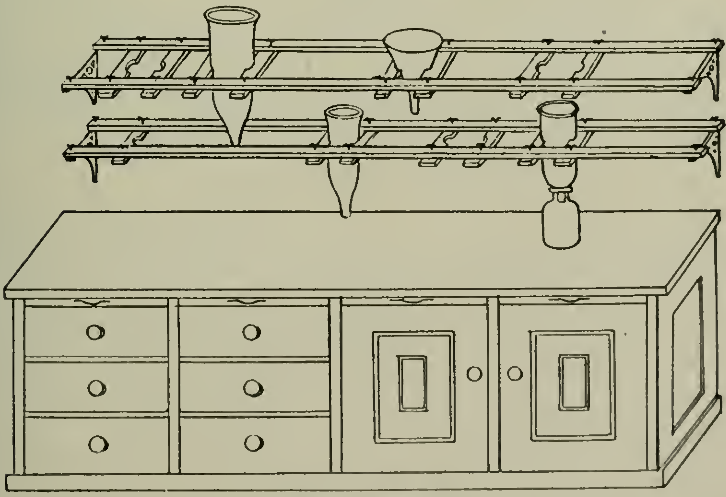
Demijohns may be protected from breakage and are conveniently used in the cellar if crated, or Banker's tilting demijohns may be used (see Fig. 489).

The custom of dispensing carbonated beverages has an advantage which is frequently overlooked,—namely, the fact that the fountains are efficient fire extinguishers. A line of gas pipe extending the whole length of the cellar, with suitable outlets, would not be an expensive investment, and yet in case of fire in the cellar it would be easy to form an attachment with a fountain of "soda-water" and thus convey a stream to the locality of the fire. The small portable steel fountains now in use would in many cases do away with the necessity for the length of gas pipe, for they could be dragged to the fire, and their contents would prove very effective if used in time.

One rule should be rigidly insisted upon in the care of the stock in the cellar, and that is that when a box of empty bottles or mineral water, or any boxed package, is opened, the contents should be distributed to the bins or places assigned for them, and the empty box and litter immediately removed.

Dampness and mould, which are generally so destructive to the stock kept in the cellar, may be avoided by ventilation. A change of air can always be secured by opening windows in the opposite ends of the cellar, and the musty odors so frequently noticed will rapidly disappear if attention is paid to ventilation.

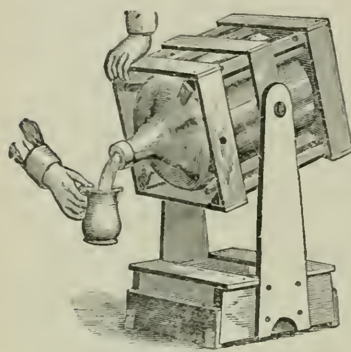
Fig. 488



Laboratory, western side

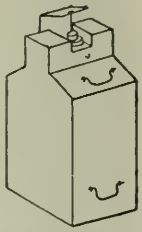
The stock of liquids is usually kept in demijohns and large green-glass bottles. These should be arranged on shelves, the larger packages on the lower shelves. The wooden covered glass demijohns and tinned iron cans, known as transportation cans and demijohns, are very useful in this connection (see Figs. 489 and 490). *Great care must be taken, however, in the use of tinned iron cans for pharmaceutical liquids.* It is not safe to store acid, alkaline, or corrosive liquids in them, nor those containing tannin, on account of their injurious action on the tinned iron. The safest plan is to limit the use of cans to oils, glycerin, alcohol, and fatty bodies, which contain nothing capable of acting on the tinned iron. The large containers should be labelled in two ways. The official name should be stencilled plainly upon the wooden side which is most prominent, and in addition there should be a tag properly labelled and tied to the handle; upon the reverse side of this tag the date showing when the contents were made, with any other useful notes or data, should be placed. The half-gallon and smaller stock bottles should be labelled distinctly with large letters. A serviceable label is made by using heavy manilla paper, and instead of an ordinary pen a camel's hair brush or a piece of pine wood whittled to a flat, stub point like a German text pen, dipped into black asphalt varnish, may be used to make the letters.

FIG. 489



Tilting demijohn

FIG. 490



Container for stock liquids

In concluding this chapter, the following rules for drug clerks are appended, they were formulated by J. B. Moore, of Philadelphia, a pharmacist of large experience and worthy attainments.

RULES FOR DRUG CLERKS[1]

Pharmacists who desire to become good and successful business men should always be on the alert, wide-awake, and observing. Watch closely the character and methods of successful business men; study human individuality; the different dispositions of people you meet in business and in your wanderings; observe the expressions on their countenances and form your opinion of their natures, characteristics, habits, tastes, etc., and study the influence of words and expressions upon your own and other minds. Think much and learn what will please and attract, also what will offend and repel.

Practise the habit of scanning the features of people who enter the store, and form an opinion of how best to pleasantly address them. Some will want you to be sociable and chatty, while others who are morose and taciturn will want but little said, and that to the point.

Remember, you have a business life ahead of you, and all this kind of knowledge is invaluable. The possession of it may also assure you success, while the lack of it may lead to failure.

The following rules will embrace almost every important act and duty of the store, and their study and observance will greatly aid you in becoming a first-class pharmacist, which every votary of the pro-

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[1] See Druggist's Circular, 1905, page 75.

fession should aim to become. If this is not your object *you certainly have mistaken your calling.*

1. **Personal Appearance.**—Clerks are expected to be well clad and present a neat and clean appearance. No one is allowed to wait upon customers in his shirt sleeves; proper respect for ladies and your own sense of propriety should forbid it.

2. **Personal Conduct.**—Avoid the use of spirituous beverages and tobacco in any form, also the offensive habit of profanity. Be truthful always.

3. We do not desire to interfere with your religious principles and inclinations, but would say that good citizenship, respect for God, and your own moral worth, should induce you, by all means, to attend divine worship once on Sunday, or at some time during the week, as your time and convenience may permit. This will tend to confer upon you a better standing, and will inspire public confidence and esteem.

4. Be particular and discriminating in the choice of your intimate associates, as your future welfare and happiness may greatly depend upon it.

5. An occasional call or short visit to the store by a friend is not objectionable, but prolonged stays, which are likely to divert a clerk's attention from his business and interfere with his duties, should not be encouraged and will not be tolerated.

6. Do not indulge in levity, loud talk, noisy conduct, whistling, singing, smoking, or other unseemly behavior in the store.

7. If necessary to ask a question of the proprietor or another clerk, go to him quietly. Do not call across the store that others may hear.

8. **Keeping up Stock.**—Be ever watchful when making a sale to notice if there remains a sufficient stock of the article sold, or that of any adjacent article; if not, make a proper minute at once upon the "want book." Every clerk and employee should be on the alert, all the time, to discover shortage in stock. Being "out of" goods called for is the bane of the business.

9. Before you place goods in stock they should be distinctly marked in ink with the cost and selling price; and later, if in handling you discover any goods unmarked, you should mark them at once, or leave them out to be marked.

10. Every day, or at leisure moments, never neglect to look after the stock of all goods that are kept in packages, bottles, boxes, etc. Also all the specialties and other goods that are put up for immediate delivery. Make a memorandum of all those that are out or nearly so, and replenish the stock at once, or at the earliest possible moment. Do not keep people, who may be in a hurry, waiting until you prepare a bottle of solution of magnesium citrate, or a seidlitz powder, or put up some other article which you ought to have ready for instant delivery. Also keep your shop bottles and shop drawers well filled. Scantily filled shop bottles suggests poverty or a lack of good business management.

11. In handling stock of any kind, either in the store, cellar, or laboratory, be careful to observe any article that has deteriorated or is becoming impaired by age, exposure, or any other unfavorable con-

dition; also, if any preparation, or any product of the laboratory, needs replenishing. Your duty and your just concern for your employer's interest should induce you to immediately report to him all such facts and circumstances.

12. The show cases, the counters, and the stock upon them should be kept clean and in order. If the cases have metal frames, these should be scoured two or three times a week and be kept bright. The cases should be wiped off every morning and dusted frequently. The contents of the cases should be kept in order, the goods changed and rearranged often to make them look fresh and attractive.

13. Avoid entirely, or as much as possible, sweeping and dusting while customers, especially ladies, are in the store.

14. In dispensing asafetida, powdered aloes, and other offensive articles, suppress as much as possible their objectionable odors, and prevent them from permeating the atmosphere of the store. In making and dispensing all offensive articles like elixir of ammonium valerianate and other valerianic preparations, and all other articles which diffuse an unpleasant smell, you should confine the work to the cellar and laboratory when practicable. The atmosphere of a pharmacy should be kept as pure and as free from all offensive odors as possible.

15. The good and desirable clerk, who aspires to a permanent position, with advancement and increase of salary, will take pride and pleasure in keeping the store in a neat and clean condition, will keep the counter show cases and all the other show cases always in order, and the stock neatly arranged and displayed in a tasteful and attractive style.

16. **Waiting on Customers.**—When a customer enters the store, greet him with a bow or a pleasant "Good morning" (or "afternoon" or "evening," as the case may be). If the customer is a lady, unaccompanied by a gentleman, and it is convenient for you to do so, accompany her to the door, and open and close it for her. These little courtesies and evidences of refinement are always appreciated.

17. If you are in the rear of the store, the sound of the door opening, or of footsteps upon the floor, should be a summons for immediate attention. Do not keep a customer waiting and wondering if any one is in. If you are out of view or deeply engaged, announce your presence, or step forward and pleasantly ask him to wait a moment; if, however, he cannot wait, endeavor to serve him at once.

18. All persons must be waited upon promptly, and the same courtesy, patience, and kindness must be shown to the smallest child and humblest citizen, irrespective of color, as is paid to the most distinguished personage. The dollars you get from them are of the same value.

19. All customers should be waited upon as nearly as possible in the order in which they entered the store. Some diffident and modest persons, especially children, may enter while you are busy and will not press forward to take their turn at the counter, and may thus be neglected. Therefore you should ever be on the alert and call or beckon to them to come forward to be waited on, otherwise they may go out offended, feeling that they have been neglected.

20. Never hastily tell a customer that you do not keep or that you are "out of" an article until you have searched for it and assured yourself by inquiring of others that it is not in stock. Then kindly offer to promptly get it for him.

21. Never be so ill-bred as to sneer or smile in derision at persons who happen to ask for an article under a wrong or distorted name. You might go just as far astray in asking for something in another kind of store.

22. Never hesitate to ask all necessary questions. This is often requisite to enable you to act intelligently in serving a customer.

23. When a customer is making known his wishes, pay strict attention to avoid the necessity of asking him to repeat his words. If a few minutes will be required to fill his order, pleasantly ask him to take a seat.

24. In waiting upon a customer, endeavor to give him your undivided attention, if possible.

25. In selling goods, especially toilet articles, perfumery, and fancy goods generally, never ask a customer what priced article he wants, nor in a miserly manner show a single article at a time; but hand out tooth-brushes by the handful, hair, nail, and other brushes, combs, perfumery, and all fancy articles in lavish quantities and pleasing variety, politely directing attention to your highest priced goods as a feeler, then successively descending the scale of prices, commenting modestly, intelligently, and instructively upon the merits of the goods, until you have met the views of your customer. Be not too importunate, and avoid offensively antagonizing his views and opinions. After a reasonable endeavor to suit, and you fail, express your regret at not being able to please him, evince no disappointment, but in a cordial and friendly manner invite him to call again. You can justly praise your best goods, but you should not speak disparagingly of your cheaper ones. Be *frank* and *honest* in what you say, and aim to suit and please your customer in what he wants.

26. After showing goods, replace them at once, or at the earliest possible moment, and properly rearrange the stock. Never allow tempting goods to lie around on the counter or show cases, where they are liable to be carried off.

27. All goods of every description, from the most insignificant to the most important, should be neatly wrapped in paper and tied with a string. If there is more than one article all should be wrapped together and made into one neat and compact package. To hand a customer a syphon of soda water, or a bottle of any of the drinking or mineral waters without wrapping it in paper, as is so often done, is a crude and slovenly style of doing business. To many fastidious persons this would be an offence against propriety which might be resented by the withdrawal of their patronage.

28. In supplying syringes or other surgical appliances, and especially to ladies, do it in the most respectful, modest, and becoming manner. Exhibit the goods at a part of the counter or other part of the store where there is the most privacy.

29. When medicines of a private nature are called for, and especially by a lady, avoid indicating by word or action that you are aware of their uses.

30. In case of any complaint, serious misunderstanding, or dispute with a customer, refer the matter at once to the proprietor, if he is in the store; or, if he is absent, be conciliatory in your manner, and reason pleasantly, making all necessary explanations, and if complete reconciliation cannot be effected, leave the matter for future adjustment by the proprietor.

31. Remember that our customers are our friends and benefactors. It is their generous patronage that gives us prosperity and enables us to provide ourselves with the necessaries and comforts, if not with the luxuries, of life. Therefore, how important it is that when a customer crosses our threshold we should greet him with every evidence of kindly welcome and extend to him every accommodation within reason to win and retain his confidence and patronage. Never treat him, as too many do, with an air of independence and indifference.

32. **Recommending Goods.**—In selling goods or medicines of any kind which are of rare and superior quality and excellence, you can with propriety modestly call your customer's attention to the fact. Many persons would be interested and pleased to know it.

33. Our specialities and goods of our own make are the most profitable, and should be given the preference when it can be done without offence. You can with propriety and often with advantage, *after the customer has made his purchase*, call his attention to and show him a similar medicine or article of our own make, speaking highly but modestly of its excellence, and at the same time saying that if the article he is getting does not cure, or is not satisfactory, you would be pleased to have him try our make, at the same time handing him a circular of the article, if you have one. But do not annoy or make an unfavorable impression upon him by importunity.

34. In selling medicines of any kind you should be frank, conscientious, and *truthful* in your statements in reference to its quality and usefulness. Never commend an article above its intrinsic therapeutic merits. Do not advise a customer to purchase a medicine of whose composition and medicinal qualities you are ignorant, nor recommend the use of a medicine whose therapeutic adaptability to the case you may question. In fact, it would rather be well to drop a word of warning and discouragement, especially to the poor and ignorant, against the purchase of a medicine, the use of which you believe may prove more harmful than beneficial. There is hardly a business in which fraud and deception can be practised with such impunity, and with so little fear of detection, as in pharmacy, and it is a bad man who would take advantage of the opportunity to practise it, where the health and the very life of the individual is involved.

35. **Stamps, Directory, Telephone, etc.**—When persons call for stamps, postal cards, etc., you should sell them all they want, or as many as can be spared, and wait upon them as promptly and courteously as if they were buying the most profitable articles.

36. Politely hand the directory to people calling to consult it, or tell them where to get it, and pleasantly answer all questions concerning its use, and, if necessary, try to find the name of anything they may be looking for and do not know how to find.

37. Be agreeable and obliging to your telephone customers; extend to them every aid you can in finding names in the telephone book;

advise them in the use of the telephone, and 'phone for them if you have time and if they request it, or do not understand how to use the instrument.

38. Willingly accommodate persons calling for change, whether customers or not, and manifest pleasure in serving them. These little accommodations cost us nothing and occasion slight trouble, and often confer a great service in time of need, and are generally appreciated by the public and redound to our credit and promote our success in business.

39. Persons stepping into the store to wait for a car or for any other purpose should be politely and pleasantly invited to take a seat, and by your cordial manner made to feel that they are welcome.

40. When persons call to inquire about *anything*, answer in the most courteous and agreeable manner, giving them the fullest information possible, even if it puts you to some trouble. This may often make a friend and future customer, while a rude and discourteous reply is apt to make you an implacable enemy.

41. **In the Prescription Department.**—When a person hands you a prescription, do not stand in his presence and ponder over it as though you did not understand it. Politely thank him and invite him to be seated, and at once go behind the prescription counter, where you can critically examine it.

42. In refilling prescriptions you must see that all soiled containers are thoroughly cleaned, a new label is affixed, and, in the case of a bottle, a new cork is used, making the package as fresh looking as when new. All labels must be neatly and distinctly written and carefully applied.

43. All pill masses should be carefully made. Proper excipients should be chosen and so cautiously and carefully added as to give the pill sufficient firmness to retain its shape on standing without the addition of any absorbent powder to stiffen it, and which unnecessarily augments its size. When the ingredients are mixed and ready for the excipient, if doubt exists as to the best one, it will be well to experiment with several small portions of the mixture to ascertain the best excipient, then mix all together and go ahead. This may often save you much trouble.

44. In compounding liquid medicines, all crystalline salts and all solid substances of tardy or sparing solubility, or that are insoluble in the liquid ingredients of a mixture, should first be reduced to the finest possible state of division in a mortar before admixture. They should not simply be thrown into the bottle to be shaken up with the liquid ingredients, perhaps to deposit and remain in coarse particles, to the disgust of the patient and to mar the appearance of the mixture. You have no right to strain out any insoluble *medicinal* ingredient. Physicians never add any ingredient that they do not want retained in the mixture. When you have reduced the solid material to the utmost fineness, you have done your duty. Put a "shake well" label on the bottle of all mixtures containing insoluble matter, and if the deposit is of much potency, also verbally call attention to the importance of shaking the medicine well before taking. You must in such cases sacrifice beauty and elegance to medicinal efficiency. Look through and examine all mixtures and remove any

visible specks or other accidental impurities. It is well to pass all suspected mixtures through a fine tea strainer, which I consider an indispensable adjunct to the prescription counter.

45. In dispensing powders, after the ingredients are all thoroughly mixed, to insure greater uniformity, elegance, and purity, the mixed powder should be passed through a No. 80 sieve, and the coarse particles should be returned to the slab or mortar for further trituration and repeated sifting until the process is completed, when the powder should be again thoroughly mixed and then dispensed as directed.

46. All mortars, graduates, spatulas, and utensils whatsoever, employed in filling prescriptions and in the manufacture of preparations, should be washed, cleaned, and put away where they belong immediately after use. All shelf bottles and all bottles and containers brought from the cellar or elsewhere to supply a portion of their contents, should likewise be at once returned to their proper places and not allowed to remain on the counter or floor. The sponges used at the prescription counter and sink should be frequently washed with soap and ammonia water to keep them clean. Do not leave them lying about the counter or in the sink, foul and filthy, as is too often done.

47. Be sure to cork all bottles carefully and well, especially those containing medicine dispensed on prescription. Select corks of good quality and proper size. After properly pressing them, gently force and adjust them into the neck of the bottle to about one-third their length, or sufficient to give a firm fixedness, leaving enough of the cork projecting for convenient handling.

48. All errors in compounding prescriptions, in dispensing or in the delivery of prescriptions or medicines of any kind, should be at once reported to the proprieter; for by his prompt, intelligent, and timely action he may frustrate, avert, or at least modify any evil consequence.

49. **Charging Goods.**—When goods are to be charged, no duty, however important, must prevent the clerk from charging them at once or filing a memorandum. No one can estimate the loss to retail dealers each year on account of neglect of this precaution.

50. In the absence of the proprietor and his manager, refrain from opening new accounts with persons of doubtful or unknown responsibility, and abstain from augmenting long-standing, unpaid accounts. The clerk can generally, with grace and without offence to any honest person, decline by politely saying, "I am extremely sorry, but in the absence of the proprietor I cannot assume the responsibility of selling goods on credit." Of course, if you believe the person to be responsible, and the account is small, you might, to avoid delay and possible offence to a good customer, accommodate him and report the transaction at the earliest opportunity.

51. A clerk or employee who desires any article out of the stock of the store, should not take it surreptitiously,—that is, without the knowledge of the proprietor or his manager. Whether he pays for it or not, such a transaction is questionable and reprehensible. He should make his wants known to the proprietor, preferably, or to his manager, who may accede to the request, adjust the price and terms of sale. If the goods are charged, payment should be made to the

proprietor or manager. This is the only proper and honorable course to pursue. It protects the reputation of the clerk and inspires confidence in his integrity.

52. **Using the Cash Register.**—In using the cash register, all registrations must be so made as to indicate the full amount of the sale. Intentional and persistent infractions of this rule will insure summary discharge.

53. **Sending out Goods.**—There must positively be no unnecessary delay in despatching all goods for which orders have been left or sent, whether haste has been requested or not. Nothing more injuriously affects the business character of a store than habitual tardiness in the delivery of goods, and especially if they be prescriptions, when, perhaps, a sick and nervous person may be waiting in intense and feverish anxiety. When an unavoidable cause has occasioned delay, a proper apology or explanation should be made in writing or verbally upon the delivery of the goods. Promptitude in business establishes confidence, is characteristic of a good pharmacist, and is a potent factor in his business success.

54. **Poisons.**—You must exercise great care and caution in selling poisonous, strongly caustic, and highly irritating or corrosive substances. They should be carefully and correctly labelled, and also with the word "poison." The purchaser should be cautioned as to their dangerous character, and all necessary verbal precautionary directions for their use and keeping should be given to awaken attention and emphasize their noxious nature. A correct registration of the sale of the article should always be made in compliance with the poison law of the State.

55. **Answering the Night Bell.**—The night bell must be promptly and pleasantly answered. It is one of the inseparable and disagreeable features of the business. But for consolation, imagine it is yourself at the door, suffering with cramp-colic, a hemorrhage, or some other painful or dangerous malady, seeking relief, or with a prescription to be renewed for a sick mother, wife, child, or other dear one lying at the point of death, and I know your wrath will be appeased and you will pardon your untimely caller.

56. **The Soda Counter.**—Everything pertaining to the soda fountain should be kept in order and scrupulously clean ; glasses, spoons, etc., should be washed immediately after being used. A sloppy soda counter, with glasses, tumbler holders, spoons, etc., strewn about in confusion and in a dirty condition, together with soiled napkins and old straws, is repulsive and disgusting to customers, and bespeaks laziness and slovenliness. Dirty glasses and spoons should not be allowed to remain in the sink. The soda apparatus should be washed daily, and the draught tubes, syrup faucets, and the other metal parts should be scoured frequently. The towels and sink should also be kept clean. The sponge should be washed daily, or oftener, with soap and ammonia water, and thoroughly rinsed. The supply of syrups and their condition should be objects of solicitude and daily inspection. Discard at once all syrups that are not in prime condition. Being "out of" any of the usual syrups when they are called for makes a bad impression. The beverages should be drawn with care. Syrups and other admixtures should be well mixed and not allowed

to remain in the bottom of the tumbler to be drunk at the last swallow, as is often the case. In dispensing ice cream soda first mix the syrup and soda water thoroughly with a spoon before adding the ice cream.

57. **General Guide to Work.**—Every act in pharmacy should be performed with care, thoughtfulness, intelligence, and the greatest accuracy. Your own liberty and the lives of your customers depend upon it. Do nothing that does not receive the sanction of your conscience and your best judgment. Be ever mindful of the old adage: "Be sure you are right, then go ahead."

58. The opening and closing of doors and drawers, and the handling of utensils should be done as noiselessly as possible; especially avoid the clanging of the pestle against the sides of the mortar, which is so trying to the nerves of delicate and sensitive people. In fact, every movement about a pharmacy should be made as silently as possible. Quietude is characteristic of a first-class pharmacy.

59. Always carefully and accurately weigh and measure everything you sell or use, and acquire the habit of wrapping and tying packages neatly and tastefully. At the prescription counter weigh and measure with the greatest accuracy. See that your prescription scales are clean and accurately balanced and always wipe the balance pans after using. Take pride in learning to fold powders with care, neatness, and the greatest uniformity.

60. Be ever watchful and never sell a bottle of solution of magnesium citrate that is cloudy or contains an unsightly flocculent or solid precipitate; nor any medicinal syrup in fermentation, or otherwise in bad condition; nor any tincture or other liquid preparation which is avoidably cloudy or containing any unmedicinal precipitate until it has been filtered; nor oatmeal, orris root, or other vegetable powder, ground or unground, inhabited by worms or insects. In fact, you should sell no article that has so visibly deteriorated as to impair or destroy its usefulness. The reputation of any pharmacy will depend largely upon the rigid observance of this rule.

61. We do not expect, nor do we desire, our clerks to be mere machines. We wish them to be wide awake, thoughtful, experimental within proper bounds, studious, and observing. If they are ambitious, apt, inventive, ingenious, and practical, and seek to learn, they may, in their daily practical experience in the prescription department and the laboratory, conceive, develop, and discover many new ideas and better methods. To this end there is a wide field open in the preparation of the various peculiarly difficult and unusual mixtures, emulsions, capsules, intractable pill masses, troublesome ointments, etc., also in the extemporaneous manufacture of some galenical and chemical preparations which put to the test the tact, skill, and ingenuity of the most experienced manipulator. They may also be able to offer useful suggestions in the dressing of windows, the arrangement of stock in the show cases, in the store generally, and also in the cellar, and in other matters connected with the business. Aspirations and achievements of this kind will be appreciated and encouraged. All such well matured ideas and suggestions will receive our most cordial consideration, and, if approved, will merit our hearty commendation and their adoption.

62. "It is a wise man who knows what to do next." Never commence to do anything that is not required to be done for a day or more, when your last of some package goods, a bottle of one of your specialties, or other preparation which is liable to be called for at any moment, has been sold.

63. Honor and loyalty should also prompt you to report at once all mistakes in the manufacture of preparations, all breakage of glassware or other valuable articles; loss or damage to valuable material or stock; any occurrence that involves pecuniary loss; or any circumstance which is calculated to injure the reputation of the store or the interests of its proprietor. Such creditable evidences of honesty and frankness will elevate you in the confidence and esteem of your employer, while the suppression and concealment of such knowledge might justly lead to your discharge.

64. Store secrets and all private matters connected therewith should be held sacred and inviolate. The clerk who would divulge them is disloyal, and should be deemed unworthy to hold a position in any respectable pharmacy.

A Word of Advice.—Every clerk should take pride in acquiring and cultivating a kind and amiable disposition and the habit of working quickly and well.

Intelligent, quick, careful, honest, and good workers, who are polite and obliging, are "jewels," and they are always in demand at good salaries. People in a hurry will wait with patience for attention from an energetic and hustling clerk when they see he is doing his best. Besides, he inspires confidence and good will.

Avoid the habit of changing positions for trifling reasons. When you are fairly paid for your services, and opportunities are good for acquiring knowledge of your business, do not leave. Hard work will not hurt you. Shifting and idleness will. Really good clerks seldom change positions. The wanderer is always on the go, and he is the bane of the business, both to himself and to his employer. Strive to please your employer and your position will be assured. Sensible men seldom change clerks without substantial reasons. Do not listen too much to the persuasion and advice of others. Be true to yourself, honest, and loyal; do your duty and you will have nothing to fear. Remember there are counter-balancing objections to almost any new position. Many have painfully regretted the changes they have unwisely made.

CHAPTER LXIV

PRESCRIPTIONS

THE word prescription is derived from the Latin word *præscriptio* (*præ*, "before," and *scribo*, "I write"). It may be defined as the formula which a physician writes, specifying the substances he intends to have administered to a patient.

The Latin language is preferred here in writing prescriptions, as it is also in Great Britain, Germany, and other European countries. The advantages of the use of Latin in designating the ingredients of the prescription are obvious : 1. It is the language of science, and is understood, to a greater or less extent, throughout the civilized world. 2. It is a dead language, and therefore not subject to the changes that are common to all living forms of speech. 3. The Latin names for medicines are distinctive, and very nearly the same in all countries. 4. It is frequently necessary, and always advisable, to withhold from a patient the names and properties of the medicinal agents administered. This can usually be effected by the use of the Latin technical terms.

The Parts of a Prescription.—For the purpose of examination or study a model prescription may be divided into six parts : 1. *The superscription, or heading.* 2. *The name of the patient.* 3. *The inscription, or the names and quantities of the ingredients.* 4. *The subscription, or the directions to the compounder.* 5. *The signa (mark), or the directions for the patient.* 6. *The name or initials of the physician, with the date.*

1. **The Superscription, or Heading.**—This invariably consists, in Latin prescriptions, of the symbol ℞, which is an abbreviation of the word *recipe* ("take"), the imperative of the Latin verb *recipio.* In French prescriptions the letter *P*, the initial letter of the word *prenez* ("take"), is used.

The use of the inclined stroke upon the tail of the R is traced to a custom, common in the ancient days of superstition, of placing at the top of the prescription an abbreviation, called an invocation, which represented a prayer to a favorite deity. The sign of Jupiter (♃), the chief mythological divinity of the ancient Romans, was usually employed. This was gradually replaced by the letter R ; but the last stroke of the symbol of the all-powerful Jove has not yet been surrendered, and it remains as an ornament to the superscription to the present day.

2. **The Name of the Patient.**—This is frequently omitted from the prescription through inattention. It should always be placed at the top of the prescription, and should be transferred to the label by the compounder. Serious accidents have sometimes occurred through neglect of this direction, as when an adult dose of a medicine has been given to a child, owing to the similarity of the appearance of an

adult's and a child's medicine, and the name of the patient not appearing on either label.

3. The Inscription, or the Names and Quantities of the Ingredients.—This part of the prescription is undoubtedly the most important of all, and requires the greatest amount of care. The official title (see page 29) of the ingredients should always be used for designating those which are official. A model prescription, if it is of the compound class, is presumed to embrace the following: 1. The *basis*, or chief active ingredient. 2. The *adjuvant*, or aid to the basis, to assist its action. 3. The *corrective*, which is intended to qualify the action of the basis and adjuvant. 4. The *vehicle*, the ingredient which serves to "carry all," or hold them together, dilute them, and give to the whole the proper consistence, form, and color. This is sometimes called the *diluent*.

The ingredients are sometimes written down by the physician in the order given above; but this rule is frequently deviated from, and they follow in the order of their importance. This is a matter of small moment to the pharmacist, however, for he always has to consider solubility, compatibility, and other necessary considerations which determine the order, if the prescription is to be compounded properly.

Many prescriptions contain but one or two ingredients, there being no especial need of a corrective, vehicle, or diluent, the tendency of modern therapeutics being against polypharmacy and in the direction of simple and concentrated remedies, or those having positive effects. There are many advantages to be derived, however, from the combination of ingredients, even when these have similar medicinal action.

The name of each ingredient, and the quantity attached to it, should occupy but one line, and great care should be observed in abbreviating, to see that the abbreviation is distinctive and not liable to be mistaken for an article not intended by the writer. The cabalistic characters in present use, designating the quantities in a Latin prescription, must be very plainly written, if serious errors are to be avoided.

The method of ascertaining the quantities of each of the ingredients generally followed by physicians, is first to write down the names of the ingredients in the proper order, each on a separate line, without affixing the quantities; then having decided upon the total number of doses that are to be given, or the total number of pills, lozenges, capsules, suppositories, etc., by multiplying this by the amount proper to give for the single dose the quantity of the ingredient is obtained.

Method of allotting Quantities

Parts in Order	℞ Ingredients	No. of Doses	Multiplied by	Single Dose	Quantity of each Ingredient
Basis	Chloralis	16	×	7½ gr.	ʒii
Adjuvant	Potassii Bromidi . . .	16	×	15 gr.	ʒiv
Corrective	Syrupi Zingiberis . . .	16	×	fʒss	f℥i
Vehicle	Syrupi	16	×	fʒiss	f℥iii

Symbolic Characters used in Latin Prescriptions.—Although the subject of weights and measures is treated in the earlier chapters of this work, the special characters used in prescriptions, with their values attached, may be appropriately recalled in this connection. They are as follows:

♏, *Minim*, $\frac{1}{60}$ of a fluidrachm
gtt., *Gutta*, a drop; plural, *guttæ*, drops
gr., *Granum*, a grain; plural *grana*, grains
ss., *Semis*, a half
℈, *Scrupulus*, a scruple (20 grains)[1]
ʒ, *Drachma*, a drachm (60 grains)
fʒ, *Fluidrachma*, a fluidrachm (60 minims)
℥, *Uncia*, a troyounce (480 grains)
f℥, *Fluiduncia*, a fluidounce (8 fluidrachms)
℔, *Libra*, a pound, rarely used in prescriptions (5760 grains)
O, *Octarius*, a pint (16 fluidounces)

The Roman numerals are used to designate quantities,—i, ii, iii, iv, v, vi, vii, viii, ix, x, xx, xxx, xl, l, lx, lxx, lxxx, xc, c, etc. These are always written after the ingredient, as Sacchari ʒiv. Care should be taken to dot the i's in each case, to avoid possible errors. The "j" is sometimes used in place of "i" where more than one i is needed at the end of the quantity; thus, "gr. ij," meaning two grains. The "j" is oftener written like an elongated "i;" thus, "ij."

4. **The Subscription, or the Directions to the Compounder.**—The progress made in pharmacy is well shown by the present custom of omitting specific directions to the compounder. In the vast majority of prescriptions the subscription is contracted to a single letter or word, as *M.*, or *misce*, *S.*, or *solve*, *F.*, *fiat*, etc. The physician relies upon the skill of the pharmacist, and generally gives no specific directions.

5. **The Signa, or Directions for the Patient,** sometimes called Signatura, is usually abbreviated *Sig.* or *S.* Formerly these directions were written in Latin, but this is rarely the case now, except in Great Britain. There is, indeed, no good reason for writing them in Latin. The Latin which is in common use in prescription writing is idiomatic, and, although the ordinary rules of Latin grammar are generally applicable to it, many of the terms have a special meaning, and it differs in several respects from classical Latin, and hence has to be a special object of study. The directions should be known to the patient, and should be written in the vernacular on the label in a clear, distinct hand. The careless habit of not specifying the directions, by writing "As dir." for "As directed" or "Use as directed," is greatly to be deprecated. Frequently the patient forgets the verbal directions, or misunderstands them, and asks the pharmacist, "How is this medicine to be taken?" The answer must of necessity be as worthless as the direction, unless the pharmacist by skilful questioning can cause the directions to be recalled by the patient. Then, again, the dose of the prescription gives the only clue to its safety. Without knowing it, the pharmacist cannot be held responsible for not detecting an error. The patient, even if he remembers at the time the verbal directions, may soon forget them, and afterwards take

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[1] This weight is rapidly passing out of use. It is quite as convenient to write gr. xx, and this is not likely to be mistaken for ʒ, as ℈ is.

a double dose by mistake. The directions for the patient should be written in full, explicitly, and in plain English.

6. **The Name or Initials of the Physician, with Date.**—The name of the prescriber is rarely signed in full, particularly since the very general use of printed prescription blanks, which contain not only the full name and address of the physician but also his office hours. It is very necessary sometimes to communicate quickly with the physician in case of error or ambiguity, and, when printed blanks are not used, the name and address of the prescriber should be written in full.

Unusual Doses in Prescriptions.—It is to be regretted that some uniform system of indicating unusual doses has not been adopted by physicians. Occasions frequently arise where the patient, either from becoming habituated to its use, or from some other cause, will tolerate an excessive or ordinarily poisonous dose of a remedy. A careful pharmacist always hesitates to compound such a prescription if the dose is not especially marked as unusual, and delays necessarily occur. The most satisfactory method of indicating such a dose is that of underscoring the quantity deemed unusual, as shown in the following :

℞ Morph. Sulph. gr. vi
Syrup. Limonis fʒii
Aquæ q. s. ft. f℥i.
Sig. A teaspoonful every two hours until relieved.

Other marks are sometimes used,—the exclamation mark (!), for instance, or Q. R. (*quantum rectum*). These are not so distinctive as underscoring, and are open to the objection that in handwriting, which is very apt to be defective, they are likely to puzzle or mislead the pharmacist by being mistaken for some other parts of the prescription. A heavy black line under the unusual dose cannot be mistaken.

One of the best works published upon prescription Latin is the Latin Grammar of Pharmacy, by Joseph Ince, London. The student will be well repaid by a careful perusal. The following Latin prescription from Whitla's Elements, with the grammatical analysis, is so thoroughly illustrative that it is inserted almost in its entirety :

℞ . . . . SUPERSCRIPTION
(Basis.) *Pot. Acet.* ʒv.
(Adjuvant.) *Tinct. Digitalis* fʒi. INSCRIPTION
(Corrective.) *Syr. Aurantii* f℥i.
(Vehicle.) *Decoct. Scoparii ad* f℥viii.
M., ft. mist. . . . . SUBSCRIPTION
Cpt. cochl. mag. ii. 4ta q.q. hora ex paul. aquæ. SIGNA

Without abbreviations or contractions it would read thus :

Recipe
Potassii Acetatis drachmas quinque.
Tincturæ Digitalis drachmam unam.
Syrupi Aurantii unciam unam.
Decocti Scoparii ad uncias octo.

Misce, fiat mistura. Capiat cochlearia duo magna quartâ quâque horâ ex paululo aquæ.

The student will find benefit from a careful study of the following page, in which the Latin of the above prescription is arranged according to the English idiom, and each word parsed and translated.

Recipe Potassii Acetatis drachmas quinque

℞ (Recipe)	v. irr. tr. imp. m. 2d per. s., to agree with its nom. Tu—"thou" (understood). Recipi-o, recepi, receptum, recipere. From re and capio.	Take thou
v (quinque)	num. adj. indec. ac. pl. qual. and agreeing with drachmas.	five
ʒ (drachmas)	n. f. ac. pl. Drachma, -æ.	drachms.
Acet. (acetatis)	n. f. gen. s. qual. drachmas. Acetas, -atis.	of acetate
Pot. (potassii)	n. f. gen. s. qual. acetatis. Potassium, -ii	of potash

Recipe Digitalis Tincturæ drachmam unam

℞ (Recipe)	(understood.)	Take thou
i (unam)	num. adj. ac. s. qual. and agreeing with drachmam. Unus, -a, -um.	one
f ʒ (drachmam)	n. f. ac. s. gov. by recipe. Drachma, -æ.	drachm.
Tinct. (tincturæ)	n. f. gen. s. qual. drachmam. Tinctura, -æ.	of the tincture
Digit. (digitalis)	n. f. gen. s. qual. tincturæ. Digitalis, -is.	of digitalis

Recipe Aurantii Syrupi unciam unam

℞ (Recipe)	(understood.)	Take thou
i (unam)	(Parsed as before.)	one
f ℥ (unciam)	n. f. ac. s. gov. by recipe. Uncia, -æ.	ounce
Syr. (syrupi)	n. m. gen. s. qual. unciam. Syrupus, -i.	of syrup
Aur. (aurantii)	n. neut. gen. s. qual. syrupi. Aurantium, -ii.	of orange peel

Recipe Decocti Scoparii ad uncias octo

℞ (Recipe)	(understood.)	Take thou
Ad.	prep. used adverbially.	up to
viij (octo)	num. adj. indec. qual. uncias.	eight
f ℥ (uncias)	n. f. ac. pl. gov. by recipe. Uncia, -æ.	ounces
Decoct.[1] (decocti)	n. neut. gen. s. qual. uncias. Decoctum, -i.	of the decoction
Scop. (scoparii)	n. masc. gen. s. qual. decocti. Scoparius, -ii.	of broom

Misce, fiat mistura

M. (misce)	v. trans. imp. m. p. t., agreeing with and governed by Tu (understood). Misceo, -ui, mixtum or mistum, miscere.	Mix you, or mix
Mist. (mistura)	n. f. nom. s., governing fiat. Mistura, -æ.	Let the mixture
Ft. (fiat)	v. used as passive of facio, pres. sub. 3d s. Used as imp. gov. by and agreeing with mistura. Fio, factus sum, fieri; to be made or become.	be made

Capiat cochlearia duo magna quarta quâque horâ ex paululo aquæ

Cpt. (capiat)	irr. v. tr. sub. m. pr. t. 3d per. s., agreeing with and gov. by Is—"he" (understood). Capio, cepi, captum, capere, the present subjunctive used as an imperative.	He may take, or let him take
ii (duo)	num. adj. ac. pl. neut. qual. and agreeing with cochlearia. Duo, -æ, -o.	two
Mag. (magna)	adj. ac. pl. neut. qual. and agreeing with cochlearia. Magnus, -a, -um.	large
Coch. (cochlearia)	n. ac. pl. neut., gov. by capiat. Cochleare, -is.	tablespoonfuls
q.q. (quâque)	pron. indef. abl. s., qualifying and agreeing with horâ. Quisque, quæque, quodque.	at each
4ta (quarta)	num. adj. abl. s., qualifying and agreeing with horâ. Quartus, -a, -um.	fourth
Horâ	n. f. abl. s. Hora, -æ.	hour
Ex.	prep.	out of
Paul. (paululo)	adj. abl. s. Used as a noun, gov. by ex. Paululus, -a, -um.	a little
Aq. (Aquæ)	n. f. gen. s. qual. paululo. Aqua, -æ.	of water

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[1] Some authorities would put Decoct. in the accusative, governed by recipe. In the same way, where the student meets Aquæ ad f℥ in the different prescriptions and formulæ throughout this work, he may substitute Aquam ad f℥; but this latter is by no means so idiomatic as Aquæ ad f℥.

Abbreviations are necessary in writing prescriptions, and they are universally employed. Great care must be taken, however, to avoid ambiguities, which may mean *death to the patient.* Usually, the careful pharmacist gathers from the directions and the quantities the information which guides him safely. A few examples of defective abbreviations are appended, a number of which are taken from Pareira's Physician's Prescription Book.

Acid. Hydroc.	May mean Acidum Hydrochloricum or Acidum Hydrocyanicum
Aconit.	Aconitina Aconiti Radix Aconiti Folia
Ammon.	Ammonia (alkali) Ammoniac (gum resin)
Aq. Chlor.	Aqua Chlori Aqua Chloroformi
Aq. Fontis.	May often be read Aqua Fortis
Calc. Chlor.	Calcium Chloride Chlorinated Lime
Chlor.	Chlorine Chloroform Chloral
Emp. Lyt.	Emp. Lytharg. (lead plaster,—old name) Emp. Lyttæ (blistering plaster
Ext. Col.	Extractum Colchici Extractum Colocynthidis
Hyd. Chlor.	Calomel Corrosive Sublimate Hydrated Chloral
Hydr.	Hydrargyrum (mercury) Hydras (hydrate) Hydriodas (hydriodate) Hydrochloras (hydrochlorate) Hydrocyanas (hydrocyanate)
Hydr. Perox.	Hydrogen Peroxide Hydrargyri Peroxidum
Mist. Ammon.	Ammonia Mixture Mixture of Ammoniac (gum resin)
Potass. Hyd.	Potassium Hydrate (caustic potassa) Potassium Hydriodate (potassium iodide)
Sod. Hypo.	Sodium Hyposulphite Sodium Hypophosphite
Sod. Sulph.	Sodium Sulphate Sodium Sulphite Sodium Sulphide
Sulph.	Sulphur Sulphide Sulphate Sulphite
Zinci. Phosph.	Zinc Phosphate Zinc Phosphide

The above list might be indefinitely prolonged. Sufficient has been clearly shown, however, to convince even the most sceptical practitioner of the grave danger of careless abbreviation. The following table of abbreviations, terms, etc., used in prescriptions will be of service to the pharmacist, by enabling him to translate some of the technical phrases used in writing prescriptions :

Word or Phrase	Contraction	Meaning
A, āā	. . . .	Of each
Ablutio	. . . .	A washing
Absente febre	Abs. febr.	In the absence of fever
Accuratissime	Accuratiss	Most carefully
Acerbus	. . . .	Sour
Ad	Ad	To, up to
Ad conciliandum gustum	. . . .	To suit the taste
Ad defectionem animi	Ad def. animi	To fainting
Adde, addantur, addendus, addendo	Add.	Add, or let them be added, to be added, by adding
Ad duas vices	Ad 2 vic.	At twice taking
Ad gratam aciditatem	Ad grat. acid.	To an agreeable sourness
Adhibendus	. . . .	To be administered
Ad libitum	Ad lib.	At pleasure
Admove, admoveatur, admoveantur	Admov.	Apply, let it be applied, let them be applied
Ad partes dolentes	Ad part. dolent.	To the painful parts
Ad secundum vicem	. . . .	To the second time
Adstante febre	Adst. febre	When the fever is on
Ad tertiam vicem	. . . .	For three times
Adversum	Adv.	Against
Ætas	. . . .	Age, time of life
Aggrediente febre	Aggred. febre	While the fever is coming on

Word or Phrase	Contraction	Meaning
Agita	Agit.	Shake, stir
Agitato vase	. . . .	The vial being shaken
Albus	Alb.	White
Alcoholizatus	. . . .	Alcoholized, finely powdered
Aliquot	. . . .	Some, a few
Alter	. . . .	The other
Alternis horis	. . . .	Every other hour
Aluta	. . . .	Leather
Alvo adstricta	Alv. adst.	The bowels being confined
Alvus	. . . .	The belly
Amplus	. . . .	Large
Ana	A., āā.	Of each
Ante	. . . .	Before
Aqua aërata	Aq. aërat.	Carbonated water
Aqua astricta	Aq. astr.	Frozen water
Aqua bulliens	Aq. bull.	Boiling water
Aqua communis	Aq. comm.	Common water
Aqua fervens	Aq. ferv.	Hot water
Aqua fluviatilis	Aq. fluv.	River water
Aqua fontalis (or fontis or fontana)	Aq. font.	Spring water
Aqua marina	Aq. mar.	Sea water
Aqua nivalis	Aq. niv.	Snow water
Aqua pluviatilis (or pluvialis)	Aq. pluv.	Rain water
Aut	. . . .	Or
Baccillum	. . . .	A bougie
Balneum arenæ	B. A.	Sand bath
Balneum mariæ or maris	B. M.	A salt water bath
Balneum vaporosum or vaporis	B. V.	A vapor bath
Barbadensis	B.B., B.B.S.	Barbadoes
Bene	. . . .	Well
Bibe	Bib.	Drink
Biduum	. . . .	Two days
Bis	. . . .	Twice
Bis in die	Bis in d.	Twice a day
Bis in dies	Bis in d.	Twice a day
Bolus	Bol.	A large pill
Bonus	. . . .	Good
Brevis	. . . .	Short
Bulliat, bulliant	Bull.	Let boil
Butyrum	But.	Butter
Calefactus	. . . .	Warmed
Capiat	Cap.	Let him (or her) take
Capsulæ amylaceæ	. . . .	Starch capsules,—*i.e.*, cachets
Carbasus	Carbas.	Lint, linen
Caute	. . . .	Cautiously
Charta	Chart.	Paper
Charta cerata	Chart. cerat.	Waxed paper
Chartula	. . . .	Small paper
Cibus	. . . .	Food
Cito dispensetur	Cito disp.	Dispense quickly

Word or Phrase	Contraction	Meaning
Cochlear or cochleare, Cochleatim	Coch., Cochleat.	A spoonful, by spoonfuls
Cochleare amplum	Coch. amp.	A tablespoonful
Cochleare magnum	Coch. mag.	A large spoonful (about half an ounce)
Cochleare medium or modicum	Coch. med.	A dessertspoonful (about two fluidrachms)
Cochleare parvum	Coch. parv.	A teaspoonful (about one fluidrachm)
Coctio	Coct.	Boiling
Cœruleus	Cœrul.	Blue
Cogantur	. . . .	Let them be combined
Cola	Col.	Strain
Colaturæ	Colatur.	To, or of, the strained liquor
Colatus	Colat.	Strained
Colentur	Colent.	Let them be strained
Coletur	Colet.	Let it be strained
Collunarium	. . . .	A nose wash
Collutorium	Collut.	A mouth wash
Collyrium	Collyr., Coll.	An eye wash
Coloretur	. . . .	Let it be colored
Commisce	. . . .	Mix together
Compositus	Comp.	Compounded
Concisus	. . . .	Cut
Concussus	. . . .	Shaken
Confectio	Conf.	Confection
Confricamentum	. . . .	A liniment
Congius	Cong.	A gallon
Conquassando	. . . .	Vigorous shaking
Conserva	Cons.	A conserve; also keep (thou)
Consperge	Consperg.	To dust or sprinkle
Contere	. . . .	Rub together
Continuantur remedia	Cont. rem.	Let the medicines be continued
Contra	. . . .	Against
Contusus	. . . .	Bruised
Coque, Coquantur	Coq.	Boil, let them be boiled
Coque ad medietatis consumptionem	Coq. ad. med. consump.	Boil to the consumption of half
Coque in sufficiente quantitate aquæ	Coq. in S. A.	Boil in a sufficient quantity of water
Coque secundum artem	Coq. S. A.	Boil according to art
Cor, cordis	. . . .	The heart
Cortex	Cort.	The bark
Cotula	. . . .	A measure
Coxa	. . . .	The hip
Cras, Crastinus	Crast.	To-morrow
Cras mane sumendus	. . . .	To be taken to-morrow morning
Cras nocte	. . . .	To-morrow night
Crastinus	. . . .	For to-morrow, early

Word or Phrase	Contraction	Meaning
Cras vespere	. . . . . .	To-morrow evening
Cujus, Cujuslibet	Cuj.	Of which, of any
Cum	C.	With
Cyatho theæ	. . . . . .	In a cup of tea
Cyathus, or Cyathus vinarius	Cyath., C. vinar.	A wineglass (from one-half to two fluidounces)
Da, detur	D., det.	Give, let be given
De	. . . . . .	Of, or from
Deaurentur pilulæ	Deaur. pil.	Let the pills be gilded
Debita spissitudo	Deb. spiss.	A proper consistence
Debitus	. . . . . .	Due, proper
Decanta	Dec.	Pour off
Decem, Decimus	. . . . . .	Ten, the tenth
Decubitus	Decub.	Lying down
De die in diem	De d. in d.	From day to day
Deglutiatur	Deglut.	May or let be swallowed
Dein	. . . . . .	Thereupon
Dejicerit	. . . . . .	Let it be purged
Dentur tales doses No. iv	D. t. d. No. iv	Let four such doses be given
Detur in duplo	. . . . . .	Let twice as much be given
Dexter, Dextra	. . . . . .	The right
Diebus alternis	Dieb. alt.	Every other day
Diebus tertiis	Dieb. tert.	Every third day
Digere	. . . . . .	Digest
Diluculo	Diluc.	At break of day.
Dilue, Dilutus	Dil.	Dilute (thou), diluted
Dimidius	Dim.	One-half
Directione propriâ	D. P. or direc. prop.	With a proper direction
Dividatur in partes æquales	D. in p. æq.	Let it be divided into equal parts
Dividendus, -a, -um	. . . . . .	To be divided
Dolor	. . . . . .	Pain
Donec	. . . . . .	Until
Donec alvus bis dejiciatur	. . . . .	Until the bowels have been twice evacuated
Donec alvus soluta fuerit	. . . . . .	Until the bowels shall be opened
Donec dolor nephriticus exulaverit	. . . . . .	Until the nephritic pain is removed
Durante dolore	. . . . . .	While the pain lasts
Eadem (fem.)	. . . . . .	The same
Eburneus	Eburn.	Made of ivory
Edens	. . . . . .	Eating
Edulcorata	Ed.	Edulcorated
Ejusdem	Ejusd.	Of the same
Electuarium	Elect.	An electuary
Emulgens	. . . . . .	An emulsifying agent
Enema	En.	An enema, a clyster
Enemata	. . . . . .	Clysters
Epistomium	Epistom.	A stopper
Et	. . . . . .	And
Etiam	. . . . . .	Also, besides
Evanuerit	. . . . . .	Shall have disappeared
Ex or E	E	From, one of
Exhibeatur	Exhib.	Let it be exhibited
Ex modo prescripto	E. m. p.	After the manner prescribed, as directed
Extende	Ext.	Spread
Extende super alutam mollem	Ex. sup. alut. moll.	Spread thou upon soft leather
Fac, Fiat, Fiant	F., Ft.	Make, let it be made, let them be made
Fac pilulas duodecim	F. pil. xii	Make 12 pills
Farina	. . . . . .	Flour
Fasciculus	. . . . . .	A bundle which can be carried under the arm
Febre durante	Feb. dur.	During the fever
Febris	. . . . . .	Fever
Femoribus internis	Fem. intern.	To the inner parts of the thighs
Fervens	Ferv.	Boiling
Fiant chartulæ xii	Ft. chart. xii	Make 12 powders
Fiant pilulæ xii	Ft. pil. xii	Make 12 pills
Fiant pulveres xii	Ft. pulv. xii	Make 12 powders
Fiant suppositoria iv	Ft. suppos. iv	Make 4 suppositories
Fiat cataplasma	Ft. cataplasm.	Make a poultice
Fiat ceratum	Ft. cerat.	Make a cerate
Fiat collyrium	Ft. collyr.	Make an eye wash
Fiat confectio	Ft. confec.	Make a confection
Fiat electuarium	Ft. elect.	Make an electuary
Fiat emplastrum 6 × 4	Ft. emp. 6 × 4	Make a plaster 6 by 4 inches
Fiat emplastrum epispasticum	Ft. emp. epispast.	Make a blister
Fiat emplastrum vesicatorium	Ft. emp. vesicat.	Make a blister
Fiat emulsio	Ft. emuls.	Make an emulsion
Fiat enema	Ft. enema.	Make an injection (for rectum)
Fiat gargarisma	Ft. garg.	Make a gargle
Fiat haustus	Ft. haust.	Make a draught
Fiat infusum	Ft. infus.	Make an infusion
Fiat injectio	Ft. injec.	Make an injection (for urethra)
Fiat lege artis	F. L. A.	Let it be made by the rules of art
Fiat linimentum	Ft. linim.	Make a liniment
Fiat massa	Ft. massa	Make a mass

Word or Phrase	Contraction	Meaning	Word or Phrase	Contraction	Meaning
Fiat massa et divide in pilulas xii	Ft. mas. div. in pil. xii	Make 12 pills	Hirudo	. . . . . .	A leech
Fiat massa in pilulas xii dividenda	Ft. mas. div. in pil. xii	Make 12 pills	Hora	H.	An hour
Fiat massa in trochiscos xl dividenda	Ft. mas in troch. xl. div.	Make 40 lozenges	Horâ decubitûs	H. D.	At the hour of going to bed
Fiat mistura	Ft. mist.	Make a mixture	Horæ unius spatio	Hor. un. spatio	At the expiration of an hour
Fiat pulvis	Ft. pulv.	Make a powder	Horâ somni	H. S. or Hor. som.	Just before going to sleep, or on retiring to rest
Fiat pulvis et divide in chartulas xii	Ft. pulv. et. div. in char. xii	Make 12 powders	Horâ undecimâ matutinâ	. . . . . .	At the eleventh hour of the morning
Fiat pulvis in chartulas xii dividenda	. . . . . .	Make 12 powders	Horis intermediis	Hor. interm.	In the intermediate hours
Fiat secundum artis regulas	F. S. A. R.	Let it be made according to the rules of art	Idem	. . . . . .	The same
Fiat solutio	Ft. solut.	Make a solution	Identidem	. . . . . .	Repeatedly
Fiat suppositorium	Ft. suppos.	Make a suppository	Idoneus	. . . . . .	Proper
Fiat trochisci xxiv	Ft. troch. xxiv	Make 24 lozenges	Immitatur	. . . . . .	Introduce it into
Fiat unguentum	Ft. ung.	Make an ointment	Imprimis	. . . . . .	First
Fiat venæsectio	. . . . . .	Bleed	Incide, Incisus	Inc.	Cut (thou), being cut
Fictilis	. . . . . .	Earthen	Inde	. . . . . .	Therefrom
Filtra	. . . . . .	Filter (thou)	In dies	In d.	From day to day, daily
Fistula armata	. . . . . .	A syringe fitted for use	Infunde	Inf.	Pour in
Flavus	Flav.	Yellow	Ingerendo capsulas	. . . . . .	Put in capsules
Folius	Fol.	A leaf	In impetu effervescentiæ	. . . . . .	In the height of effervescence
Frustillatim	Frust.	In little pieces	Injectio	. . . . . .	An injection
Fuerit	. . . . . .	Shall have been	Injiciatur enema	. . . . . .	Let an injection or clyster be given
Gargarisma	Garg.	A gargle	In lagena bene obturata	. . . . . .	In a well-stoppered bottle
Gelatinâ quâvis	. . . . . .	In any kind of jelly	In pulmento	. . . . . .	In gruel
Gradatim	. . . . . .	By degrees, gradually	Instar	. . . . . .	As big as
Grana sex pondere	. . . . . .	Six grains by weight	Inter	. . . . . .	Between
Granum, Grana	. . . . . .	Grain, grains	Internus	. . . . . .	Inner
Gratus	. . . . . .	Pleasant	Involve gelatina	. . . . . .	Coat with gelatin
Grossus	. . . . . .	Large, coarse	Ita	. . . . . .	In such manner
Gutta	Gtt.	A drop	Jam	. . . . . .	Now
Guttæ	Gtt.	Drops	Jentaculum	Jent.	Breakfast
Guttatim	Guttat.	By drops	Julepus, Julepum	Jul.	A julep
Guttis quibusdam	Gutt. quibusd.	With a few drops	Jusculum	. . . . . .	A broth
Harum pilularum sumantur tres	Har. pil. sum iii.	Let three of these pills be taken	Juxta	. . . . . .	Near to
Haustus	Haust.	A draught	Kali præparatum (potassæ carbonas)	Kal. ppt.	Prepared kali, or carbonate or bicarbonate of potash
Haustus purgans noster	H. p. n.	A purging draught made according to a practitioner's own formula	Lac	. . . . . .	Milk
Hebdomada	. . . . . .	A week	Lamella	. . . . . .	Leaf or scale
Herba	. . . . . .	An herb	Lana	. . . . . .	Flannel
Heri	. . . . . .	Yesterday	Largus	. . . . . .	Abundant, plentiful
Hic, Hæc, Hoc	. . . . . .	This	Laridum	. . . . . .	Lard
			Lateri dolenti	Lat. dol.	To the side that is painful
			Laxus	. . . . . .	Loose, open
			Lectus	. . . . . .	A bed
			Leniter terendo	. . . . . .	By rubbing gently
			Leviter	. . . . . .	Lightly
			Linteum	. . . . . .	Lint
			Magnus	Mag.	Large

Word or Phrase	Contraction	Meaning
Mane, Mane primo	......	In the morning, very early in the morning
Manipulus	M. or Man.	A handful
Manus	......	The hand
Massa, Massa pilularis	......	A mass, a pill mass
Matula	......	A vessel or pot
Matutinus	......	In the morning
Medius	......	Middle
Mensura	......	By measure
Mica panis	Mic. pan.	Crumb of bread
Minimum	M. or Min.	A minim
Minutum	......	A minute
Misce	M.	Mix
Mitte, Mittatur, Mittantur	......	Send, let it be sent, let them be sent
Mitte sanguinem ad uncias duodecim saltem	......	Take away blood to 12 ounces at least
Mitte talis	......	Send of such or this
Modicus	......	Middle sized
Modo præscripto	Mod. præsc.	In the manner prescribed
Mora	......	Delay
More dictu, More solito	More dict., More sol.	In the manner directed, in the usual manner
Mortarium	......	A mortar
Necnon	......	Also
Ne tradas sine nummo	Ne tr. s. num.	Do not deliver it unless paid. (Used by apothecaries as a caution to the assistant when the presence of the patient prevents the master from giving a verbal direction)
Nisi	......	Unless
Non	......	Not
Nonrepetatur	Non. rep.	Do not repeat
Nox, noctis	......	Night
Nucha	......	The nape of the neck
Numerus	No.	Number
Nunc	......	Now
Nux Moschata	......	A nutmeg
Obduce	......	Cover, conceal, or coat
Obtritus	......	Crushed
Occlusus	......	Enclosed
Octarius	O.	A pint
Octavus	......	Eighth
Octo	......	Eight
Oculus	......	The eye
Oleum lini sine igne	......	Cold drawn linseed oil
Oleum olivæ optimum	O. O. O.	Best olive oil
Ollicula	......	A little pot
Omni horâ, Omni bihorio, Omni quadrante horæ	Omn. hor., Omn. bih., Omn. quadr. hor.	Every hour, every two hours, every quarter of an hour
Omni mane	......	Every morning
Omni nocte	......	Every night
Opus	......	Need, occasion
Ovum	......	An egg
Pabulum	......	Food, nourishment
Panis	......	Bread
Pannus	......	A rag
Pars, partis	......	A part
Partes æquales	P. æ.	Equal parts
Partitis vicibus	Part. vic.	In divided doses
Parvulus	......	An infant
Coch. parvulum	Coch. parv.	A teaspoonful
Parvus	......	Little
Pastillus, Pastillum	......	A little ball of paste, to take like a lozenge, etc.
Pectus	......	The breast
Pediluvium	......	A foot bath
Per	......	Through, by
Peractâ operatio emetici	......	When the operation of the emetic is finished
Per deliquium	......	By deliquescence
Pergo, pergere	......	To go on with
Perindo	......	In the same manner as before
Pes	......	The foot
Phiala prius agitata	P. P. A.	The bottle having been first shaken
Pilula	......	A pill
Pilus	......	The hair
Pinguis	......	Fat, grease
Placebo	......	To please, satisfy
Plenus	......	Filled
Poculum, Pocillum	Pocul., Pocill.	A cup, a little cup
Pondere	P.	By weight
Pondus civile	......	Civil weight (avoirdupois weight)
Pondus medicinale	......	Medicinal (apothecaries') weight
Pone aurem	......	Behind the ear
Post cibo	......	After eating
Post singulas sedes liquidas	......	After every loose stool
Potus	......	Drink
Prandium	Prand.	Dinner
Primo mane	......	Very early in the morning
Primus	......	The first
Pro	......	For
Pro ratione ætatis	......	According to the age of the patient

Word or Phrase	Contraction	Meaning
Pro re nata	P. r. n.	Occasionally
Proximo	. . . . . .	Nearest
Pruis	. . . . . .	Before, former
Pugillus	Pug.	A pinch, a grip between the thumb and first two fingers
Pulpa	. . . . . .	Pulp
Pulvis, Pulverizatus	Pulv.	A powder, powdered
Pyxis	. . . . . .	A pill box
Quam libet	. . . . . .	As much as you wish
Quantum libet, Quantum placet, Quantum vis, Quantum volueris	Q. l., Q. p., Q. v.	As much as you please
Quantum sufficiat, Quantum satis	Q. S.	As much as is sufficient
Quaque	Q. Q.	Each or every
Quaque horâ	. . . . . .	Each hour
Quartus	. . . . . .	Fourth
Quater	. . . . . .	Four times
Quatuor	. . . . . .	Four
Quibus	. . . . . .	From which
Qui libet	. . . . . .	Whatever you please
Quinque	. . . . . .	Five
Quintus	. . . . . .	The fifth
Quoque	Q. Q.	Also
Quorum	Quor.	Of which
Quotidie	. . . . . .	Daily
Quoties	. . . . . .	As often as
Rarus	. . . . . .	Loose, thin, rare
Ratio	. . . . . .	Proportion
Recens	Rec.	Fresh
Recipe	℞	Take
Redactus in pulverem, redigatur in pulverem	Red. in pulv., redig. in pulv.	Let it be reduced to powder
Regio umbicilli	. . . . . .	The umbilical region
Reliquus	. . . . . .	Remaining
Renovetur semel	. . . . . .	Renew once only
Repetatur, Repetantur	Rept.	Let it be repeated, let them be repeated
Res, rei	. . . . . .	Thing, substance, object, etc.
Residuus	. . . . . .	Remaining
Respondere	. . . . . .	To answer
Retinere	. . . . . .	To keep
Ruber	. . . . . .	Red, ruddy
Saccellatio	. . . . . .	A dry poultice
Saepis	. . . . . .	Often, frequently
Saltem	. . . . . .	At least
Scatula	Scat.	A box
Scilicet	. . . . . .	Namely
Scutum	. . . . . .	For protection
Secundum artem, Secundum naturam	S. A., S. N.	According to art, according to nature
Secundus	. . . . . .	Second
Sedes	. . . . . .	The alvine evacuation
Semel	. . . . . .	Once
Semidrachma	Semidr.	Half a drachm
Semihora	Semih.	Half an hour
Semis	Ss.	A half
Seorsum	. . . . . .	Apart, separate
Septem	. . . . . .	Seven
Septimana	. . . . . .	A week
Sericum oleatum	. . . . . .	Oiled silk
Sescuncia	. . . . . .	An ounce and a half
Sesquihora	. . . . . .	An hour and a half
Sex	. . . . . .	Six
Sextus	. . . . . .	Sixth
Si	. . . . . .	If
Siccus	. . . . . .	Dry, dried
Sic, Sic?	. . . . . .	So, is it so?
Signa	Sig.	Mark thou
Signetur nomine proprio	. . . . . .	Let it be written upon with the proper name (not a trade name)
Sile hujus	. . . . . .	Keep silent concerning this
Simul	. . . . . .	Together
Sine	. . . . . .	Without
Singulorum	Sing.	Of each
Si non valeat	Si n. val.	If it does not answer
Si opus sit	Si op. sit	If necessary
Sit	. . . . . .	Let it be
Si vires permittant	Si vir. perm.	If the strength will bear it
Solatium	. . . . . .	Soothing, assuaging
Solitus	. . . . . .	Accustomed, ordinary
Solus	. . . . . .	Alone
Solve	. . . . . .	Dissolve
Solvo, solvere, Solutus	. . . . . .	To dissolve, dissolved
Somnus	. . . . . .	Sleep
Sparadrapus	. . . . . .	A spread plaster
Spiritus vini rectificatus	. . . . . .	Rectified spirit of wine
Spiritus vini tenuis	. . . . . .	Proof spirit
Spiritus vinosus	. . . . . .	Ardent spirit of any strength
Spissus	. . . . . .	Dense, hard
Statim	Stat.	Immediately
Stet, Stent	St.	Let it stand, let them stand
Stillatim	. . . . . .	By drops, or in small quantities
Stilus	. . . . . .	Pencil, stick, or crayon
Stratum super stratum	S. S. S.	Layer upon layer
Subactus	. . . . . .	Subdued

Word or Phrase	Contraction	Meaning
Sub finem coctionis	. . . . . .	When the boiling is nearly finished
Subinde	. . . . . .	Frequently
Subtilis	. . . . . .	Fine, smooth, nice
Succus	. . . . . .	Juice, sap
Sumat talem	. . . . . .	Let the patient take one like this
Sume, Sumat, Sumatur, Sumantur, Sumendus	Sum.	Take (thou), let him take, let it be taken, let them be taken, to be taken
Summitates	. . . . . .	The summits or tops
Superbibendo haustum	. . . . . .	Drinking afterwards this draught
Supra	. . . . . .	Above
Tabella (dim. of tabula, a table)	Tabel.	A lozenge
Talis	. . . . . .	Such, like this
Tandem	. . . . . .	At last, finally
Tantum	. . . . . .	So much, so many
Tegmen or Tegumen	. . . . . .	A cover
Tempori dextro	. . . . . .	To the right temple
Tempus, temporis	. . . . . .	Time or temple
Tenuis	. . . . . .	Fine, thin
Ter	. . . . . .	Three times
Tere	Ter.	Rub
Ter in die, or Ter die	T. i. d., or t. d.	Three times a day
Tertius	. . . . . .	Third
Tres	. . . . . .	Three
Triduum	. . . . . .	Three days
Tritura	Trit.	Triturate
Tum	. . . . . .	Then, furthermore
Tussis	. . . . . .	A cough
Tuto	. . . . . .	Safely
Ubi	. . . . . .	Where, wherever, whenever
Ultimo (or Ultima) præscriptus	Ult. præsc.	The last ordered
Una	. . . . . .	Together
Uncia	. . . . . .	An ounce
Unctulus	. . . . . .	Besmeared, anointed
Unguilla	. . . . . .	An ointment box
Ustus	. . . . . .	Burned
Ut dictum	Ut Dict.	As directed
Utendum	Utend.	To be used
Uto, uti	. . . . . .	To make use of
Vas Vitreum	. . . . . .	A glass vessel
Vehiculum	. . . . . .	A vehicle
Vel	. . . . . .	Or
Venæsectio brachii	. . . . . .	Bleeding in the arm
Venenosus	. . . . . .	Poisonous, a poison
Verus	. . . . . .	True, genuine
Vesper, vesperis	Vesp.	The evening
Vices	. . . . . .	Turns
Vis, viris	. . . . . .	Strength
Vitellus	. . . . . .	Yolk
Vitello ovi solutus	. . . . . .	Dissolved in the yolk of an egg
Vitreum vitrum	. . . . . .	Glass
Vomitione urgente	Vom. urg.	The vomiting being troublesome

AUTOGRAPH AND QUESTIONABLE PRESCRIPTIONS

In the following pages will be found facsimiles of prescriptions taken from the author's collection. One of the most important duties of the pharmacist is the unravelling of prescriptions, and upon his cleverness in accurately divining the intention of the physician will often depend his reputation for skill and ability. It may be found that as one's experience in the art of interpreting increases, there will be ample justification and respect for the philologist who dignified the art of writing prescriptions by such a massive word as "Pharmacocatagraphologia." It is not to be supposed that all of the prescriptions which follow are of a character which would prove stumbling blocks to those having had experience in this difficult art; indeed, the author has the highest regard for the rare sagacity possessed by the American pharmacist, who has an international reputation for acuteness, and his only apology for presenting them is that he has some hope of aiding the younger members by some useful practice.

It should be noted that the facsimile prescriptions in the following pages, while faithful reproductions, are really clearer and are usually easier to read than the originals, because it has been found impossible to reproduce blurred lead pencil marks, greasy spots, finger marks, and the crumpled paper, which are such important factors in obscuring the legibility of every day prescriptions.

The succeeding illustrations are all that there is space for. They show the importance of writing prescriptions upon regularly printed or engraved blanks, on which the name of the physician is clearly shown, with his office hours and address, in order that the pharmacist in case of necessity may confer with him speedily and have all doubts removed about the interpretation of the prescription.

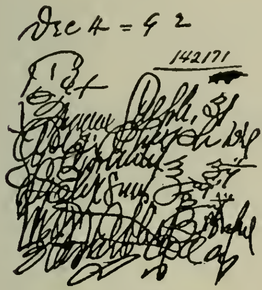
Omissions and Errors.—If an *obvious* error or omission is detected by the pharmacist, or an unusually large or poisonous dose has been prescribed, it is generally easy to gain the requisite delay, upon the plea that the prescription will require considerable time to compound, or for some other reason which will not excite the suspicions of the patient and in the meantime the physician may be consulted and the difficulty removed. Good judgment is necessary at all times, and where delay is entirely inadmissible there is nothing left for the pharmacist to do but to assume the responsibility of making the dose safe, or of supplying the omission according to his best judgment. In this case a written explanation should be sent immediately to the physician.

In the case of omissions or errors on the part of the pharmacist, so much judgment is needed which must depend upon the circumstances surrounding each case, that it would be unsafe to offer any suggestions. Generally the physician must be appealed to, and upon his skill and tact reliance must be placed. In such cases it is not often that he is found unwilling to exercise his good offices. One instance is on record showing rare tact on the part of an apothecary. It occurred before the practice of checking prescriptions became common. After renewing a mixture, he realized, just as he was in the act of handing the bottle to the nervous and suspicious old gentleman for whom it was intended, that he had omitted one of the principal ingredients. To hand it to him and permit his departure would have been professional suicide; to hesitate and take it back after the patient had watched the process of compounding, and had seen the bottle labelled and wrapped, would have excited unpleasant suspicions and have been equally disastrous. At once grasping the situation, he dropped the bottle upon the counter, allowing it to break to pieces, while in the act of handing it to the patient; then, with an apology for the accident, he quickly proceeded to compound the mixture over again, this time with every ingredient in it. He fully believed that any proper sacrifice should be cheerfully made to avoid loss of confidence.

Facsimile Prescriptions, with Notes.—In Fig. 491 will be found a reproduction of a prescription in the author's collection which illustrates what appears to be an attempt to confuse one who is not familiar with the writer's style. It is a mass of "jumbled" characters. Patience is necessary to decipher it, but it can be done by any pharmacist if time is taken to do it. Quinine sulphate, one drachm; acid. phosph. dil., two drachms; syr. aurantii, three ounces. He then intended to direct another syrup, but changed his mind and crossed out the "sy" and wrote elix. simp., three ounces. The directions are a tablespoonful three times a day.

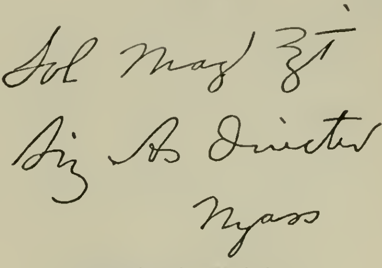
Fig. 492 is a good representation of a class of prescriptions far too common in every day practice. If taken by a patient to a pharmacy where the habit and handwriting of the physician are not known it would prove a veritable puzzle. The first thought of the compounder will naturally be solution of magnesia ; then the absence of directions will cause him to stop and consider. He may then run over in his mind the numerous solutions of magnesia with which he is familiar

Fig. 491


Dec 4 = 92
142171

"Jumbled" prescription

Fig. 492

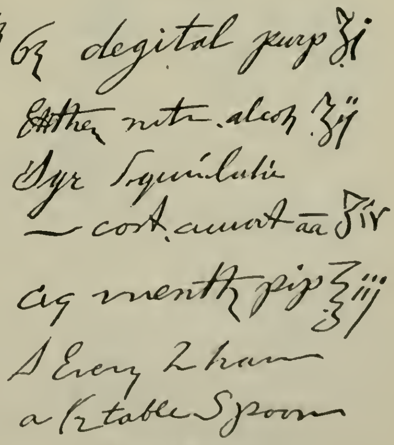

Sol Mag ℥i
Sig As Directed
Nyass

Questionable prescription

and possibly select one of the most harmless ; then, choosing the best course, he asks the patient, in a matter-of-fact way, whether the doctor left any directions how the medicine was to be used. "Oh, yes, with a syringe." More puzzled now than ever, but not showing to the patient the slightest embarrassment, he suddenly catches the idea that Magendie's solution of morphine is to be used hypodermically. A few more skilful questions remove all doubt, and the patient hastens away convinced that the apothecary is careful, and never suspects that faulty abbreviation and a worse fault in writing the directions on the part of the physician have given the pharmacist one more reason to lament the doctor's serious want of care.

The writer displays a lack of education by prescription 493, although there are no particular difficulties in compounding it. "Tr. degital purp" would be easily rendered by an experienced compounder tincture of digitalis. "Eather nitr. alcoh" would become spirit of nitrous ether. The next ingredient would be apt to puzzle the uninitiated, but any one familiar with German prescriptions would have no difficulty in selecting syrup of licorice as the article wanted, "Syr. Liquiritiæ" being the common term for it. The bad habit of using a dash to signify "the same," in place of a ditto mark, is not thoroughly established in this country, although there would be no great difficulty in guessing at the prescriber's meaning. The use of either ditto marks or dashes in prescription writing is a practice more honored in the breach than in the observance. The unusual order in which the quantity in the "Signa" appears betrays the nationality of the writer,—"Every 2 hours a ½ table spoon,"—although it would be easily understood to mean, Take a dessertspoonful every two hours.

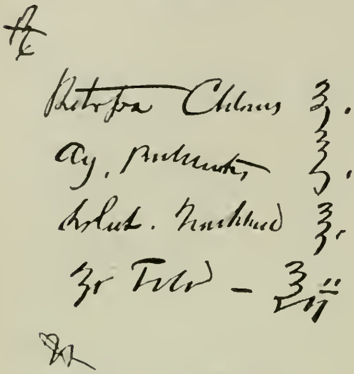
Fig. 493


Tr degital purp ℥i
Æther nitr. alcoh ℥ii
Syr Liquiritiæ
— cort. aurant āā ℥iv
aq menth pip ℥iij ℥i
S Every 2 hours
a ½ table Spoon

Faulty prescription

Prescription 494 has proved a puzzle to many expert pharmacists. The bad habit of running the quantities into one another, the equally bad taste shown in using both English and Latin in the same prescription, and the exhibition of gross carelessness about the whole composition, make it a unique specimen. The original in the author's possession was written with a very soft lead pencil, and is considerably blurred. One drachm of potassium chlorate is to be dissolved in one ounce of boiling water, one ounce of solution of morphine, and two ounces of syrup of tolu. The dots which should be over the numerals representing 1's have so strayed from their legitimate use as to have lost their identity entirely, and the third line is almost unrecognizable. One would suppose that its dangerous character would have saved it from such a fate.

Fig. 494



℞

Potass. Chloras ʒ.

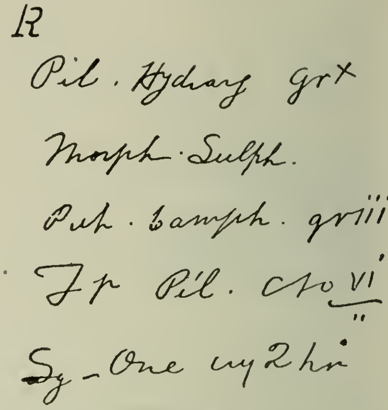
Aq. Bullient ℥.

Solut. Morphiae ℥.

Syr Tolu — ℥ii

Carelessly written prescription

Fig. 495



℞

Pil. Hydrarg gr x

Morph. Sulph.

Pulv. Camph. gr iii

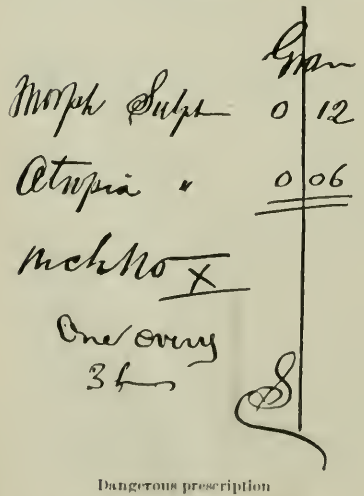
Ft Pil. No vi

Sig — One ev'y 2 hrs

Faulty prescription

Prescription 495 illustrates a common fault,—an omitted quantity. It has evidently been written for a patient suffering some pain, and has been designed for immediate use. Of course such a prescription should be instantly returned to the prescriber, the pharmacist gaining time by stating to the patient that it will take some time to compound it. If, however, there is great urgency, the physician not being accessible, and the pharmacist is prepared to assume the risks which such a course entails, one grain of morphine sulphate may be used if the patient is an adult

Fig. 496



Gram

Morph Sulph 0 | 12

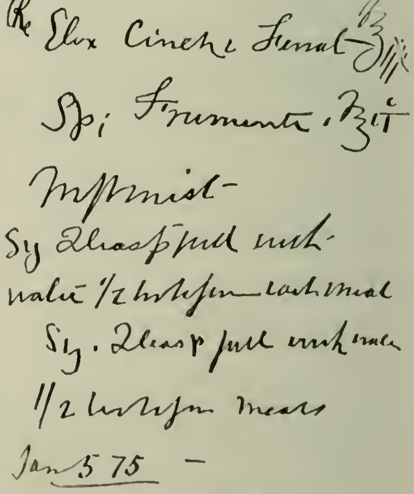
Atropia " 0 | 06

M ch No X

One every 3 hrs

Dangerous prescription

Fig. 497



℞ Elix Cinch e Ferri ℥iii

Spi Frumenti ℥i

M ft mist—

Sig 2 teasp full with water 1/2 hr before each meal

Sig. 2 teasp full with water 1/2 hr after meals

Jan 5 75 —

Double direction prescription

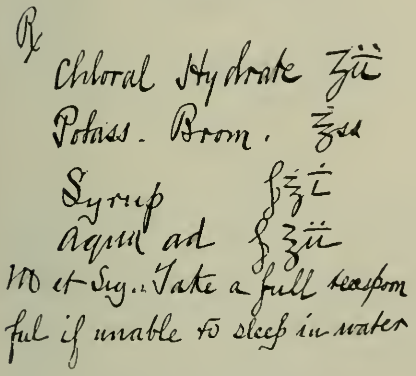
and able to bear it, as it is strongly probable that the intention of the prescriber was to give one-sixth of a grain as a dose. This course is not recommended, however, as one to be followed by the pharmacist, except in rare emergencies, and the physician should be notified at once of the facts.

Fig. 496 is an exact reproduction of a prescription presented in the ordinary course of business. It was written by a young physician who had become enamoured of European methods, but had not sufficiently mastered the intricacies of the metric system to be sure of his doses. A dose of six centigrammes (about nine-tenths of a grain) of atropine sulphate was ninety times larger than he intended to give to the patient. In this case the prescription was held until amended, and the proverbial caution of the pharmacist saved the patient's life and probably the physician's reputation.

Prescription 497 is a facsimile of one written by a celebrated physician of Philadelphia. In all probability no greater difficulty was experienced in compounding the prescription than was found by the patient in taking it. It is rather unusual to duplicate the signa.

Prescription 498 would probably offer some difficulty in compounding on account of the deficiency of water, particularly in cold weather, potassium bromide being much more soluble in warm than in cold water. But the chief interest in this prescription centres in the directions to the patient, who, if so unfortunate as to be "unable to sleep in water," is required to take a "full" teaspoonful.

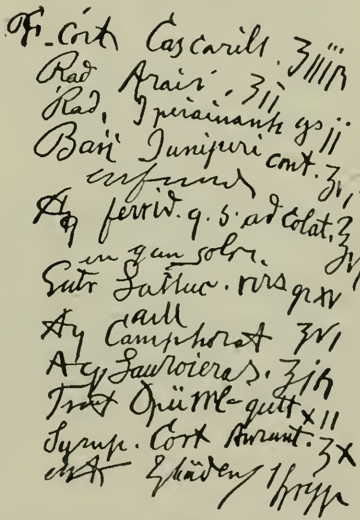
FIG. 498



℞ Chloral Hydrate ℥ii
Potass. Brom. ℥ss
Syrup f℥i
Aqua ad f℥iii
M et Sig.: Take a full teaspoonful if unable to sleep in water

Prescription with ambiguous signa

FIG. 499



℞ Cort Cascarill ʒiii ss
Rad Asari ʒii
Rad Ipecacuanh gr ii
Bacc Juniperi cont. ʒvi
infund
Aq fervid. q. s. ad colat. ℥vi
in qua solv.
Extr Lactuc. viros gr xv
Aq Camphorat ʒvi
Aq Laurocerasi ʒiss
Tinct Opii simpl. gutt xii
Syrup. Cort Aurant. ʒx
MDS Eßlöffel 1/3 stündl

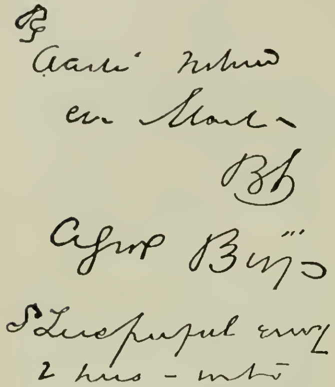
Involved prescription

In prescription 499, which was written by a German physician of the old school, we have an illustration of a peculiarly involved and cramped style; the difficulty in deciphering the original being greatly enhanced by the doctor's selection of a narrow, soiled piece of paper and a soft black lead pencil as the means of communicating his ideas of the patient's needs. The facsimile gives the style and the construction of the letters correctly, but fails to reproduce the imperfections of the lead pencil and coarse paper. Three and a half drachms of cascarilla bark, two drachms of asarum root, two grains of ipecac root, six drachms of bruised juniper berries, are to be infused with sufficient hot water to make the strained infusion measure six ounces, in which are to be dissolved fifteen grains of extract of lactucarium; it is then mixed with six drachms of camphor water, one and a half drachms of cherry laurel water, twelve drops of simple tincture of opium, and ten drachms of syrup of orange peel. A tablespoonful every three hours.

The prescription shown in Fig. 500 is a type of a style familiar to all who have occasion to read prescriptions. No attention whatever has been paid to reserving a line for each ingredient, and faulty abbreviation and careless writing have made a prescription not easy to decipher with any degree of certainty. If physicians would endeavor to use the official names for the preparations they prescribe, much labor would be saved and the liability to err would be greatly lessened. Half a fluidrachm of nitric and muriatic acid with three and a half fluidounces of water is the translation, and it is known in this case that the official nitrohydrochloric acid was wanted.

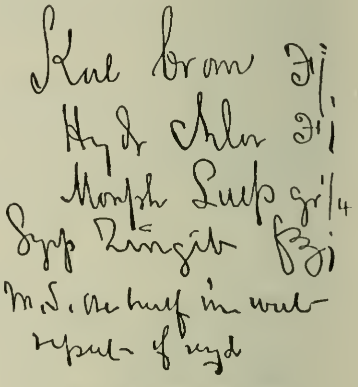
Fig. 501 affords another illustration of want of care in writing a prescription. Some of the letters show an ability on the part of the writer to form letters properly, which would indicate that he could write a legible prescription if he wished to; but the illegibility increases as the end of the prescription is approached, and hurry is plainly indicated. It happened that the medicine was intended for a poor dispensary patient; but one might suppose that poverty and sickness are heavy enough burdens to carry without having the additional and unnecessary one of the risk of losing life. One scruple of potassium bromide, one scruple of hydrated chloral (not chloride of mercury, calomel, or corrosive sublimate), one-quarter of a grain of morphine sulphate, are dissolved in one fluidounce of syrup of ginger. One-half is taken in water. *Repeated if required.*

Fig. 500



Badly written prescription

Fig. 501

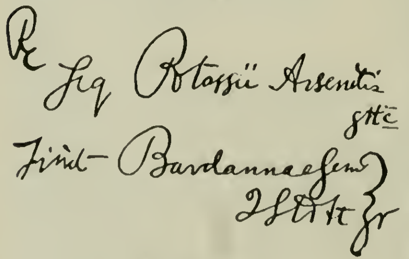


Kal brom ℈j
Hyd Chlor ℈j
Morph Sulp gr 1/4
Syp Zingib ℥j
M.S. One half in water
repeat if reqd

Carelessly written prescription

There is no lack of legibility in prescription 502. It is presented as showing a custom which some physicians practise,—*i.e.*, the employment of an unusual name. The object of using an out-of-the-way name may be a laudable one, although the physician is usually given the credit of trying to cover up some secret arrangement with an initiated and favored pharmacist. In this case the word "bardane" appears in the United States Dispensatory, and no intelligent pharmacist would have any difficulty in understanding that tincture of burdock seed was wanted. This being unofficial, it would be desirable to know from the physician what strength of tincture might be preferred.

Fig. 502

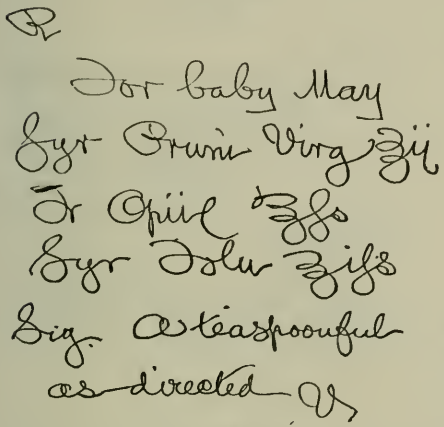


Odd prescription

At first glance it would seem that prescription 503 is ordinarily well written and free from fault. When the cautious dispenser looks it over carefully, however, he will observe that half a fluidounce of tincture of opium in a four ounce mixture, with a teaspoonful dose, would be a large quantity for "Baby May," and in all probabilitiy would permanently end her pain. A thorough examination indicates an abortive attempt at forming the letter "c" after the "opii," and if the ingredient is rendered "camphorated tincture of opium," a popular cough mixture is revealed, which is really what was intended by the prescriber.

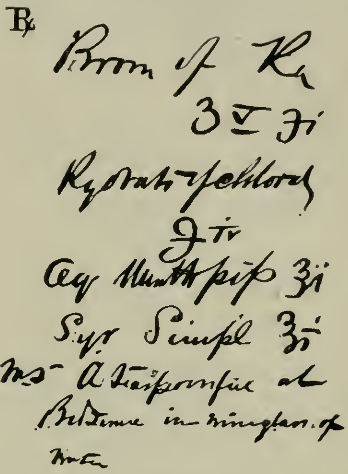
Fig. 504 illustrates the effects of the loose methods that dispensary physicians are apt to acquire through the great haste usually practised in "getting through a clinic on time." Abbreviations, mixed Latin and English, and general lack of finish characterize the style. Five drachms and one scruple of potassium bromide and four scruples of hydrated chloral are to be dissolved in one fluidounce each of peppermint water and syrup; the quantity of bromide is excessive, and if the peppermint water is of full strength, a cloudy mixture results, due to throwing the volatile oil dissolved in the peppermint water out of solution. "A teaspoonful at bedtime in wineglass of water" should surely give the needed rest to the patient.

Fig. 503


℞
For baby May
Syr Pruni Virg ℥ij
Tr Opii ʒss
Syr Tolu ℥iss
Sig. A teaspoonful
as directed

Faulty prescription

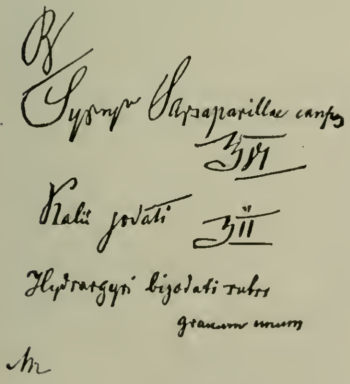
Fig. 504


℞ Brom of K
ʒv ℈i
Hydrate of chloral
℈iv
Aq Menth pip ℥i
Syr Simpl ℥i
M S. A teaspoonful at
Bedtime in wineglass of
water

Odd prescription

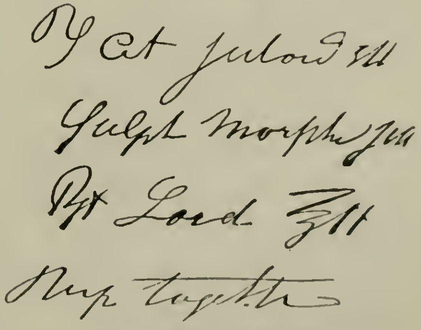
The prescription shown in Fig. 505 was written by a well educated German physician, and is presented as showing unusual care in designating the quantity of the dangerous ingredient. It certainly is rare to see upon American prescription files prescriptions in which the quantity of any ingredient is spelled out in full, either in Latin or in English; indeed, the whole prescription gives evidence of careful thought. One grain of red mercuric iodide and two drachms of potassium iodide are to be dissolved in six ounces of compound syrup of sarsaparilla.

Fig. 505


℞
Syrupi Sarsaparillae comp.
℥VI
Kalii jodati ʒII
Hydrargyri bijodati rubri
granum unum
M.

Careful prescription

Fig. 506

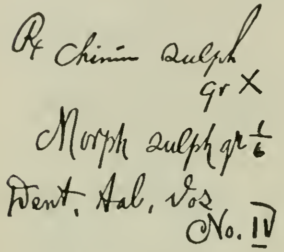

℞ Cat julod ʒii
Sulph morph gr ii
Pt Lead ℥ii
Mix together

Badly written prescription

Fig. 506 shows a style now fortunately extinct in Philadelphia,—the worthy author having been "gathered to his fathers." He was a physician of excellent character, large practice, and unusual sagacity, but, alas! of execrable memory in prescription writing. Several of his prescriptions will be shown in this series, but the one now under consideration exhibits "one of his best." Two drachms of Goulard's extract, three grains of morphine sulphate, and two ounces of prepared lard (not lord) are to be rubbed together.

Fig. 507 is presented mainly with the view of illustrating a German custom which has not been adopted in this country to any extent by American physicians. Such prescriptions are common, however, in large cities. It will be noticed that the quantities are those for one dose. The abbreviated subscription is in full, "Dentur tales doses No. IV,"—let four such doses be given. The absence of any further direction to the apothecary might raise the question, Are powders or pills intended? But as the ingredients themselves are in the form of crystalline powders, and as pills are not specified, it would be proper to dispense four powders.

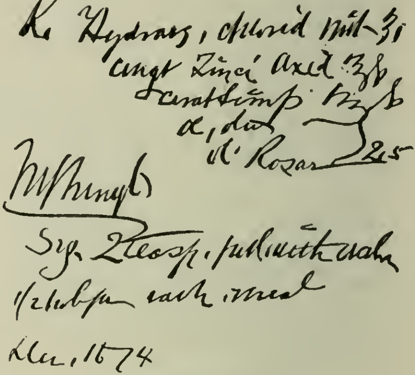
FIG. 507



℞ Chinin sulph
gr X
Morph sulph gr $\frac{1}{6}$
Dent. tal. dos
No. IV

German prescription

FIG. 508

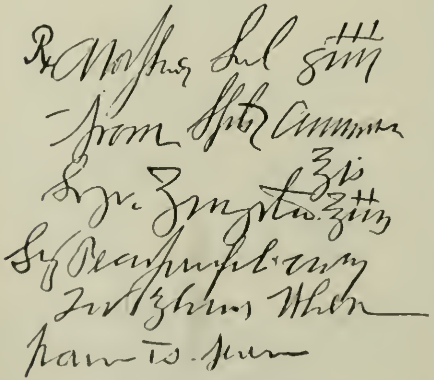


℞ Hydrarg. chlorid mit. ʒi
Ungt Zinci Oxid ℥ss
Cerat simp. ℥ss
ol. oliv.
ol. Rosae q.s.
M ft ungt
Sig. 2 teasp. put with water
1/2 hr before each meal
Dec., 1874

Erroneous signa

Prescription 508 is a facsimile of one penned by a noted Philadelphia physician. Although not written in the clearest style, still it is legible, and no one would hesitate about preparing the ointment by taking one drachm of calomel, half an ounce of ointment of zinc oxide, half an ounce of simple cerate, and sufficient olive oil and oil of rose to make a smooth and sweet smelling ointment; but just here the apothecary will halt,—for, notwithstanding the attractiveness of the "unguent" and the delicious savor exhaled by it, it would not be judicious to label the box as the doctor has directed: "Two teaspoonfuls with water half an hour before each meal." It is clearly a case of "lapsus calami," and no harm would ensue if the apothecary were to shelter himself behind that convenient barrier provided for all such cases and simply write on the label, "Use as directed,"—for it is hardly likely that the doctor made the same error when giving the patient verbal directions that he has done in writing the prescription. In handing the ointment to the patient, any undignified tendency that the dispenser may have to relieve his feelings must be rigidly suppressed.

FIG. 509



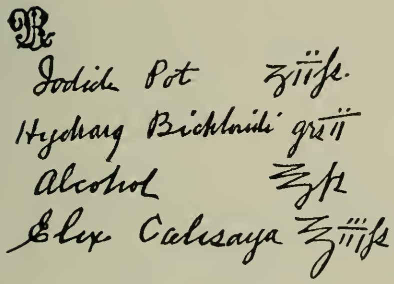
℞ Morphia Sul gr iii
Arom Spts Ammon ʒiv
Syr. Zingiber ℥iiss
Sig Teaspoonful every
2 hours when
pain is severe

Badly written prescription

Prescription 509 exhibits ignorance of the laws of chemical incompatibility, coupled with a careless style of writing; yet abundant evidence of ability to write better is furnished in the formation of many of the letters. Three grains of morphine sulphate are to be dissolved in half an ounce of aromatic spirit of ammonia and two and a half ounces of syrup of ginger. The directions are, "a teaspoonful every two or three hours when pain is severe." The incompatibility belongs to the class illustrated in Chapter LXV, and is due to the fact that alkalies precipitate alkaloids from alkaloidal salts. The danger here would be apt to arise from the alkaloid morphine precipitating out and collecting in the bottom of the bottle, and the liability of the patient swallowing a poisonous quantity if the last dose be taken.

Fig. 510 shows a mixed style. The writing is legible, but "Iodide Pot," an abbreviation of the English name, and "Hydrarg Bichloridi," a partial abbreviation of the Latin name, with the lack of knowledge of correct terminology or abbreviation shown in writing out the other ingredients, quite prepare one for the writer ignoring the fact that the mercuric potassium iodide formed by dissolving corrosive sublimate in solution of potassium iodide will be apt to precipitate the cinchona alkaloids in the elixir of calisaya, for it is now the most useful and the most delicate reagent for alkaloids that has ever been discovered. One thing may, however, prevent this danger,—*i.e.*, the use of one of the very agreeable but worthless elixirs of calisaya that contains no alkaloids.

FIG. 510



℞

Iodide Pot ℥iiss.

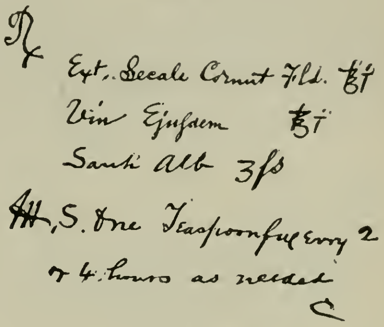
Hydrarg Bichloridi gr ii

Alcohol ℥ss

Elix Calisaya ℥iiiss

Incompatible prescription

FIG. 511



℞

Ext. Secale Cornut Fld. ℥i

Vin Ejusdem ℥i

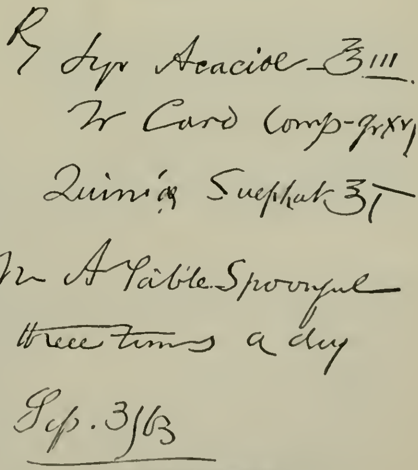
Sacch Alb ʒss

M. S. One Teaspoonful every 2 or 4 hours as needed

C

Old fashioned prescription

FIG. 512



℞ Syr Acaciae ℥iii

Tr Card Comp gr xvj

Quiniae Sulphat ʒi

M A Table Spoonful three times a day

Sep. 3/13

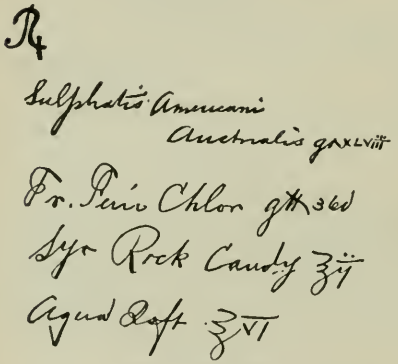
Erroneous prescription

In the case of prescription 511 no serious fault can be found with the manner of writing it; the interest in it simply lies in the fact that the druggist to whom it was presented had forgotten his Latin, the schoolmaster being needed. The second article proved a poser to him, and, after searching through the dispensatories and text books, and finding no substance in the materia medica bearing the title of "Ejusdem," he concluded that it was one of those "new-fangled proprietaries" that doctors are always writing for, and, with an air of injured dignity and superiority, he informed the patient that one of the ingredients he did not keep, and, returning the prescription, sent him away. The patient succeeded easily in having the prescription compounded by a neighboring pharmacist, and the story leaked out. The translation is, one fluidounce of fluidextract of ergot, one fluidounce of wine of the same (ergot), and half a drachm of white sugar.

Prescription 512 is a facsimile of one written by a well known physician. It is legible, and free from serious fault, with one exception,—the quantities have been inadvertently transposed. Sixteen grains of compound tincture of cardamom and one ounce of quinine sulphate are so far away from reasonable expectations that there should be no difficulty in "diagnosing this case" and deciding it to be one of transposition of quantities. It would be fortunate, indeed, if all instances of transposition were as glaring as this. It is a fault that often goes undetected, and its frequency arises from the habit which many good physicians have of deciding upon the ingredients that they wish to give their patient and filling in the quantities afterwards, not in consecutive order. An interruption or slight " lapsus" will be very apt to cause transposition.

In prescription 513 an illustration is given of the use of a specially coined term to designate a well known substance, the intention being to calm the fears of a patient who has a perhaps unreasonable prejudice against a remedy which the physician believes to be necessary to alleviate the malady. Circumstances arise in the practice of every physician when patients need a remedy which they will refuse to take if they are aware of it, and hence the alleged necessity for the use of an unusual term which they will not understand when written on the prescription. "Sulphatis Americani Australis," South American Sulphate, is, in plain English, sulphate of quinine. The stilted Latin by which the first ingredient is designated is in strong contrast with the plain English of the third ingredient,—"Syrup of Rock Candy." The last line may cause a little studying, but it is soon translated Aqua q. s. ft. ℥vi.

FIG. 513



℞

Sulphatis Americani
Australis gr xlviii

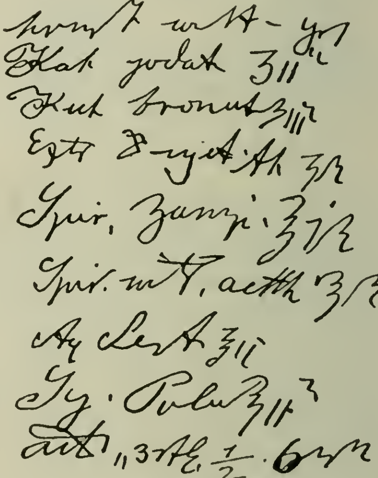
Tr. Ferri Chlor gtt 360

Syr Rock Candy ℥ii

Aqua Soft ℥vi

Puzzling prescription

FIG. 514

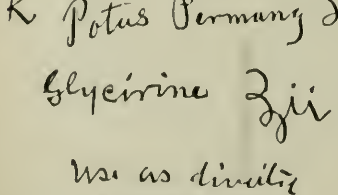


German prescription

Fig. 514 is a facsimile of a prescription written by a German physician, which at first appears curiously involved, but really presents no great difficulty in deciphering when carefully scanned. One grain of morphine sulphate, two drachms of potassium iodide, three drachms of potassium bromide, half a drachm of ethereal extract of digitalis, one and a half ounces of spirit of juniper, half an ounce of spirit of nitrous ether, two ounces of distilled water, and two ounces of syrup of tolu, are the ingredients ; while the signa, or the directions to the patient, are,—every three hours half a tablespoonful.

Prescriptions like that shown in Fig. 515 should be declined when presented, potassium permanganate exploding violently when mixed with glycerin and other bodies containing organic matter. This fact, and the additional one that glycerin does not have two i's, were doubtless overlooked by the writer of the prescription.

FIG. 515



R Potas Permang ℈i

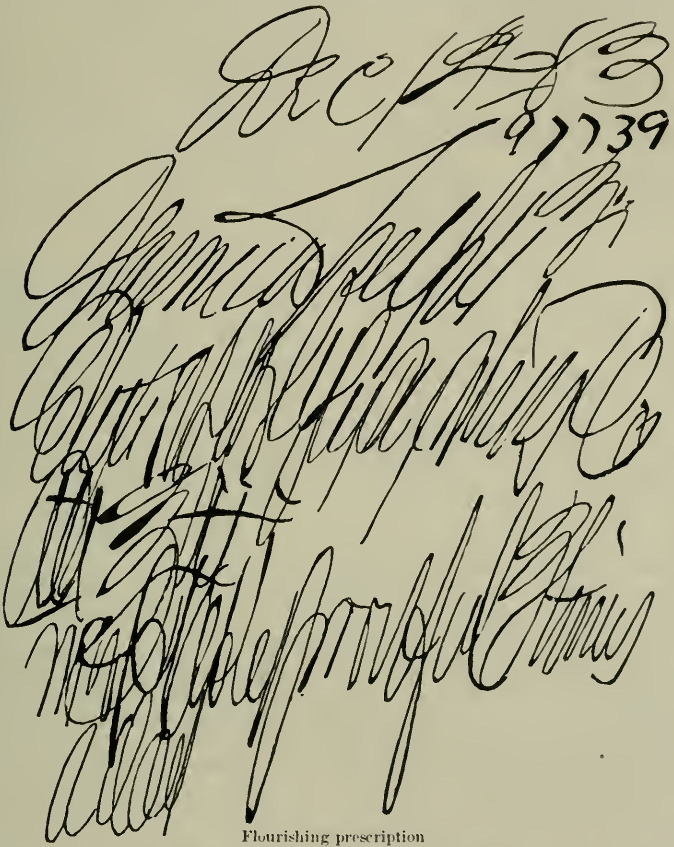
Glyceirine ℥ii

Use as directed

Explosive prescription

Prescription 516 has defied the efforts of all experts in calligraphy up to the present time. The author has shown the original and the facsimile to more than one hundred skilled pharmacists without receiving a correct solution from one of them. It was written by a Cleveland physician in the ordinary course of business,

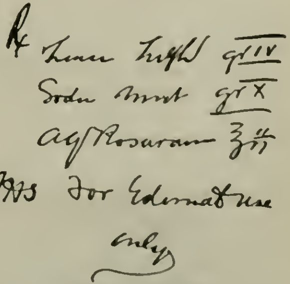
FIG. 516



Flourishing prescription

and was presented to the author by a brother pharmacist. The principal difficulty in deciphering it arises from the fact that two ingredients are unofficial and rather out of the way, and, in addition, their titles are run together and obscured almost beyond recognition. The full translation is as follows: "Dec. 14, 83. 97739. Quinia Sulph. ʒi; Elix. et Syr. Glycyrrhiza Co. āā ℥ii. M.—Tablespoonful 3 times a day." The author was informed by a pharmacist who was familiar with the doctor's method of writing prescriptions that the above specimen was not unusually obscure.

FIG. 517



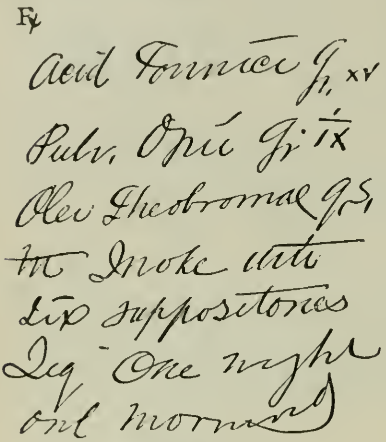
℞ Zinci Sulph gr iv
Sodii Borat gr x
Aq Rosarum ℥ii
M S For External use
only

Obscure prescription

Fig. 517 is a facsimile of a prescription for an eye wash. The original was written with a hard lead pencil upon a rough bit of paper. Any one familiar with the doctor's style would have little difficulty in solving the obscurity by dissolving four grains of zinc sulphate and ten grains of sodium borate in two ounces of rose water. Incidentally, it may be remarked that precipitation frequently occurs in prescriptions of this character, due to precipitation of hydrated zinc oxide by the alkali in the sodium borate. It is better to filter the mixture than to add a little sulphuric acid to clear the solution, because the slightest excess of the latter might prove irritating.

The habit of making one letter look exactly like some other letter is one of the worst faults that a writer can have, and it is usually only a question of time for a prescriber with such a habit to make a serious error. It will be observed that in the facsimile (Fig. 518) the fault is that the doctor's small "a's" are always "o's." He writes "Tonnici" for "Tannici." "Inoke" is intended for "make." The next word is not "mte," but "into." The words "six suppositories" are, fortunately, plain enough, and the directions, "One night and morning," present no difficulty to a good guesser. The writer is an intelligent and unusually able physician, and force and character are indicated by the general style of the writing, marred, however, by the one serious fault.

Fig. 518



℞

Acid Tonnici Gr. xv

Pulv. Opii Gr. i/ix

Olei Theobromae q.s.

M Inoke mte

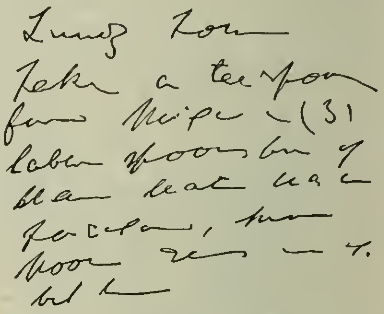
Six suppositories

Sig. One night

and morning

Faulty prescription

Fig. 519



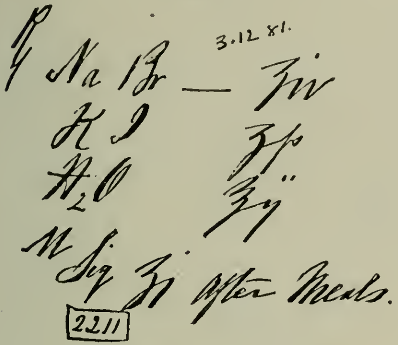
Badly written prescription

A study of the prescription illustrated in Fig. 519 will thoroughly justify the verdict that no extenuation can be fairly accorded to the writer. The facsimile cannot show the crumpled piece of manilla paper, nor reproduce the indistinct lead pencil marks, which are prominent characteristics of the original,—yet it was written by a noted physician "in a hurry." Who would guess that the first line is "Tinct. Iron"? and if any one should be so fortunate as to get so far, could he by any possibility translate the remainder?—"Take a teaspoonful mixed with (3) tablespoonsful of warm water sweetened, an hour before eating and at bedtime;" and yet this is the translation which was given by the friend who sent it to enrich the author's collection and affirmed to be correct. The difficulty about the acceptance of this guess centres around the word which is rendered "sweetened." The other words may or may not be correctly deciphered. Doubt and confusion reign supreme.

The use of chemical symbols in writing prescriptions is not a common custom, and although there can be no serious fault found with the prescription shown in facsimile in Fig. 520, there are objections to the custom notwithstanding some advantages. To begin with the latter, symbols are usually brief, distinctive, and capable of being written in unmistakable characters, but a physician who attempts to use them altogether must have a circumscribed list of remedies to prescribe from, for symbols have not been contrived for elixirs, syrups, or any galenical preparation; then, again, the symbols for alkaloids and some of the new antipyretics would be complicated and not so easily nor so clearly made out as the usual Latin abbreviations. In the example shown it is plain that the prescriber wants four drachms of sodium bromide and half a drachm of potassium iodide dissolved in two ounces of water.

Fig. 521 is a type of prescription which is very frequently seen in practice. It is impossible to expect any physician to retain in his memory the solubilities or exact physical properties of all the substances that he desires to prescribe. As pharmacy has advanced prescribers have grown into the habit of depending upon pharmacists to use their art in supplying the needed knowledge; and it follows, as a matter of course, that those who make a profession of handling the substances that enter into prescriptions every day should have this information ready for such an emergency. In this prescription two minims of oil of copaiba, two grains of magnesia, and one grain of powdered acacia are the ingredients for one pill, and the directions are that "thirty-six such pills are to be sent." A little more magnesia, a trace of water, and possibly a little powdered soap are needed to give the mass sufficient adhesivess and firmness.

FIG. 520



3.12.81.

℞ Na Br — ℥iv

K I ℥ss

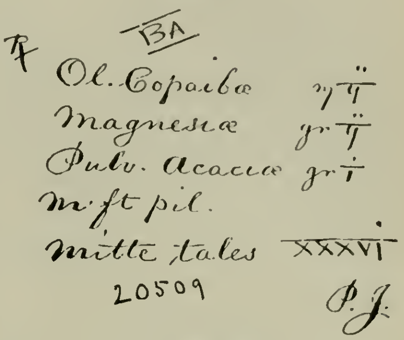
H_2O ℥ij

M Sig ʒi after meals.

2211

Prescription in symbols

FIG. 521



BA

℞ Ol. Copaibæ ♏ ij

Magnesiæ gr ij

Pulv. Acaciæ gr i

M. ft pil.

Mitte tales xxxvi.

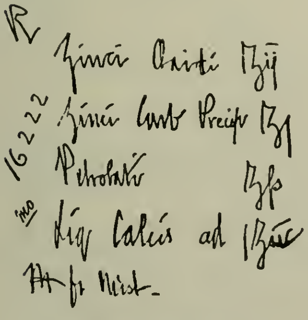
20509

P. J.

Pill prescription

A prescription like the one shown in Fig. 522 bears evidence of error on its face. The subscription directs a mixture to be made, and 75 percent. of the mixture is composed of solids. On the other hand, the dispenser is unable to guess whether the prescriber made an error in directing a mixture, or whether, unable to class the compound as an ointment, he has concluded to call it a mixture, and that the quantities of the ingredients are just what he intended to write. Probably most pharmacists would mix the powders thoroughly, rub in the petrolatum and lime water, and dispense the mixture in a box, labelling it, in the absence of directions, "Use as directed." If the physician could not be seen, this would be the course to pursue; but in the above case the quantity "f℥iv" after the "Liq. Calcis ad" happens to be a mistake. It should have been "f℥iv," and it was intended for an external application to an inflamed surface. There are, however, many instances on record where similar errors which were never corrected have occurred and the prescription dispensed as written, the patient subsequently returning to have the apparently absurd prescription renewed and ultimately praising the doctor for the speedy cure which had been effected.

FIG. 522



℞ Zinci Oxidi ℥ij

Zinci Carb Precip ℥j

Petrolatum ℥ss

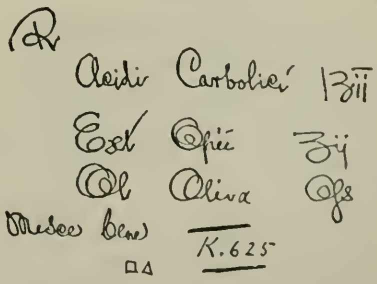
Liq Calcis ad f℥iv

M ft Mist.

162

Erroneous prescription

FIG. 523



℞ Acidi Carbolici f℥ij

Ext Opii ℥j

Ol Olivæ q.s.

Misce bene

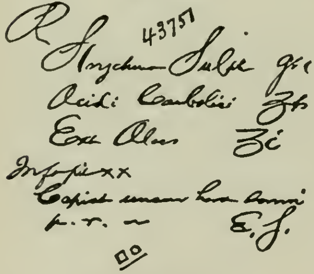
K. 625

Incompatible prescription

In prescription 523 physical incompatibility is illustrated. Extract of opium is an aqueous extract, the greater bulk of it being insoluble in olive oil. The mixture is evidently intended for an external application, and all that is expected is a reasonably smooth mixture. The proper method of compounding this would be to rub the extract of opium with sufficient water to make a smooth paste. Now, having poured the oil into the bottle in which the mixture is to be dispensed, add the carbolic acid, shaking it well until solution is effected, then gradually add the thick aqueous mixture of extract of opium, shaking after each addition. Do not filter the mixture, but dispense with a shake label.

Prescriptions like the one shown in Fig. 524 are very common; too much liquid has been ordered. It is a difficult matter for prescribers to educate themselves in the matter of not exceeding practical limits in ordering liquids for pill masses; indeed, the absorptive power of the solid substances used in making pill masses varies so much that usually nothing short of an actual attempt to make the mass will prove the extent of the excess. In this case, in all probability, the prescriber regarded carbolic acid as a solid, and he did not know of its tendency to liquefy under warmth and manipulation and its liability to cause other solids to soften. The difficulty here is that if sufficient absorbent powder be used to take up the excess (powdered althea would be an excellent one to use here) the pills will be very large. A nice question arises just at this point: Has the pharmacist the right to double the number of pills and alter the doctor's directions so that the dose shall be two pills instead of one? There are certain occasions when this may be done, *but they should be rare indeed.* It is not creditable for a pharmacist to acquire a reputation for altering the directions of a physician. Every expedient known to the art should be exhausted before attempting the slightest change, and, if it must be, the intention of the prescriber should always be kept closely in view. In the above case, if the number of pills is doubled without the doctor's sanction or knowledge, the patient must be acquainted with the fact at the time, otherwise, he will suspect that the pharmacist has blundered and has made too many pills; and if the patient is informed about it when the pills are dispensed, unless great tact is used he will probably suspect that the doctor does not understand his business, and may state his opinion to him at his next visit, in which event the pharmacist will probably have a call from the doctor. The best practice is to notify the prescriber at once of the change and let him make the necessary explanation to the patient.

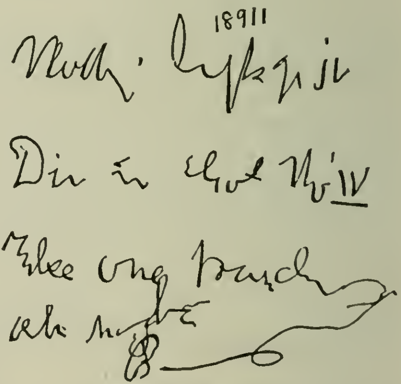
Fig. 524



℞ 43751
Strychn. Sulph. gr. i
Acidi Carbolici ʒss
Ext. Aloes ʒi
M. ft. pil. xx
Capiat unam hor. somni
p. r. n. E. J.

Faulty prescription

Fig. 525



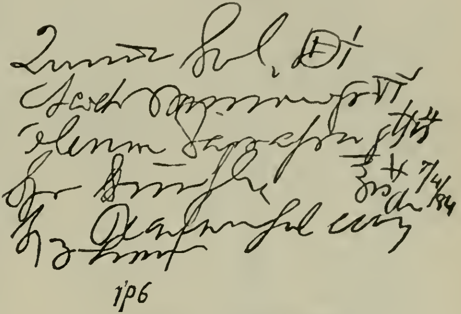
18911
Morph. Sulph. gr. iv
Div. in Chart. No. IV
Take one each
at night

Intemperate prescription

Prescriptions like the one shown in facsimile 525 are fortunately rare. It was written and presented personally by a physician very early in the morning, soon after having parted with some friends with whom he had been spending the evening, the pharmacist having been rung up by the night bell to dispense it. The prescriber's mental condition is accurately indicated by the fluctuating irresolution of some of the written characters and by the poisonous dose of morphine. He endeavored to explain that the dose was intended for himself, and it is hardly necessary to say that it was not dispensed as written. The translation is: Four grains of morphine sulphate divided into four powders; take one powder at night. He really wanted one grain divided into four powders, and this was given to him. In cases of this kind a pharmacist could not be justly condemned for refusing to compound the prescription; and, indeed, it should be the rule always to decline to furnish morphine or other poisonous remedies to any intoxicated person. In this particular instance the physician had friends with him who made themselves responsible for his safety.

Prescription 526 is another illustration of a badly written prescription, and one which defies the laws of both chemical and physical incompatibility. One scruple of quinine sulphate, six grains of morphine acetate, two drops of oil of sassafras, and five and a half ounces of simple syrup are to be mixed, and a teaspoonful administered every three hours. The insertion of the curious character, which resembles a capital letter A reversed, is an illustration of a careless and reprehensible method of correcting an error. The quantity originally attached to the "Syr. Simple" was ℥ss. This would yield a poisonous quantity of morphine, the mixture being given in teaspoonful doses. The addition of V over the "ss" was intended to make the dose of morphine a proper one; but it would in most cases fail signally to accomplish the intention of the prescriber, for it would not be so interpreted. When strong solutions of quinine sulphate and morphine acetate are brought together, decomposition results, with the production of the insoluble quinine acetate. In addition to this, the oil of sassafras would not dissolve entirely in the syrup, and it would consume a great deal of time to filter so thick a mixture. The only way out of such a combination of errors for the pharmacist, in the absence of the physician, is to paste a shake label on the bottle and dispense it.

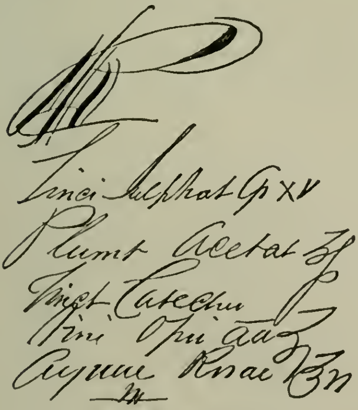
FIG. 526



Carelessly written prescription

In prescription 527, which is reasonably well written, is afforded an example of intentional incompatibility. Fifteen grains of zinc sulphate, half a drachm of lead acetate, and one drachm each of tincture of catechu and wine of opium are to be mixed with six ounces of rose water. This mixture should not be filtered, of course. The unusually elaborate character for recipe at the top of the prescription might reasonably be accused of indicating a relapse to the habit of former ages, when prescriptions were decorated with mystic signs. These were supposed to possess supernatural powers. The patient who needed such a prescription as 527, however, probably required a special invocation.

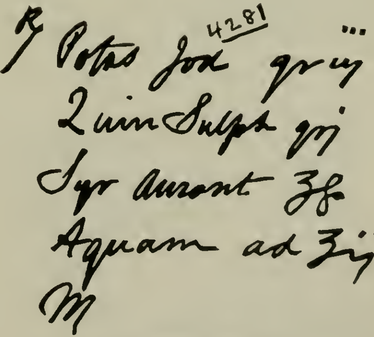
FIG. 527



Zinci Sulphat Gr XV
Plumb Acetat ʒß
Tinct Catechu
Vini Opii aa
Aquae Rosae ℥vi

Careless prescription

FIG. 528

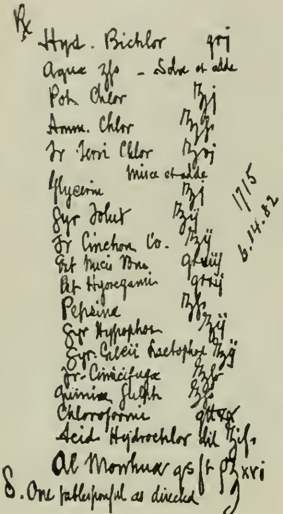


℞ Potas Iod 4281 gr iij
Quin Sulph gr j
Syr Auront ʒß
Aquam ad ℥ij
M

Incompatible prescription

In 528, precipitation, due to decomposition between the potassium iodide and the quinine sulphate, will take place and quinine iodide will separate. The addition of mucilage as a retarding agent has been recommended in such cases, but it is very ineffective, and the best course is to depend upon a shake label pasted on the bottle, with verbal directions to the patient to call attention to the necessity for shaking the mixture before taking a dose. Iodides and bromides should never be given in combination with alkaloidal salts (see page 1166). There can be no difficulty in reading this prescription. The translation is: Three grains of potassium iodide, one grain of quinine sulphate, half a drachm of syrup of orange, with sufficient water to make two drachms.

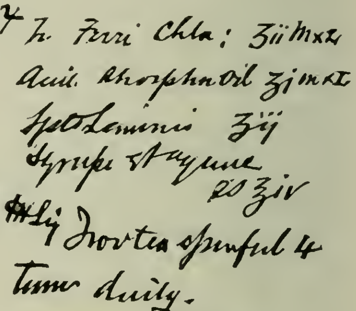
Fig. 529


℞
Hyd. Bichlor gr j
Aquæ ℥ss – Solve et adde
Pot. Chlor ʒj
Amm. Chlor ʒss
Tr. Ferri Chlor ʒvj
Misce et adde
Glycerin ʒj
Syr. Tolut ʒij
Tr. Cinchon Co. ʒij
Ext. Nucis Vom. gr viij
Ext. Hyoscyami gr xij
Pepsine ʒss
Syr. Hypophos ʒij
Syr. Calcii Lactophos ʒij
Tr. Cimicifugæ ʒss
Quinine Sulph ʒss
Chloroformi gtt xx
Acid Hydrochlor dil ʒiss
Ol. Morrhuæ q.s. ft. ℥xvi
S. One tablespoonful as directed
1715
6.14.82

Polypharmacal prescription

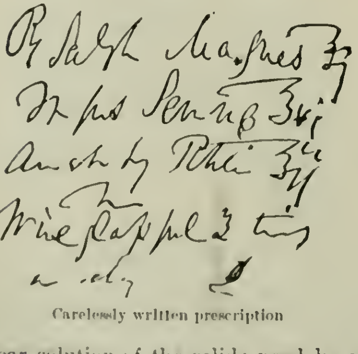
Fig. 529 is a copy of a prescription which was written by a physician in Canada. Three similar prescriptions were sent to the author by a Canadian pharmacist to enrich his collection, and the one selected for this illustration is by no means the best or the worst. They were all written by the same physician. He believes in "polypharmacy" and the doctrine that "there can't help but be something in such a prescription which will do good." Such prescriptions are not worthy of analysis. The best way to compound this one is to mix all the solids, reduce them to as fine a powder as possible, dissolve them in the mixed liquids, leaving out the chloroform and cod liver oil; then with the aid of acacia make a mixture with the cod liver oil and chloroform. No attempt to prepare a clear solution of the solids need be made; any excess will be suspended in the emulsion of cod liver oil.

Fig. 530



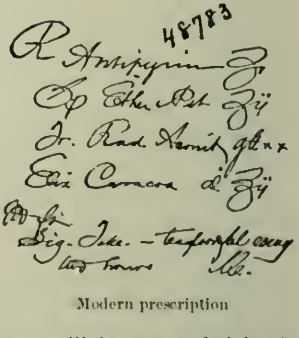
Obscure prescription

Fig. 531



Carelessly written prescription

Fig. 532



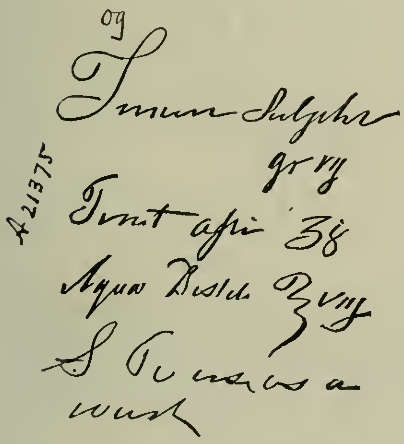
Modern prescription

Fig. 530 is a facsimile of a prescription which has been carefully considered by the prescriber; he has evidently bestowed the greatest attention upon the dose of the active ingredients, but there is considerable obscurity about the third ingredient.

An experienced compounder, however, would read the prescription without difficulty. Two drachms and forty minims of tincture of ferric chloride, one drachm and forty minims of diluted phosphoric acid, two drachms of spirit of lemon, and syrup and water to four ounces. "Two teaspoonfuls" four times daily. A precipitation may take place when the tincture of ferric chloride is mixed with the diluted phosphoric acid, due to the formation of insoluble ferric pyrophosphate, particularly if the diluted phosphoric acid which is used has been freshly made. This precipitate may be dissolved by adding a trace of potassium citrate or any alkaline citrate.

The facsimile shown in Fig. 531 is that of an old fashioned prescription, and a type of the sort now fortunately numbered with the past. Epsom salt, infusion of senna, and aromatic syrup of rhubarb form a trio which would be difficult to surpass in developing nausea; but the dose,—a "wineglassful three times a day" (presumably about meal times),—if retained, would be likely to prove an efficient cathartic. The second line might be translated, compound infusion of senna, but the letters which look something like "co" are evidently "æ," and the use of simple infusion of senna was common at the time when this prescriber studied medicine. The third line is somewhat obscure also, but the intention of the prescriber is so apparent and its artlessness is so sincere that the line may be easily guessed. One ounce of magnesium sulphate, six ounces of infusion of senna, and two ounces of aromatic syrup of rhubarb are to be compounded.

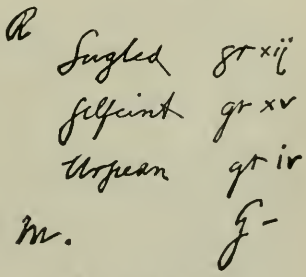
Fig. 533


A21375

Tinci Sulph
gr vij
Tinct api ʒi
Aqua Destil ℥viij
S To use as a
wash

Badly written prescription

Fig. 534


℞
Sugled gr xii
Selfeint gr xv
Urpean gr iv
M. ℥-

Misleading prescription

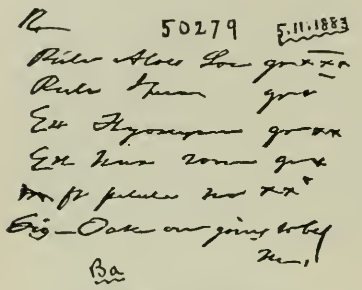
Fig. 532 is a prescription which offers a strong contrast to the preceding one. It represents modern therapeutics in more senses than one. An emerald green coloration is apt to be produced when antipyrine is brought in contact with nitrous compounds. This cannot be avoided. Investigation seems to indicate, however, that no dangerous poison is developed through this decomposition; yet it would be better to avoid prescribing antipyrine with spirit of nitrous ether until the action is clearly determined. The substitution of acetanilide or any other antipyretic for the one ordered, without the physician's knowledge or consent, as sometimes practised, is entirely without justification.

Prescription 533 shows illiteracy and general deficiency. Seven grains of zinc sulphate, one drachm of tincture of opium, and eight ounces of water are to be made into a lotion, and the direction is "To use as a wash." The letter "Z" is very far from being the ordinary form, and much more resembles the letter "T," while the other letters of this word are not recognizable as "inci;" "opi," in the second line, is more like "api," and, since preparations of celery and parsley, both "apiums," are now prescribed, there might be some danger of confusion if the construction of the letters were alone depended upon. The evident *intention of the prescriber* is a very important element, however, in guiding the pharmacist, who is expected to unravel the mysteries of compounding such prescriptions.

Prescription 534 must not be read with the Pharmacopœia as a guide; but it is best to have a layman read the prescription hastily, and then judge by the sounds how near such sounds resemble those of the names of familiar substances and which might be used in pronouncing "sugar of lead," "sulphate of zinc," "morphine." The object of writing such a prescription is concealment; and it is far safer for the pharmacist to decline to become a party to a questionable procedure, particularly one which involves the sale of a poisonous dose of morphine unauthorized by a physician. The intention is to add water to the mixture and thus complete the lotion. The temptation to overcome difficulties or to increase the number on the prescription file and to meet all possible contingencies should not be allowed to warp the pharmacist's judgment. Improper prescriptions should be declined politely but unconditionally.

Prescription 535 has been hastily written, but it is reasonably clear. The quantity attached to the first ingredient is somewhat ambiguous. Should gr. xxx or gr. xxv be dispensed? The upper part of the last x has been imperfectly made, so that an inverted v is the result. It is impossible that such a character as an inverted v would be used intentionally. Hence the conclusion is reached that thirty grains are wanted. This, with five grains of powdered ipecac, twenty grains of extract of hyoscyamus, and ten grains of extract of nux vomica, is to be made into twenty pills. The signa must also be read in the light of "obvious intention." The reading is clearly, "Take *on* going to bed." But the taking of twenty pills must be instantly dismissed from consideration, and the successful guess is then made that the "e" of the one has been flourished out of existence, and that the intended reading is, "Take *one* going to bed."

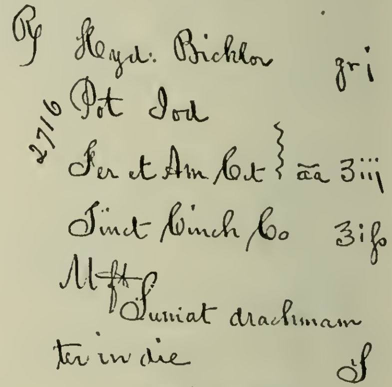
FIG. 535



℞ 50279 5.11.1883
Pilul Aloes Soc gr xxx
Pulv Ipecac gr v
Ext Hyoscyam gr xx
Ext Nux Vom gr x
M ft pilulae No xx
Sig—Take on going to bed
Ba

Carelessly written prescription

FIG. 536

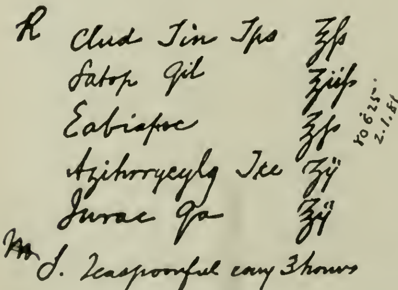


℞ Hyd. Bichlor gr i
27/6 Pot Iod
Fer et Am Cit } āā ʒiij
Tinct Cinch Co ℥iß
M ft
Sumat drachmam
ter in die
S

Incompatible prescription

Prescription 536 has been contrived with a disregard of the laws of chemical and physical incompatibility. Precipitation takes place, and this is due to the formation of mercuric potassium iodide, the alkaloidal reagent (see page 1033), and its reaction with the alkaloids in the compound tincture of cinchona. In addition to this, the quantity of ferric citrate is excessive. The prescriber may have intended to add sufficient water to effect a solution and then have forgotten to do so. The only course left for the pharmacist, if unable to communicate with the prescriber, is to dissolve the mercuric chloride in the compound tincture of cinchona with the aid of sufficient potassium iodide. This disposes of the dangerous ingredient. Then having reduced to powder the remaining solids, they are to be added and the prescription dispensed with a shake label, without filtering. There would be no impropriety in directing the patient to take the teaspoonful of medicine with water, and in this way the excess of soluble salts could be dissolved; but by far the best procedure would be to have the prescriber alter the prescription. One grain of mercuric chloride and three drachms each of potassium iodide and ammoniated ferric citrate are to

FIG. 537



℞ Clud Tin Tps ℥ß
Satop Gil ℥iiß
Eobiafoc ℥ß
Azihrryeyly Tke ℥ij
Jurac Qo ℥ij
M S. Teaspoonful evry 3 hours
40625 2.1.81

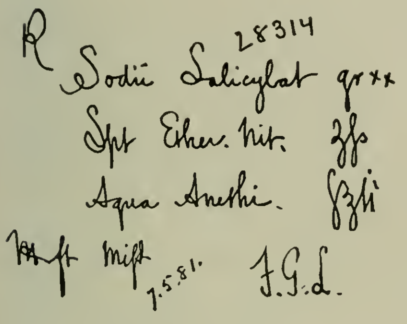
Travestied prescription

be dissolved in one and one-half ounces of compound tincture of cinchona. Let one drachm be taken three times daily.

Prescription 537 is an illustration of a travestied prescription, the intention being to mask its meaning so that only the initiated may be able to unravel its mystery. The method selected here is very simple, consisting in writing the names of the ingredients backward, and with this key the reading is very simple,—half an ounce of sweet spirit of nitre, two and a half ounces of solution of potassa, half an ounce of copaiba, two drachms of extract of licorice, and two ounces of caraway water are to be made into a mixture.

Prescriptions like the one shown in Fig. 538 are common, and they cause a great deal of trouble,—twenty grains of sodium salicylate, half a drachm of spirit of nitrous ether, and two fluidounces of dill water. Owing to some decomposition between the nitrous compounds of the spirit of nitrous ether and the salicylic acid in the sodium salicylate, the nature of which is complicated and has never been determined, a darkening in color which eventually results in the formation of a blackish deposit takes places and the odor of oil of wintergreen is observed. The annoyance to the dispenser in a case of this kind is apt to be considerable; the patient noticing a change in the appearance of the medicine, and at once suspecting that some mistake has been made, takes it to the pharmacist, and no matter how complete the defence may be, nor how earnest the latter may be in his protestations that no mistake has been made, it is only with great difficulty that an unfavorable opinion of the pharmacist's ability can be averted. Previous knowledge on the part of the dispenser that such combinations produce such mixtures would lead to the return of the prescription to the physician, with the request that it may be modified so that the two offending substances may be given separately. If this cannot be done, the prescriber should be notified as soon after the delivery of the prescription as possible, so that the medicine for the patient may be changed at the next visit.

FIG. 538

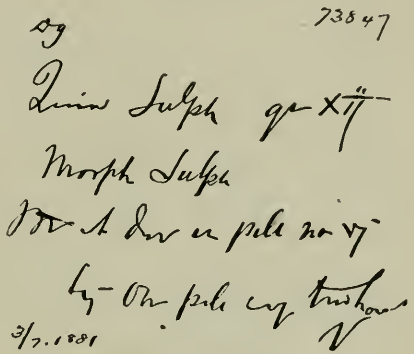


28314

R Sodii Salicylat gr xx
Spt Ether. Nit. ʒss
Aqua Anethi. ℥ii
M ft Mist
1.5.81. J.G.L.

Incompatible prescription

FIG. 539



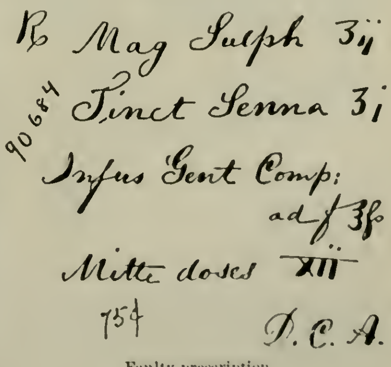
73847

R
Quin Sulph gr xii
Morph Sulph
M ft div in pil no vj
S. One pil every two hours
3/7.1881

Deficient prescription

Fig. 539 shows a facsimile prescription in which the quantity of one of the ingredients is omitted. It is presumed that the physician intended to write "gr. i" after "Morph. Sulph.," but it would not be proper for the pharmacist to insert the quantity upon his own judgment, except in case of an extreme emergency which would require prompt action without the advice of the prescriber.

FIG. 540



9064

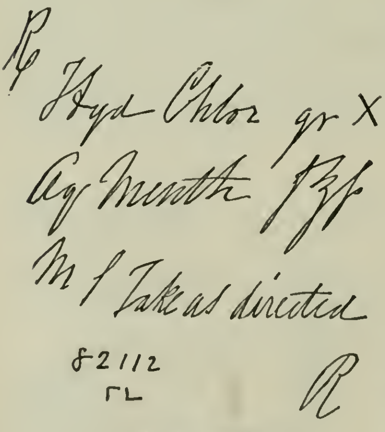
℞ Mag Sulph ʒij
Tinct Senna ʒi
Infus Gent Comp:
ad f℥ss
Mitte doses XII
75¢ D. C. A.

Faulty prescription

No fault can be found with the legibility of prescription 540. The first line could only be translated "Magnesii Sulph.;" the termination to "Senna" is, however, incorrect, as it should have the genitive termination "æ" instead of "a." Two drachms of sulphate of magnesia, one drachm of tincture of senna, and sufficient compound infusion of gentian to make half a fluidounce. Send twelve doses. Although the additional word "tales" is omitted in the directions, it is a fair inference that the prescriber wants the patient to take half a fluidounce for a dose; but the quantity of liquid is insufficient, and a portion of the sulphate will not dissolve. If the mixture is heated the excess will disappear, only to return on cooling in the form of a gelatinous precipitate. The usual course of notifying the physician should be followed if there is time, and if there is not, there would be no impropriety *in this case* of adding just sufficient water to hold the sulphate in solution, making each dose a little larger, and then sending word to the physician of the fact.

Prescription 541 is a facsimile of one which is ambiguous in two particulars: "Hyd. Chlor." may mean hydrated chloral, calomel, or corrosive sublimate (see page 1091), and "Aq. Menth" may mean peppermint water or spearmint water. "Obvious intention" in this case is the deciding factor, and this apparently points to the conclusion that a soothing draught is intended of chloral hydrate and mint water. The directions, "Take as directed," should cause the pharmacist to pause. In this case, however, a dose of calomel was intended, with mint water as the vehicle. These facts were developed only by a few questions which were asked the patient, who happened to present the prescription personally and who without much provocation said that he was "that bilious" that the doctor had given him "the same medicine as before, for it did him so much good." Further inquiry developed the fact that this was "obvious intention" on the part of the prescriber, and it would have been a very poor conjecture to use chloral hydrate. The incident points clearly to the necessity for the possession of wisdom and caution almost supernatural if errors in judgment are always to be avoided. The use of spearmint or peppermint water when "Aq. Menth." is prescribed is largely a matter of local habit; in some sections mint water always means peppermint water; in other parts of the country spearmint water is preferred. Where local preference does not exist, the fact of the kind of mint not being specified would give the pharmacist an undoubted right to use either. In every case like this a marginal note should be made on the prescription, so that in case of renewal the same mint water may be used that was employed at first.

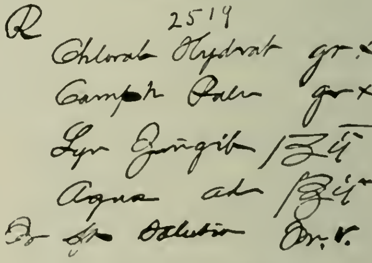
FIG. 541



℞
Hyd Chlor gr X
Aq Menth ℥ss
M / Take as directed
82112
FL

Ambiguous prescription

FIG. 542



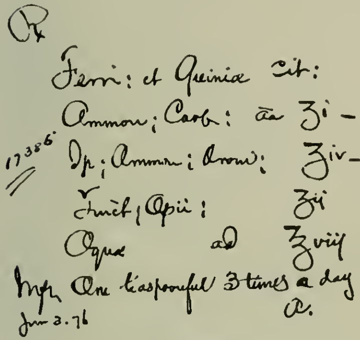
℞ 2519
Chloral Hydrat gr xl
Camph Pulv gr x
Syr Zingib ℥ii
Aqua ad ℥ii
Ft Ft Solutio Dr. V.

Incomplete prescription

In prescription 542 there is an opportunity for the dispenser to utilize his knowledge and skill. Forty grains of hydrated chloral, ten grains of powdered camphor, and two fluidrachms of syrup of ginger are to be made into a solution, with sufficient water to make two fluidounces. Hydrated chloral and camphor, when rubbed together, form a liquid (see Chloral Camphoratum, Part VI). If advantage of this knowledge is taken by the dispenser, and if the two substances are rubbed in a mortar until a smooth mixture results, and if half a drachm of powdered acacia be added, with sufficient water to make a smooth mixture, and followed with the remainder of the water and syrup, it will be found that the camphor can be uniformly distributed in the mixture with no tendency to separate. The directions to "make a solution" are faulty, because a *solution* cannot be made with the ingredients named; but the pharmacist is justified in adding acacia to make a mixture, for otherwise the camphor will separate and cannot be combined uniformly.

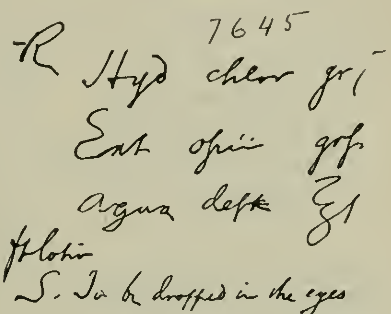
Prescription 543 exhibits chemical incompatibility. Iron and quinine citrate should never be prescribed with alkaline salts; an excess of the latter will surely decompose the quinine salt, causing precipitation of the alkaloid. The prescriber evidently intends in this prescription to get the tonic effects of the quinine and iron, the sedative properties of the tincture of opium, and the correcting and stimulating influence of the compounds containing ammonia; but in attempting to get all of them bottled up in one mixture he has defeated his purpose,—the alkaloidal salt should either be made into pills or given in a separate preparation. One drachm each of iron and quinine citrate and ammonium carbonate is dissolved in water, aromatic spirit of ammonia, and tincture of opium, with sufficient water to make an eight ounce mixture.

FIG. 543


℞
Ferri: et Quiniæ cit:
Ammon: Carb: āā ʒi –
17386 Sp: Ammon: Arom: ℥iv –
Tinct: Opii: ʒii
Aqua ad ℥viij
M. Sig. One teaspoonful 3 times a day
Jan 3.76
D.

Incompatible prescription

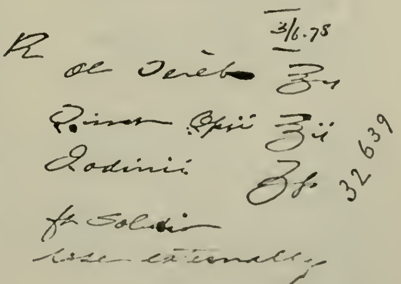
FIG. 544


7645
℞ Hyd chlor gr i
Ext opii gr ss
Aqua dest ℥i
ft lotio
S. To be dropped in the eyes

Faulty abbreviation

Prescription 544 is another illustration of incorrect abbreviation. "Obvious intention" cannot be used here to aid in the interpretation, because the intention is *not obvious* by any means. A prescriber might want corrosive sublimate, calomel, or hydrated chloral. Most pharmacists would probably guess that corrosive sublimate was intended, particularly since its use in collyria is not uncommon. But the physician in this case wanted calomel, as he had conceived the idea of replacing the practice of blowing calomel into the eyes (which is sometimes resorted to) by the more refined method of making a lotion and dropping a portion of it into the eyes. One grain of calomel and half a grain of extract of opium are to be made into a lotion with one ounce of distilled water, care being taken to paste a shake label upon the bottle. As a matter of practice it is very doubtful whether the heavy powder calomel could be distributed so uniformly through the lotion that one drop would contain the same proportion that another would.

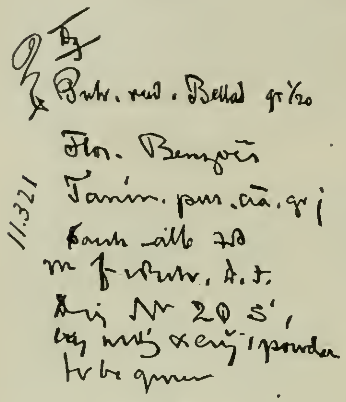
FIG. 545


3/6.78
℞ Ol Tereb ℥i
Tinct Opii ℥ii
Iodinii ʒss 32639
ft Solutio
Use externally

Incompatible prescription

In prescription 545 the prescriber intends that a solution should be made,—for he has written "ft. solutio:" but he is no doubt ignorant of the fact that iodine is not soluble either in tincture of opium or in oil of turpentine. If the prescription is compounded as written, considerable irritation will be produced from the contact of the undissolved particles of iodine with the skin. If four drachms of the oil of turpentine be replaced by strong alcohol, and as much of the iodine dissolved in this as can be, and if the moist residue be then rubbed into a smooth paste and the oil of turpentine and tincture of opium added gradually and alternately, a mixture will result in which the undissolved iodine will be in a very fine state of division. The best course to pursue would be to get the physician to use extract of opium, iodine, potassium iodide, and water as a substitute, or a mixture of tincture of iodine and tincture of opium. Incidentally, it may be mentioned that the legibility of a prescription is often seriously impaired by the careless habit of folding it before the ink is dry. This one has been blotted, though not very seriously.

Fig. 546



Rx
Pulv. rad. Bellad gr 1/20
Flor. Benzoës
Tannin. pur. ãã. gr j
Sacch. alb. q.s.
m. f. pulv. d. t.
dos. Nr 20 S',
every morng & evening 1 powder
to be given

11.321

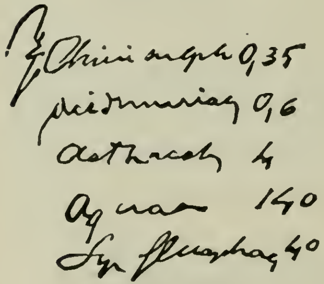
German prescription

Fig. 546 shows a facsimile of a prescription written by a German physician. It is shown for the sake of practice for those unaccustomed to this kind. One-twentieth of a grain of powdered belladonna root, one grain each of benzoic acid and pure tannin, and sufficient white sugar. Make into a powder. Send twenty such powders. Every morning and evening one powder to be given.

Fig. 547 is a facsimile of another German prescription. This one is metric, and is to be compounded according to the German method, by *weighing the liquids.* It is badly written, the last ingredient being very indistinct. Thirty-five centigrammes of quinine sulphate, sixty centigrammes of hydrochloric acid, four grammes of acetic ether, one hundred and forty grammes of water, and forty grammes of syrup of orange flowers (fl. naphæ).

Prescription 548 shows peculiarities of composition that are strongly marked, the character selected for "gr." being unusually bad,—the habit of starting the "g" above the line and slurring the "r" making a character which resembles a capital script letter "L," or the one used to designate the British pound sterling, £. Whether to make six pills or six powders might cause the pharmacist a moment's hesitation, as the directions, "M. ft. pulv vi," are a little ambiguous. But the first line is an aid here. No prescriber would be likely to direct powdered mercurial mass if pills were intended, and it is therefore clear that six powders are wanted. The signa is not difficult for an experienced compounder to interpret: the flourish after "1" would be guessed to mean "every," and that after "2" to mean "hours."

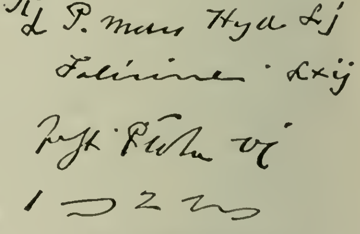
Fig. 547



Rx Chinin. sulph. 0,35
acid. muriat. 0,6
Aeth. acet. 4
Aquae 140
Syr. flor. naph. 40

German prescription

Fig. 548



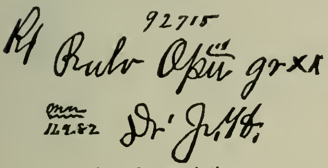
Rx P. mass Hyd gr j
[illegible] gr xij
M ft. Pulv. vi
1 [illegible] 2 [illegible]

Badly written prescription

Fig. 549 is a dangerous prescription. The absence of any directions and the use of the abbreviation "Dr." before the initials would lead a cautious pharmacist to suspect that this is a forged prescription, written by an opium eater for the purpose of obtaining his dose without difficulty or questioning. There are a few physicians who use their abbreviated title "Dr." before their initials, but it is not common except in certain localities, and an opium eater wanting his dose would be very likely to put "Dr." before the initials, imagining that such an act would lull the suspicions of the pharmacist and thus his object be more readily accomplished; but a trick like this is very apt to overshoot the mark. Advantage may be taken of the fact that no directions have been given with the prescription, and if it is returned to the alleged patient with the request that the doctor write the directions upon it the difficulty can be easily met, or an offer may be made to send to the doctor for the information. If it is a forgery, the behavior of the patient will be apt to reveal it; he will probably take the prescription away and never return. On the other hand, if it is an honest prescription, both doctor and patient can but commend the caution and discretion of the pharmacist.

Prescription 550 is an illustration of one written by a dispensary physician "on the jump." To a pharmacist accustomed to such scrawls they present no terrors, but the uninitiated are often sadly mistaken in their interpretations. This prescription is not so illegible as some others of its class in the author's collection, but it has been selected to show that dangerous poisons are sometimes prescribed in this very reckless fashion. Poor "Sarah McM." is expected to obtain relief for her cough by taking "two drachms" of a mixture made of one grain of morphine sulphate, one drachm of "muriate of ammonia," and four ounces of brown mixture (Mist. Fuscæ).

Fig. 549



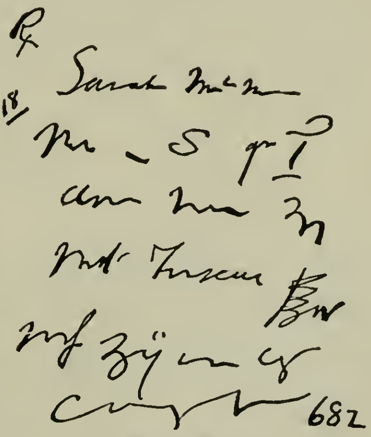
92715

R Pulv Opii gr xx

Dr. J. H. B.

Forged prescription

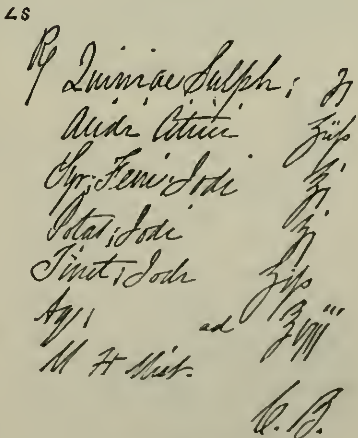
Fig. 550



Illegible prescription

In prescription 551 will be seen an illustration of an almost hopeless case of incompatibility. There are no difficulties about making a solution of the quinine sulphate in sufficient water with the aid of the large quantity of citric acid ordered. If the potassium iodide, syrup of ferrous iodide, and tincture of iodine are now added, a reddish precipitate occurs, which probably consists largely of insoluble quinine iodide. The addition of two ounces of mucilage will not only be admissible, but even beneficial as an aid in holding up the precipitate and in blunting the edge of the excess of acid. Quinine sulphate should never be prescribed in combination with iodides, and particularly with excess of iodine; and the physician should be asked to revise such a prescription.

Fig. 551



R Quiniae Sulph. ʒj

Acidi Citrici ℥ss

Syr. Ferri Iodi ʒj

Potas. Iodi ʒj

Tinct. Iodi ℥ss

Aq. ad ℥iii

M ft Mist.

C. B.

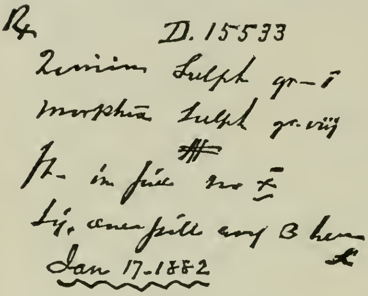
Incompatible prescription

Fig. 552 is a facsimile of a prescription which should at once arouse the cautionary instinct of the compounder. It reads, "One grain of quinine sulphate, eight grains of morphine sulphate; make into ten pills. One pill every three hours." Through a lapsus the prescriber has written the quantity intended for the quinine sulphate after the morphine sulphate, and *vice versa*. The usual rule should be followed.

Gain time, if possible, and notify the physician; if this cannot be done, take the risk, use safe quantities, and inform the prescriber.

In Fig. 553 there is shown a prescription which affords an illustration of chemical incompatibility. Quinine salicylate is not a very soluble salt, and when strong solutions of quinine sulphate and sodium salicylate are mixed, quinine salicylate precipitates. The prescriber has evidently added diluted sulphuric acid with the view of dissolving the quinine salt, but the excess of acid will decompose the sodium salicylate, producing sodium sulphate and throwing out the salicylic acid, which is not very soluble in aqueous liquids. The directions of the prescriber—"ft. solutio," make a solution—cannot be complied with literally. Of course he should be consulted; but, if this is not possible, it would be a fair inference that the diluted sulphuric acid was intended solely for its action on the quinine sulphate to increase its solubility; but, as it acts as an impediment by decomposing the sodium salicylate, it might be omitted. If this course is not permissible, the mixture should be made in a mortar and the clear liquid then separated from the precipitate; the latter may be rubbed into a smooth paste with the aid of some mucilage of acacia and mixed with the rest of the liquid. This will make a mixture, and it should be dispensed with a shake label.

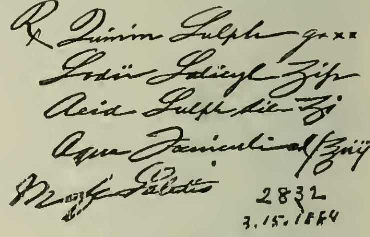
FIG. 552



Rx D. 15533
Quinin Sulph gr – i
morphia Sulph gr. viij
ft. in pil. No x
Sig. one pill every 3 hours
Jan 17-1882

Transposed prescription

FIG. 553

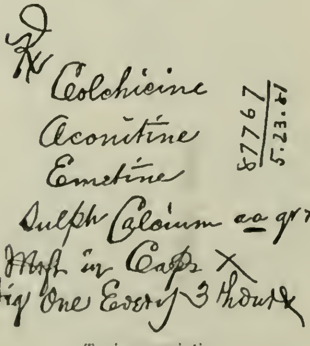


R Quinin Sulph gr xx
Sodii Salicyl ʒij
Acid Sulph dil ʒi
Aqua Foeniculi ad ℥iij
M. ft. Solutio
2832
3.15.1884

Incompatible prescription

Prescription 554 is a facsimile of one written by a medical student. The ingredients are distinctly indicated; but the dose of the poisonous alkaloids is so heroic and the prescription itself so unusual that very little risk is incurred of the patient being poisoned. No dispenser who would be likely to compound such a prescription would have such alkaloids in stock. The only course to pursue here is to gain time and return the prescription to the prescriber for correction. Ten grains each of colchicine, aconitine, emetine, and calcium sulphate are to be made into ten capsules, and one given every three hours.

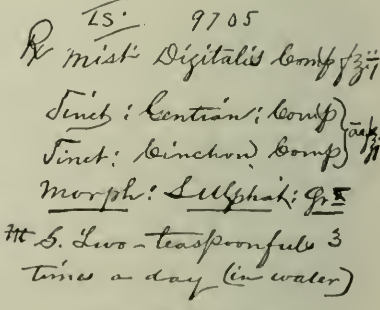
FIG. 554



Rx Colchicine
Aconitine
Emetine
Sulph Calcium āā gr x
Mft in Caps X
Sig One Every 3 hours
87767
5.23.87

Toxic prescription

FIG. 555

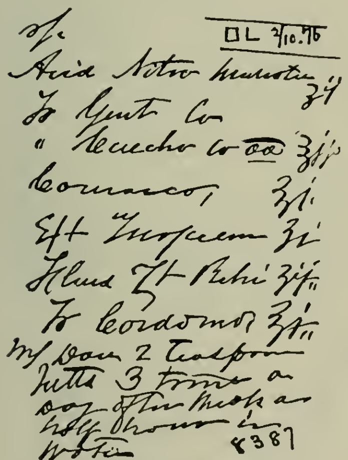


15 9705
Rx Mist Digitalis Comp f℥ii
Tinct: Gentian: Comp
Tinct: Cinchon: Comp āā ℥ii
Morph: Sulphat: gr x
M S. Two teaspoonfuls 3 times a day (in water)

Questionable prescription

Fig. 555 is a type of a prescription not uncommon. Care and good judgment are required to pilot the compounder through safely. It might be surmised that the first ingredient was intended for "compound infusion of digitalis," but this is not the case,—the "compound mixture" being a preparation devised by the physician and the formula not published, the intention being to send the patient to a special drug store to have it compounded, the druggist, of course, having been previously supplied with the private formula. This practice is common in some localities. It does not follow, however, that the physician always derives a pecuniary consideration through the method, although where the practice prevails both prescriber and compounder are soon suspected of pocketing some special profit. If the physician makes the private formula public or gives the patient the opportunity of going to a large number of pharmacists to whom he has given the formula, he is relieved of what is probably an unjust suspicion. The dose of morphine sulphate is a large one, but the underscoring of the line indicates that the prescriber has considered the likelihood of the compounder's questioning it, and he has underscored the words so that the compounder knows that the prescriber intended to give an unusually large dose. Under the circumstances there is no impropriety in dispensing it. Some careful pharmacists would prefer to decline such a prescription on the ground that they did not have the formula of the private preparation, the real reason being their unwillingness to incur the risk of dispensing so large a dose of morphine sulphate. Formulas for private preparations may often be secured through professional courtesy by applying to the pharmacist known to have them.

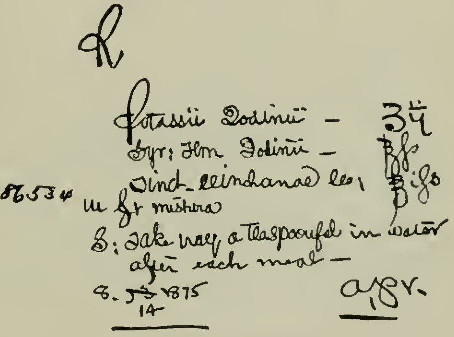
FIG. 556



℞
DL 7/10.76
Acid Nitro muriatic ʒii
Tr Gent Co
" Cincho Co āā ℥iss
Curacao ℥i
Ext Taraxcum ʒi
Fluid Ext Rehi ʒii
Tr Cordomo ℥i
M/ Dose 2 Teaspoon fulls 3 times a day after meals a half hour in water
4387

Illiterate prescription

FIG. 557



℞
Potassii Iodini — ʒii
Syr: Ferri Iodini — ℥ss
Tinct. Cinchonae Co. ℥iss
86534
M ft mistura
S: Take half a teaspoonful in water after each meal —
8. ~~5~~ 14 1875

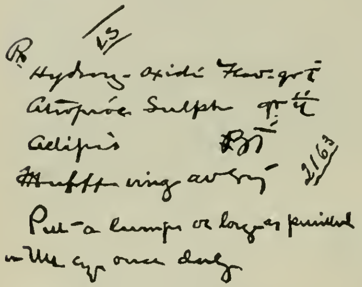
Incompatible prescription

The facsimile Fig. 556 shows the prescription of a physician who at one time had an extensive practice, but whose early education had been seriously neglected. The ingredients are: Two drachms of nitro muriatic acid, one and one-half ounces each of compound tincture of gentian and compound tincture of cinchona, one ounce of Curaçoa cordial, one drachm of extract of taraxacum, two drachms of fluidextract of rhubarb ("rehi"), one ounce of tincture of cardamom. Dose, two teaspoonfuls, three times a day, after meals a half hour, in water.

Prescription 557 illustrates two kinds of incompatibility. Two drachms of potassium iodide, half a fluidounce of syrup of ferrous iodide, and one and one-half fluidounces of compound tincture of cinchona are to be made into a mixture. Take half a teaspoonful in water, after each meal. Potassium iodide is usually crystallized by the manufacturer from an alkaline solution, and traces of the potassium hydroxide which is present in the mother liquor are retained by the crystals. The hydroxide by contact with the air, containing carbonic acid, becomes potassium carbonate, and hence commercial potassium iodide always contains traces of carbonate, and the Pharmacopœia permits the presence of 0.1 percent. of alkali. Hence it follows that when a solution of potassium iodide is brought in contact with syrup of ferrous iodide a greenish flocculent precipitate is produced which is ferrous carbonate. This may be filtered out without detriment to the prescription. The other instance of incompatibility is inexcusable. Iron salts produce with preparations of cinchona bark blackish, inky precipitates, due to the reaction between the tannin in the cinchona and the ferrous iodide. Filtration will not remedy this fault, and there is usually no recourse but to dispense the prescription with a shake label.

In prescription 558 the principal interest centres in the directions to the patient. One grain of yellow mercuric oxide, two grains of atropine sulphate, and one drachm of lard are to be made into an ointment. The prescriber intends that the patient should "put a lump as large as a *pin's head* in the eye once daily." If the label had been written according to the first reading of the compounder,—*i.e.*, put a lump as large as a *peanut* in the eye, etc.,—there would undoubtedly have been a serious time for all,—patient, physician, and pharmacist.

FIG. 558



13

℞ Hydrarg. oxidi Flav. gr. i

Atropinæ Sulph. gr. ii

Adipis ʒi

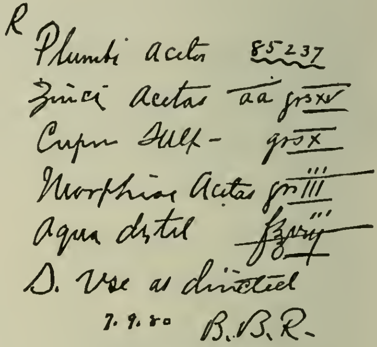
M. ft. ung. [illegible] 2163

Put a lump as large as pin head

in the eye once daily

Badly written prescription

FIG. 559



R Plumbi Acetas 85237

Zinci Acetas āā grs xv

Cupri Sulph. grs x

Morphiæ Acetas grs iii

Aqua destil f℥viii

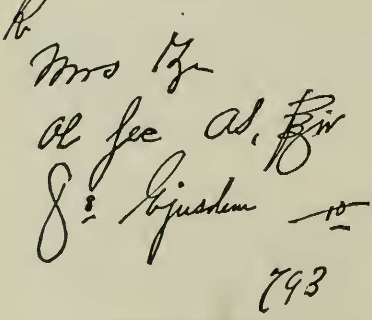
D. Use as directed

7. 9. 80 B. B. R.

Incompatible prescription

Chemical incompatibility is illustrated in Fig. 559, and while the compounder may believe that the prescriber has erred, through ignorance of the fact that sulphates are delicate reagents for lead salts, the absence of directions for use makes it impossible for him to obtain any clue. The presence of lead sulphate may have been expected and desired by the physician. In such cases the only course is to compound the prescription exactly as it is written and dispense it, without filtering, with a shake label. Fifteen grains each of lead acetate and zinc acetate, ten grains of copper sulphate, and three grains of morphine acetate are to be dissolved in eight fluidounces of distilled water. Use as directed.

FIG. 560



R

Mrs Z

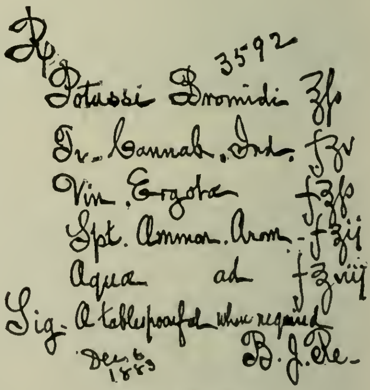
Ol. Jec. As. ℥iv

S: Ejusdem — 10 —

793

Curious prescription

FIG. 561



℞ 3592

Potassi Bromidi ℥ss

Tr. Cannab. Ind. fʒv

Vin. Ergotæ fʒss

Spt. Ammon. Arom. fʒij

Aqua ad f℥viij

Sig. A tablespoonful when required

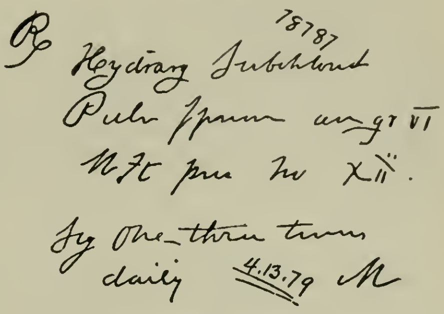
Dec 6 1883 B. J. Re.

Legible prescription

Fig. 560 shows peculiarity and brevity. It is expected that Mrs. Z. will receive four fluidounces of cod liver oil and that the bottle will be labelled the same. Oleum Jecoris Aselli is one of the synonyms for Oleum Morrhuæ, and the Latin word "Ejusdem," used in this connection, is a short but peculiar way of directing the compounder how he is to label the bottle.

Although prescription 561 is rather flourishing in its style, no fault can be found with its legibility. Half an ounce of potassium bromide, five fluidrachms of tincture of cannabis indica, half a fluidounce of wine of ergot, two fluidounces of aromatic spirit of ammonia, and sufficient water to make eight fluidounces. The chief interest in it is due to the presence of the tincture of cannabis indica. If the prescription be compounded without this, and if a drachm of granulated acacia be placed in a mortar and rubbed with sufficient of the liquid to form a thick paste and the tincture then gradually and slowly added, it will be found that the resinous matter in the cannabis can be uniformly suspended, and when this is mixed with the rest of the liquid a very satisfactory preparation will have been produced. It should of course be dispensed with a shake label.

Fig. 562



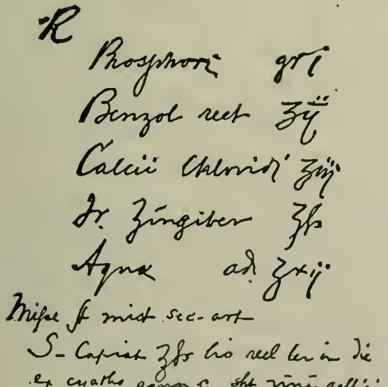
℞ 78787
Hydrarg Subchlorid
Pulv Ipecac aa gr vi
M ft pul No xii.
Sig One three times
daily 4.13.79 M

Questionable prescription

Fig. 562 is a facsimile of a prescription written by an old practitioner. Hydrargyri subchloridum is rather an old name for calomel, but not uncommon. Six grains each of calomel and powdered ipecac are to be made into either twelve pills or twelve powders, and the question is, which? A little study of the prescriber's method shows that he has fortunately acquired. the habit of dotting his "i's," and it is fair to presume that if pills were intended he would have dotted the "i" in the word. M. ft. *pul.* No. xii. is undoubtedly the correct reading. A few suggestive questions to the patient, such as—"Did the doctor direct you to take water with these?" or, "Were these to be taken after meals?" will be apt to elicit such a reply as this: "Yes, he said that I should take one *powder* three times a day, just before meals."

Prescription 563 belongs to a class fortunately rare. The intention of the prescriber is undoubtedly to give phosphorus in a fine state of division, suspended in the mixture. This may be accomplished by dissolving the phosphorus in the benzene (not petroleum benzin), and, having made a thick mucilage of acacia from one drachm of gum, the solution of phosphorus may be gradually added with stirring, followed by the tincture of ginger and the chloride of calcium, dissolved in a little water. The directions to the compounder—Misce, ft. mist. sec. art. (make a mixture according to art)—indicates that the prescriber offers the pharmacist an opportunity to exercise his skill in making a good mixture. The directions for the patient are in Latin, the translation being,—"Let him take half a fluidounce, two or three times daily, in a cup of water, with brandy."

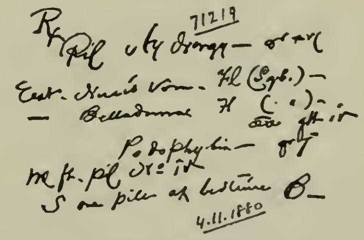
Fig. 563



℞
Phosphori gr i
Benzol rect ℥ij
Calcii Chloridi ℥ij
Tr. Zingiber ℥ss
Aqua ad ℥xij
Misce ft mist sec art
S– Capiat ℥ss bis vel ter in die
ex cyatho aquae c spt vini gallici

Odd prescription

Fig. 564



℞ 71219
Pil Hydrarg — gr xvi
Ext. Nucis Vom. Fl (Eng.) —
— Belladonnae Fl (") — āā gtt iv
Podophyllin — gr i
M ft pil No iv
S one pill at bedtime B—
4.11.1880

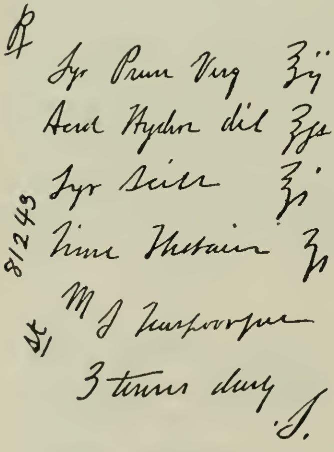
Faulty prescription

Fig. 564 is a facsimile of a prescription written by a prescriber of large experience. Sixteen grains of mercurial mass, and one grain of podophyllin, with four drops each of fluidextract of nux vomica and fluidextract of belladonna (Squibb's), are to be made into four pills. As blue mass is usually soft in consistence, it will be necessary to evaporate the fluidextracts. This may be easily done by heating a small mortar, and, after dropping the fluidextracts into it and stirring them a short time with the pestle, the blue mass and podophyllin can be subsequently added and four pills made from the mass. The reason for prescribing fluidextracts when extracts are available is not apparent.

Fig. 565 shows a prescription which is faulty in several respects. In the second line the abbreviation is questionable. Is diluted hydrochloric or diluted hydrocyanic acid desired? It would be fair to assume that diluted hydrocyanic acid is wanted, because of its action as a sedative, and that it is undoubtedly a cough mixture and the prescriber desires to reinforce the action of the syrup of wild cherry. The style of writing is anything but legible, and the use of an unusual term for "opium" in the fourth line adds to the difficulties. Two ounces of syrup of wild cherry, half a drachm of diluted hydrocyanic acid, one ounce of syrup of squill, and one drachm of tincture of opium (tinctura thebaicæ). Teaspoonful three times daily.

Prescription 566 brings up an interesting question about which there may be more than one opinion. One drachm of iron and ammonium citrate and fifteen grains of quinine sulphate are to be made into a solution with half a fluidounce of water, and five drops are to be taken three times a day, in sugar and water. If no acid be used, it will not be easy for the patient to comply with the prescriber's directions to take five drops, for the insoluble portion of the quinine sulphate will separate, and the dropping, if each drop is to contain its proper proportion of quinine, will be very defective. If the directions were different and the patient could secure a fair dose each time, it probably would be best not to make an addition of acid; but in this case there could be no impropriety in making a solution of the quinine sulphate in the water with a trace of acid (citric acid, if preferred), and then dissolving the iron and ammonium citrate in the solution. The practice of adding acids or alkalies to prescriptions generally and upon very little provocation is a bad one, and the author would not be understood as encouraging the habit; but occasions occur when there should be no hesitation about employing a trace of acid or alkali when the compounder is satisfied that the intention of the prescriber will not be frustrated. Of course the risk of making an error in judgment must be taken; but "first be sure that you are right, and then—do right."

FIG. 565



℞

Syr Prun Virg ℥ii

Acid Hydro dil ʒss

Syr Scill ℥i

Tinc Thebaic ʒi

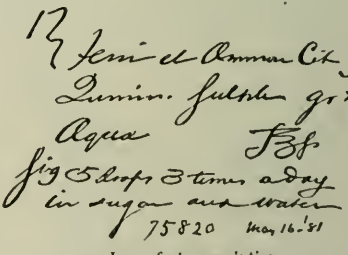
M S Teaspoonful

3 times daily

21243

Badly written prescription

FIG. 566



℞ Ferri et Ammon Cit ʒi

Quinin. Sulph gr xv

Aqua f℥ss

Sig 5 drops 3 times a day

in sugar and water

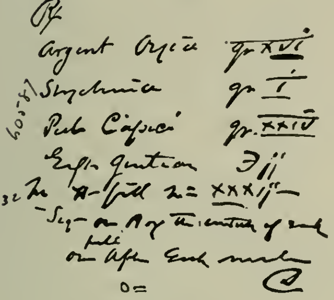
75820 May 16 '81

Imperfect prescription

Fig. 567 is a facsimile of a prescription for pills. Sixteen grains of silver oxide, one grain of strychnine, twenty-four grains of powdered capsicum, and forty grains of extract of gentian are to be made into thirty-two pills. If these pills are made in the ordinary way, with an excipient of syrup, glucose, or similar liquid, the pills will be very apt to explode, owing to the decomposition of the silver salt. The directions are not very legible, but it is not difficult to read,—Sig. on box the contents of *each* pill. One after each meal. The prescriber would probably be satisfied if the contents of *one* pill were written on the label; he certainly does not intend that the contents of *thirty-two* pills be so written, although this is what he directs.

Prescription 568 is a strange mixture, thrown together in opposition to the laws of chemical combination and compatibility. The quinine will be precipitated through the formation of a double bismuth and potassium iodide,—a precipitant for alkaloids, sometimes used as a reagent. The presence of the hybrobromic acid aids in the precipitation, instead of dissolving the precipitate. The translation is,—One drachm of potassium iodide, half a drachm of diluted hydrocyanic acid, three drachms of solution of bismuth and ammonium citrate, twelve grains of quinine sulphate, one and a half drachms of hydrobromic acid, and sufficient water to make two ounces. The only course to pursue is to dissolve the quinine salt in four drachms of water containing the hydrobromic acid, dissolve the potassium iodide in the remainder of the water, and add the other ingredients.

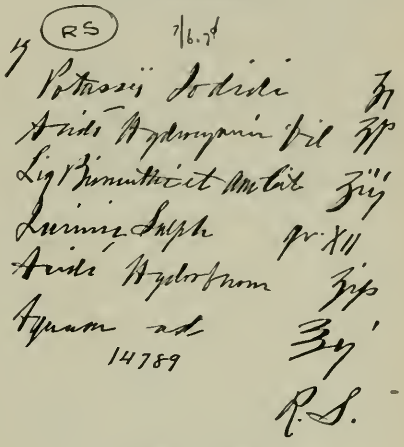
FIG. 567



℞
Argent Oxide gr XVI
Strychnia gr I
Pulv Capsici gr XXIV
Ext Gentian ℈ii
M ft pill No XXXII
Sig one pill after each meal

Explosive prescription

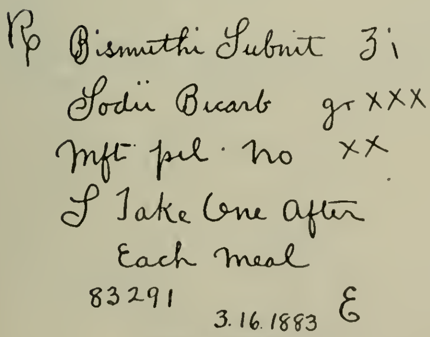
FIG. 568



℞ RS 7/6.78
Potassii Iodidi ʒi
Acidi Hydrocyanic Dil ʒss
Liq Bismuth et Am Cit ʒiij
Quininæ Sulph gr XII
Acidi Hydrobrom ʒiss
Aquam ad ℥ij
14789
R.S.

Incompatible prescription

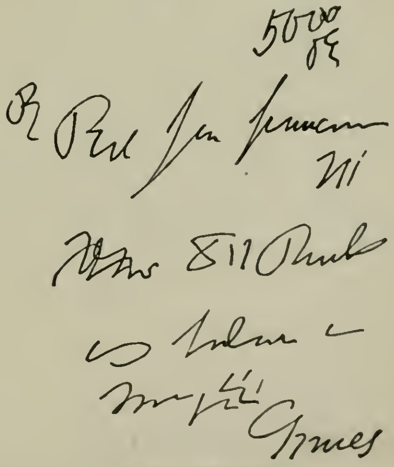
FIG. 569



℞ Bismuthi Subnit ʒi
Sodii Bicarb gr XXX
Mft pil · No XX
S Take One after
Each meal
83291 3.16.1883 E

Doubtful prescription

FIG. 570



500

Illegible prescription

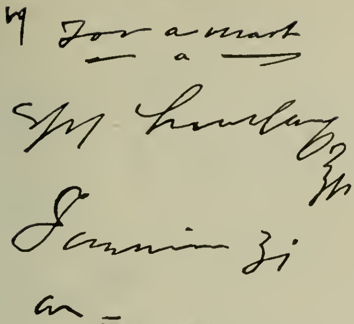
Prescription 569. Pills made from bismuth subnitrate and sodium bicarbonate have been known to explode, owing to decomposition in the sodium bicarbonate from acid in the bismuth salt, carbon dioxide being liberated. Of course no explosion can take place if the pills are not dispensed in a tightly corked vial or other container which will not permit of the escape of the liberated gas. Risk of explosion may be obviated by piercing the lid of the pill box with a few holes; but the pills may swell to an enormous size, due to the non-escape of the gas.

Prescription 570 is a facsimile of one written by a noted physician. One other specimen of his handiwork may be seen on page 1103. The translation is,—Two drachms of powdered gum guaiacum. Make twelve powders. One taken at night.

In concluding these comments it may truly be said that the necessity for more care in writing prescriptions has been unquestionably proved by abundant evidence. Physicians have in many cases grown careless in this respect, often relying upon the proverbial caution and self interest of the pharmacist to correct errors or supply deficiencies; while the additional responsibility thus thrust on the compounder has a tendency to develop his faculties, it does not lighten his cares, nor is it labor which is appreciated by the prescriber, who usually regards the service as quite within the routine of the pharmacist's duties, and the latter is expected, as a matter of course, to check errors and decipher scrawls with ease. On the other hand, there are often occasions when great haste must be exercised in writing a prescription; in addition, it should be remembered that it frequently happens that the physician is harassed by many annoyances and interruptions while writing the prescription. These circumstances, coupled with the gentlemanly instincts which all true pharmacists are credited with possessing, should exercise their proper restraining influences upon the latter while undertaking the mission of interviewing the physician upon a subject which is often mortifying to him. It is impossible to conduct an active business without encountering occasions which require the exercise of much forbearance and tact, and the reflection that both physician and pharmacist are *at all times* human, and hence liable to err, should prevent either from indulging in expressions detrimental to the good name of the other. In the unusual instance of a physician taking umbrage when a judicious course has been followed by the pharmacist in correcting his mistake, a firm and dignified defence should be at once made by the latter, and maintained with spirit, but not in the presence of the patient, if it can possibly be avoided.

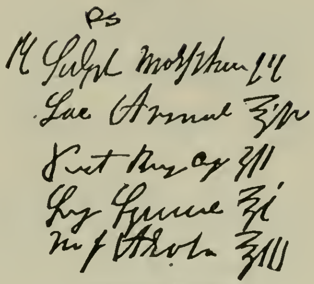
The prescriptions and orders upon the following pages are submitted without comment, with the view of affording the reader an opportunity for individual practice.

FIG. 571



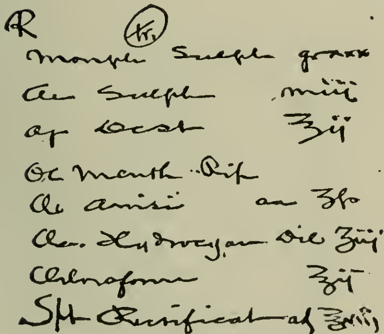
Obscure prescription

FIG. 572



Illegible prescription

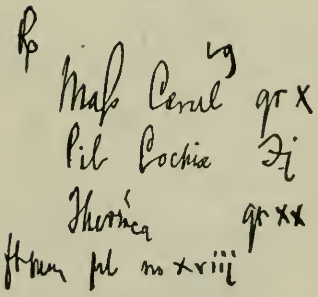
FIG. 573



R
Morph Sulph gr xxx
Ac Sulph m viii
Aq Dest ℥ii
Ol Menth Pip
Ol anisi aa ʒss
Ac. Hydrocyan Dil ℥ii
Chloroform ℥ii
Spt Rectificat ad ℥viii

Difficult prescription

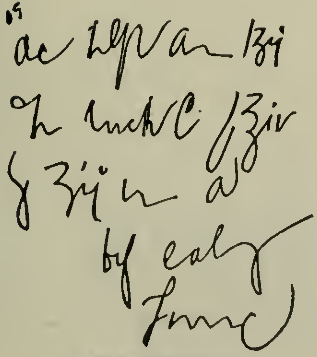
FIG. 574



℞
Mass Cerul gr x
Pil Cochiæ ℈i
Quinia gr xx
ft pil no xviii

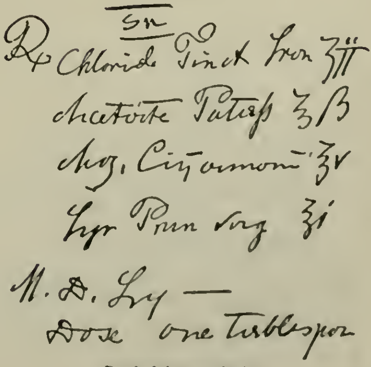
Antique prescription

FIG. 575



Careless prescription

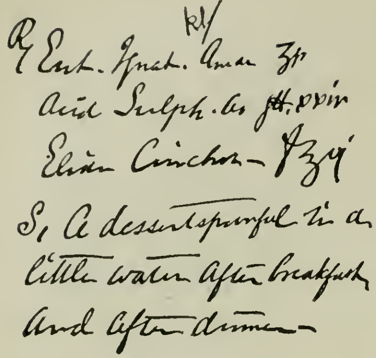
FIG. 576



℞ Chloride Tinct Iron ℥ii
Acetate Potass ʒß
Aq. Cinnamon ℥v
Syr Prun Virg ℥i
M. D. Sig —
Dose one Tablespoon

Doubtful prescription

FIG. 577



KL/

℞ Ext. Ignat. Amar ʒi

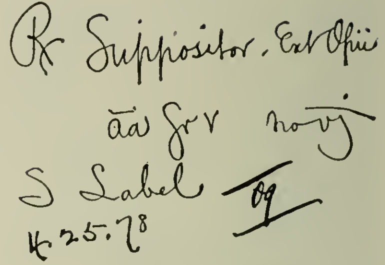
Acid Sulph. Ar ♏ xxiv

Elixir Cinchon. f℥iij

S. A dessertspoonful in a little water after breakfast and after dinner.

Questionable prescription

FIG. 578



℞ Suppositor. Ext Opii

āā gr v no. vj

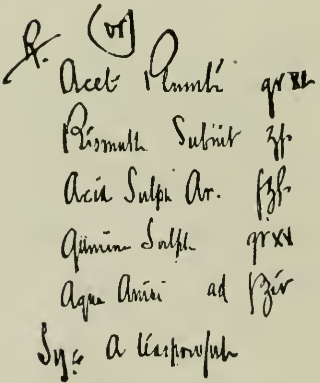
S Label

Og

4.25.78

Erroneous prescription

FIG. 579



℞ (or)

Acet Plumbi gr xl

Bismuth Subnit ʒi

Acid Sulph Ar. f℥ß

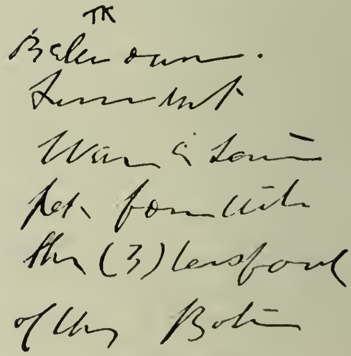
Quinine Sulph gr xx

Aqua Anisi ad f℥iv

Sig. A teaspoonful

Incompatible prescription

FIG. 580



TK

Belladonna.

liniment

Warm c̄ [illegible]

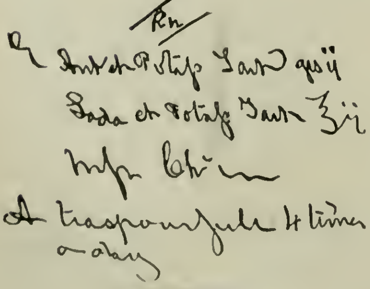
[illegible] flannel with

three (3) teaspoonful

of the Bottle

Illegible prescription

FIG. 581



Kn

℞ Sod. et Potass Tart gr ij

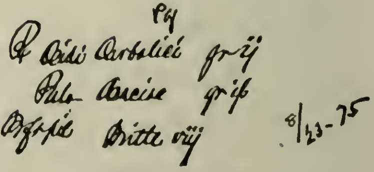
Soda et Potass Tart ℥ij

Misce [illegible]

A teaspoonful 4 times a day

Odd prescription

FIG. 582



Pg

℞ Acidi Carbolici gr ij

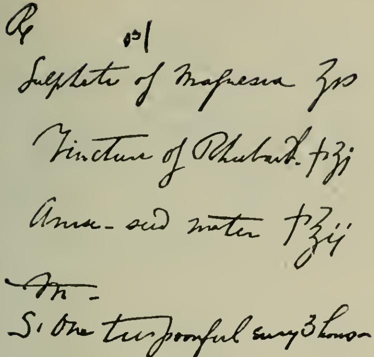
Pulv. Acaciae gr iß

[illegible] [illegible] viij

8/23-75

Difficult prescription

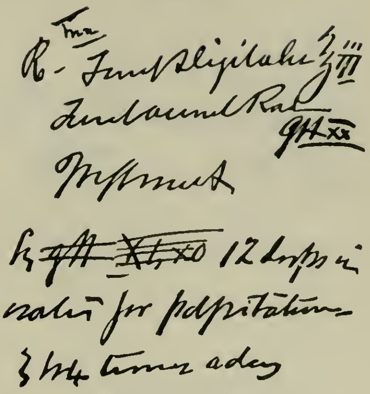
Fig. 583



℞ 91
Sulphate of Magnesia ℥ss
Tincture of Rhubarb f℥j
Anise-seed water f℥ij
M.
S. One teaspoonful every 3 hours

Doubtful prescription

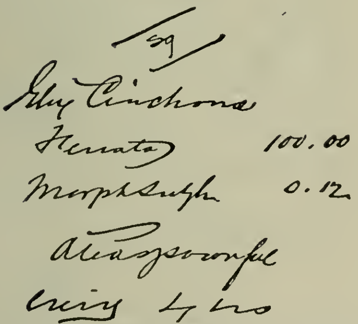
Fig. 584



℞ Tinct Digitalis ʒiij
Tinct Aconite Rad gtt xx
M. et S.
Sig ~~gtt XL~~ 12 drops in water for palpitation 3 to 4 times a day

Erroneous prescription

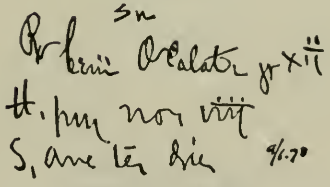
Fig. 585



59
Elix Cinchona
Ferrata 100.00
Morph Sulph 0.12
A teaspoonful
every 4 hrs

Metric prescription

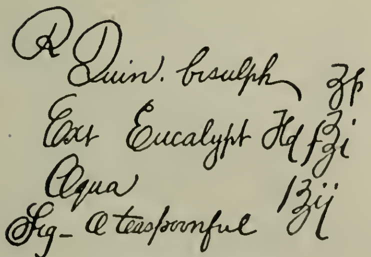
Fig. 586



5n
℞ Cerii Oxalate gr xii
Ft. pulv no viij
S, one ter die 9/1.70

Questionable prescription

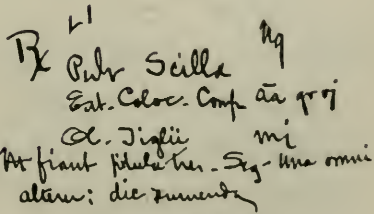
Fig. 587



℞ Quin. bisulph ʒß
Ext Eucalypt Fld f℥i
Aqua f℥ij
Sig- A teaspoonful

Incompatible prescription

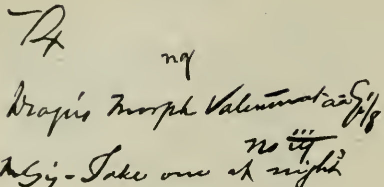
Fig. 588



℞ Pulv Scillæ
Ext. Coloc. Comp āā gr vj
Ol. Tiglii mi
M. fiant pilulæ tres - Sig- Una omni altera die sumenda

Difficult prescription

Fig. 589



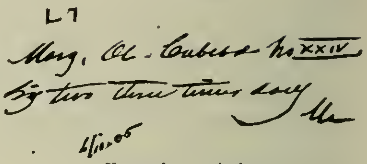
℞

Dragées Morph Valerianat aa gr 1/8 No iii

Sig - Take one at night

Safe prescription

Fig. 590

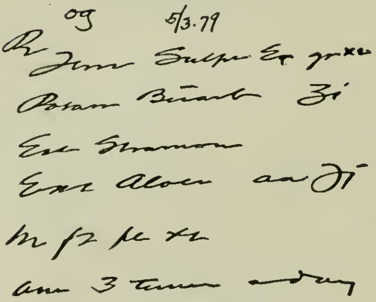


Mag. Ol. Cubebs No XXIV

Sig two three times day

Unusual prescription

Fig. 591



5/3.79

℞ Ferri Sulph Ex gr xx

Potass Bicarb ʒi

Ext Stramon

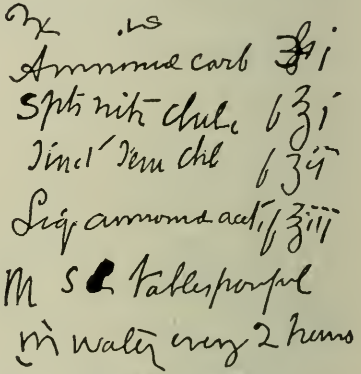
Ext Aloes aa ℈i

M ft pil xx

one 3 times a day

Difficult prescription

Fig. 592



℞

Ammonia carb ʒi

Spts nitr dulc f ʒi

Tinct Ferri chl f ʒii

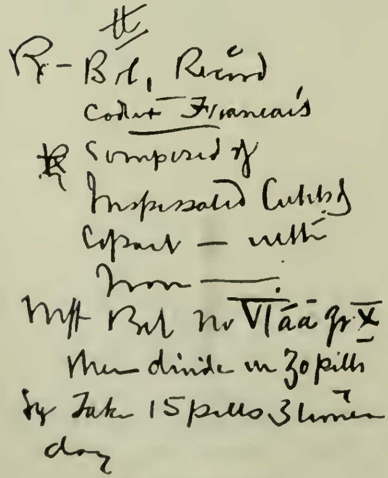
Liq ammonii acet f ℥iii

M S tablespoonful

in water every 2 hours

Incompatible prescription

Fig. 593



℞ - Bol, Ricord

Codex Français

composed of

Inspissated Cubebs

Copaiv — with

Iron —

Mft Bol No VI aa gr X

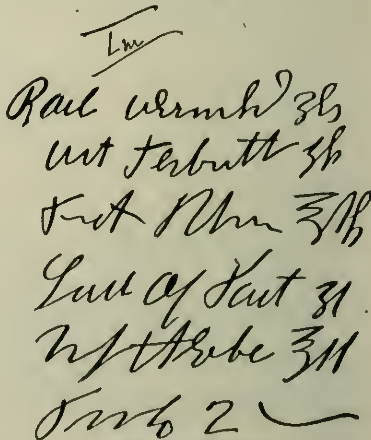
then divide in 30 pills

Sig Take 15 pills 3 times

day

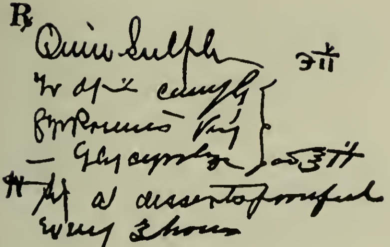
Unusual prescription

Fig. 594



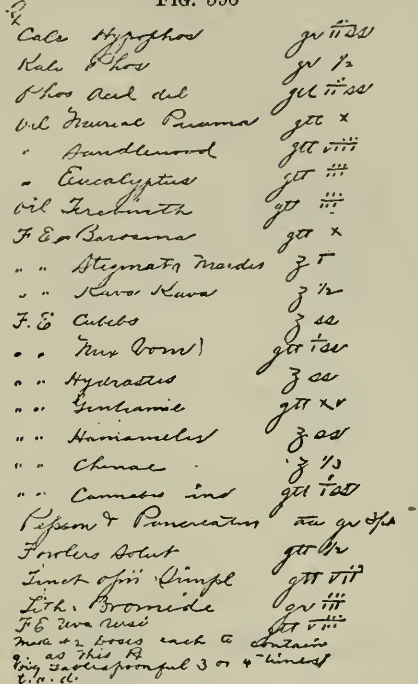
Illegible prescription

FIG. 595


℞ Quin Sulph ℈ ij
Tr opii camph
Syr Pruni Virg
— Glycyrrhiz aa ℥ ij
M Sig a dessertspoonful every 3 hours

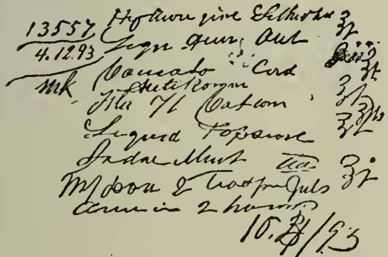
Questionable prescription

FIG. 596


℞
Calc Hypophos gr iiss
Kali Phos gr ½
Phos Acid dil gtt iiss
Oil Myrcia Pimenta gtt x
" Sandlewood gtt viii
" Eucalyptus gtt iii
Oil Terebinth gtt iii
F E Barosma gtt x
" " Stigmata Maidis ʒ i
" " Kava Kava ʒ ½
F. E. Cubebs ʒ ss
" " Nux Vomi gtt iss
" " Hydrastis ʒ ss
" " Gentianæ gtt xv
" " Hamamelis ʒ ss
" " Chinae ʒ ⅓
" " Cannabis ind gtt iss
Pepsin & Pancreatin aa gr [illegible]
Fowlers Solut gtt ½
Tinct opii Simpl gtt vii
Lith. Bromide gr iii
F E Uva ursi gtt viii
make 42 doses each to contain as this ℞
Sig Tablespoonful 3 or 4 times t.i.d.

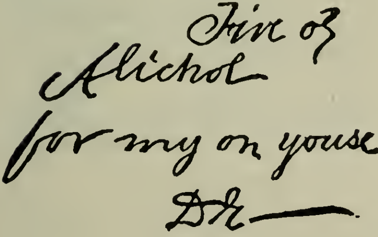
Polypharmacal prescription

FIG. 597


13557
4.12.93
MK
[illegible] ℥ i
[illegible] ʒ iij
Cascara [illegible] Cord ℥ ss
[illegible]
[illegible] ℥ i
Liquid Peptone ℥ iv
Sodae Mur aa ℥ i
M Dose 2 teaspoonfuls
every 2 hours
10. 8/93

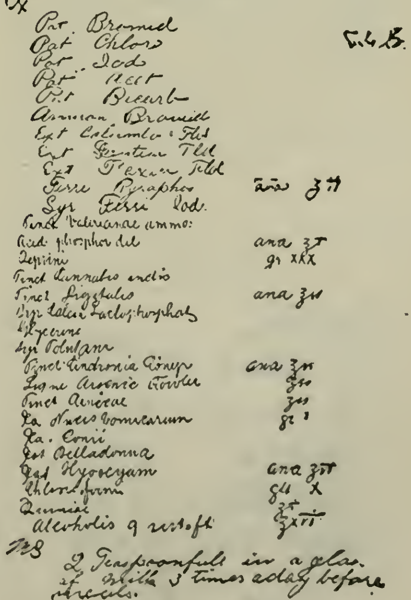
Badly written prescription

FIG. 598


Five oz
Alichol
for my on youse
DR—

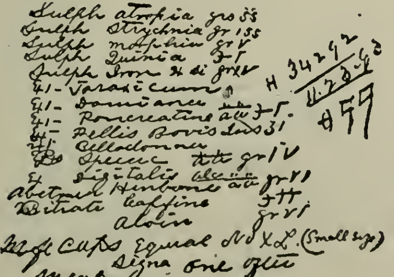
Illiterate order

FIG. 599


℞
Pot Bromid
Pot Chlor
Pot Iod
Pot Acet
Pot Bicarb
Ammon Bromid
Ext Calumba Fld
Ext Gentian Fld
Ext Taraxa Fld
Ferri Pyrophos aa ʒ ij
Syr Ferri Iod.
Tinct Valerianae ammo:
Acid phosphor dil ana ʒ i
Pepsini gr xxx
Tinct Cannabis indic
Tinct Digitalis ana ʒ ss
Syr Calcis Lactophosphat
Glycerine
Syr Tolutani
Tinct Cinchonia Comp ana ʒ ss
Ligne Arsenic Fowler ʒ ss
Tinct Arnicae ʒ ss
Ext Nucis Vomicarum gr i
Ext. Conii
Ext Belladonna
Ext Hyoscyam ana gr ii
Chloroform gtt x
Quinine ʒ i
Alcoholis q s ad ℥ xii
M S
2 Teaspoonfuls in a glass of Milk 3 times a day before meals.
T.L.B.

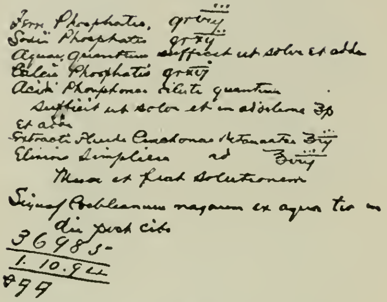
Polypharmacal prescription

FIG. 600


Sulph atropia grs ss
Sulph Strychnia gr iss
Sulph morphia gr v
Sulph Quinia ℈ i
Sulph Iron & di gr xv
Ext- Taraxicum
Ext- Damiana
Ext- Pancreatine aa ℈ i.
Ext- Fellis Bovis Ins ʒ i
Ext- Belladonna
Ext Ipecac aa gr iv
Ext Digitalis aa gr vi
Abstract Henbane aa
Citrate Caffine ℈ ii
aloin gr vi
M ft caps equal No XL. (Small size)
Signa one after meals
H 34292
4.28.93
457

Polypharmacal prescription

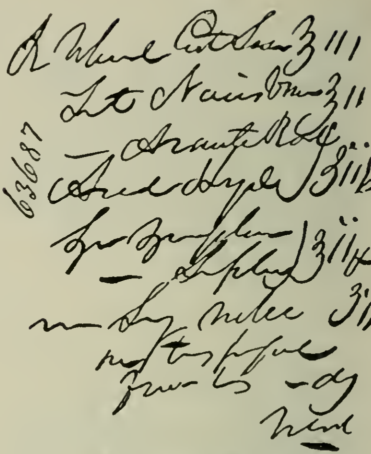
Fig. 601



Ferri Phosphatis, gr. viij
Sodii Phosphatis gr. xv
Aquae quantum sufficit ut solve et adde
Calcii Phosphatis gr. xvj
Acidi Phosphorici diluti quantum
sufficit ut solve et in dissolve ʒj
et adde
Extracti Fluidi Cinchonae Aromatici ʒiij
Elixiris Simplicis ad ʒviij
Misce et fiat solutionem
Signa Cochleare magnum ex aqua ter in
die post cibo
36985
1. 10. 94
899

Latin prescription

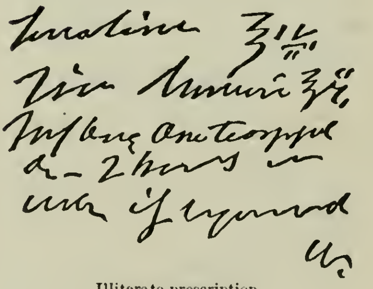
Fig. 602



63687

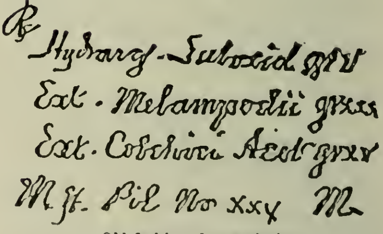
Badly written prescription

Fig. 603



Illiterate prescription

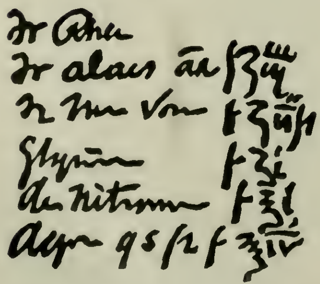
Fig. 604



℞ Hydrarg. Subchlorid. gr. v
Ext. Melampodii gr. xxx
Ext. Colchici Acet. gr. xv
M. ft. Pil. No. xxv M.

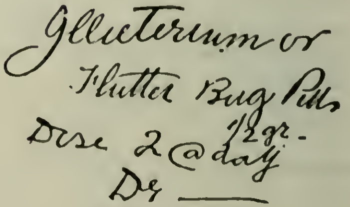
Old fashioned prescription

Fig. 605



Dangerous prescription

Fig. 606



Glleterium or
Flutter Bug Pills
1/2 gr.
Dose 2 @ day
Dr ———

Illiterate prescription

LATIN PRESCRIPTIONS

A number of Latin prescriptions will be found below, the first ten of which are printed without abbreviations; it is very unusual to receive prescriptions of this kind, nevertheless their translation and study will furnish useful practice.

Translate the following prescriptions, and also the accompanying directions:

1. Recipe Liquoris Ammonii Acetatis, drachmas tres cum semisse;
Vini Antimonii, drachmas duas;
Tincturæ Cardamomi Compositæ, drachmas tres;
Aquæ Menthæ Piperitæ, uncias quatuor.

Fiat mistura, cujus unciæ duæ omni horæ quadrante calefactæ sumendæ, durante frigore.

2. Recipe Rosæ Gallicæ, unciam dimidiam;
Aquæ ferventis, uncias octo.

Stent per horam; colaturæ adde Succi Limonum, Sacchari, ana, quantum sufficit, ad gratam acerbitatem dulcedinemque.

3. Recipe Extracti Colocynthidis Compositi, drachmam unam;
Pulveris Scammonii, scrupulum unum;
Pulveris Gambogiæ, grana quinque.

Misce.—Fiant pilulæ viginti, quarum duæ deglutiantur horâ decubitûs; diluculò, ut infra.

4. Recipe Infusi Sennæ, unciam unam.

5. Recipe Potassii et Sodii Tartratis, sesquidrachmam,
Cretæ Præparatæ, semidrachmam;
Misce.—Fiat pulvis in jusculo tenuissimo sumendus.

6. Recipe Ammonii Carbonatis, grana sex;
Syrupi Aurantii, drachmas duas;
Aquæ, drachmas decem.

Misce.—Fiat haustus, cui, tempore capiendi, adde Succi Limonis recentis cochleare medium unum, et in effervescentiâ sumatur.

7. Recipe Tincturæ Opii, semidrachmam;
Spiritûs Chloroformi, drachmam;
Misturæ Cretæ,
Aquæ Menthæ Piperitæ, ana, uncias tres.

Misce.—Fiat mistura, cujus sumantur cochlearia duo magna post unamquamque sedem mollem, phialâ prius concussâ.

8. Recipe Misturæ Ammoniaci, uncias sex;
Tincturæ Opii, drachmam.

Misce.—Capiat cochlearia duo magna statim; iterentur post horam, si tussis accreverit.

9. Recipe Extracti Belladonnæ Fluidi, drachmam cum semisse;
Lini Farinæ, uncias duodecim;
Aquæ bullientis, quantum sufficit ut fiat cataplasma admovendum calidè loco adfecto.

10. Recipe Cetrariæ, unciam;
Aquæ frigidæ, octarium.

Coque ad uncias duodenas; stet ut geletur, et utatur æger gelatinâ ad libitum.

11. ℞ Magnes. Carb., ʒ i;
Pulv. Rhei, gr. xv;
Aq. Anisi, f ℥ iss.

M.—Fiat julep.[1] cujus unum cochl.[2] minim.[3] infant.[4] lacten.[5] detur, secundis horis, phiala agitata.

---

[1] Julepum.
[2] Cochleare.
[3] Minimum.
[4] Infantulo.
[5] Lactenti.

12. ℞ Sp. Ammon. Arom., f ʒ i ;
Tinct. Asafœt., f ℥ ss ;
Syrupi, f ʒ iii ;
Aq. Cinnam., f ℥ i.

M.—Exhibe cochl. parv. ter quaterve de die, vel sæpius, urgente convuls.[1] vel spasm.[2]

13. ℞ Tinct. Hyoscyami, f ʒ iss ;
Pot. Acet., ʒ iv ;
Syr., f ʒ ii ;
Aq. Menth. Vir., ad f ℥ vi.

Ft. mist. cujus sumant.[3] cochl.[4] ii vel iii minim.[5] bis terve in die, vel ut opus sit.

14. ℞ Tinct. Opii, f ʒ ss ;
Mist. Cret., f ℥ iii.

M.—Cap. cochl. ii magn.[6] omni quadrante horæ, donec leniat.[7] dolor.

15. ℞ Pulv. Ipecac., ʒ iss ;
Pot. Bitart., ʒ i ;
Aq. fervent., f ℥ iiiss.

Macera per horam integr.[8] dein cola et adjice syr., f ℥ ss.
M.—Detur ℥ ss vel cochl.[9] ampl.[10] omni semihorâ, donec vomit.[11] proritav.[12]

16. ℞ Plumbi Acet., gr. iv ;
Syrup., f ʒ ii ;
Aq. Menth., f ℥ ii.

M.—Cap. cochl. ampl.[13] mane quotidie ; repetat.[14] dosis ad iii vices, et deinde cap.[15] æger haust[16] aliq.[17] purgant.[18]

17. ℞ Mist. Ammon.,[19] f ℥ vi ;
Cap. æger cochl. mag. bis in die ex poculo jusc.[20] bov.[21]

18. ℞ Morph. Acet., gr. $\frac{1}{4}$;
P. Colch.,[22] gr. iii.
Ft. pil. 4tis[23] horis s.[24]
Mitte vi fol.[25] arg.[26] inv.[27]

19. ℞ Sodii Bicarb., ʒ iii ;
Ammon. Bicarb., ℈ ii ;
Pot. Nit., ʒ ss ;
Syr. Aurant., f ℥ ss ;
Ac. Hydrocyan. dil., gtt. xx ;
Aquæ, ad ℥ viii.

M.—Capiat ℥ iss t. in d. cum pulv. i seq.[28] m.[29] stat.[30] effervesce.[31]

20. ℞ Ac. Tart., ℈ i ;
Mitte chart. vi.

21. ℞ Ol. Morrhuæ, f ℥ viii.

Sum.[32] coch. min. (ad. ampl.[33] augend.[34]) bis die c.[35] mist. sequent.[36] coch. ampl.[37]

22. ℞ Acid. Phosph. dil., f ℥ ss ;
Tinct. Nuc. Vom., f ʒ ii ;
Tinct. Calumb.,
Syr. Zingib., āā f ℥ i ;
Aq. Cinnam., q. s. ut ft. f ℥ viii.
M.—Ft. mist.

---

[1] Convulsione. [2] Spasmo. [3] Sumantur. [4] Cochlearia. [5] Minima. [6] Magna. [7] Leniatur. [8] Integram. [9] Cochleare. [10] Amplum. [11] Vomitum. [12] Proritaverit. [13] Amplum. [14] Repetatur. [15] Capiat. [16] Haustum. [17] Aliquem. [18] Purgantem. [19] Ammoniaci. [20] Jusculi. [21] Bovini. [22] Colchici. [23] Quartis. [24] Sumenda. [25] Folio. [26] Argenteo. [27] Involve. [28] Sequenti. [29] Mane. [30] Statu. [31] Effervescentiæ. [32] Sumatur. [33] Amplum. [34] Augendum. [35] Cum. [36] Sequentis. [37] Amplo.

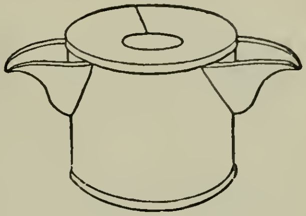
METRIC PRESCRIPTIONS

The growth of the metric system has made it necessary for every pharmacist to be acquainted with the methods employed in writing metric prescriptions.

There are two distinct methods employed in this country, which may be termed respectively the *gravimetric* and the *volumetric* method.

1. **Gravimetric Prescriptions.**—The gravimetric principle of weighing liquids is used in Germany and some other Continental countries almost exclusively. It was adopted by the U. S. Pharmacopœia of 1880, and given the name of "parts by weight;" but, although weighing liquids may be practised with advantage in the laboratory in making large quantities of preparations, and is preferable in the case of thick or adhesive liquids, it is far less convenient in compounding prescriptions than the plan of measuring the liquid ingredients. The advantage in supposed greater accuracy of weighing over measuring is more imaginary than real. A careful pharmacist will compound prescriptions just as accurately by measuring the liquids as he will by weighing them, while a slovenly one will be just as careless in using weights as he is in measuring liquids. The question of accuracy becomes then, practically, a "personal equation."

Fig. 607



Tare can

Several conveniences have been proposed in weighing liquids, which deserve notice. The Germans use a "tare can" (see Fig. 607) for the purpose of quickly taring a bottle. It is a small metallic can having a shallow funnel mouthed opening, with two spouts, one on each side. The bottle, or vessel, is placed on one of the scale pans, and the tare can, containing sufficient shot or clean dry sand to balance it, is placed upon the other. It is better, however, to use two tare cans and pour from one to the other, the one not in use on the scale pan either receiving the excess of shot or supplying the deficiency.

2. **Volumetric Prescriptions.**—In these the gramme is replaced by the cubic centimeter, which has been very appropriately termed *fluigramme* by Mr. A. B. Taylor. The principal reason for preferring the volumetric method is that the physician has the means of more readily calculating and apportioning the number of doses in the prescription. *Liquid medicines are never administered by weight*, but always by teaspoonfuls, tablespoonfuls, or other convenient measure. In some liquids there is a wide difference between their weight and their volume, as the specific gravity tables abundantly show. A teaspoonful of ether weighs forty-one grains, while a teaspoonful of chloroform weighs eighty-five grains (more than twice as much). Hence the physician cannot disregard specific gravity. In prescribing gravimetrically and administering volumetrically he must constantly bear in mind these differences, at least approximately. Mistakes are very likely to arise in making these calculations, mentally, at the bedside of a patient. Hence it is far better to avoid

them by *prescribing the medicines by the same method as that by which they are dispensed and administered, namely, volumetrically*, and thus preserving that harmony of relation which is conducive to safety. If volumetric analysis is preferred to stathmetic or gravimetric analysis in the U. S. Pharmacopœia because of its greater convenience and at least equal accuracy, why should not liquids be measured rather than weighed in pharmaceutical operations in which extreme accuracy is comparatively of less importance?

The following examples illustrate the forms of metric prescriptions most frequently used. Form A is preferable, for the reasons stated :

Form A	**Form B**	**Form C**
R (*Volumetric*) Gm. and Cc. Quininæ Sulph . . . 1 │ Strych. Sulph . . . │ 016 Fluidext. Glycyr. . 4 │ Syrupi . . . . 60 │ A teaspoonful three times a day.	R (*Gravimetric*) Quininæ Sulph. . . 1. Strych. Sulph. . . . .016 Fluidext. Glycyr. . . 4. Syrupi . . . . 60. A teaspoonful three times a day.	R (*Volumetric*) Quininæ Sulph. 1. $\underline{\text{Gm.}}$ Strych. Sulph. . .016 $\underline{\text{Gm.}}$ Fluidext. Glycyr. 4. $\underline{\text{Cc.}}$ Syrupi . . . . . 60. $\underline{\text{Cc.}}$ A teaspoonful three times a day.
R (*Gravimetric*) Hydrarg. Chlor. Mit. │ 5 Aloe. Pulv. . . . . 2 │ Rhei Pulv. . . . . 1 │ 5	R (*Gravimetric*) Hydrarg. Chlor. Mit. .5 Aloe. Pulv. . . . . . 2. Rhei Pulv. 1.5	R (*Gravimetric*) Hydrarg. Chlor. Mit. .5 $\underline{\text{Gm.}}$ Aloe. Pulv. . . . . 2. $\underline{\text{Gm.}}$ Rhei Pulv. . . . . 1.5 $\underline{\text{Gm.}}$
Make twenty pills.	Make twenty pills.	Make twenty pills.
The advantages of the decimal line are that the decimal dot is abolished, with its dangerous complications, for a spot or a fly speck on the prescription paper may increase or decrease the quantity of an ingredient *ten times*, and the use of the decimal line is familiar to all who use a dollar and cents column.	This form is used frequently, because of the familiarity with the arithmetical method of using a dot to denote a decimal fraction ; and where metric prescriptions are altogether in use, as in Continental Europe, there is no necessity for indicating the denomination, gramme being always understood.	This form is an improvement on Form B, and would be far superior to it for use in this country, where prescriptions written in the old systems will long continue to be used ; for next to writing out in full the word *gramme*, the indication of the unusual quantity by underscoring will prevent its being mistaken for *grain*.

THE ART OF COMPOUNDING AND DISPENSING

The practical work embraced in the ever varying labors of compounding and dispensing constitutes a more searching test of the adaptability and qualifications of the pharmacist than any other duty that he is called upon to perform. Careful training, tact, and much experience are needed to meet the requirements.

Receiving the Prescription or Order.—This apparently simple matter, if not carefully considered, is frequently the source of embarrassing mistakes. Very few customers, even if they are intelligent, realize the necessity of forethought or care in calling for any articles that they wish. Hence it is an excellent practice for the dispenser to *repeat the order* interrogatively at the time that it is given, and obtain from the customer a clearly expressed assent before delivering the article, lest the wrong one be dispensed. If it is a poisonous substance, the use that is to be made of it should be carefully inquired into, and in all cases a written order, properly dated and signed, should be required. The best plan is to have a regular poison book, in which the record is made. Poisonous or dangerous substances should never be dispensed to children or minors without a written order, and even then the receiver should be cautioned about the contents.

The following prescription memorandum, which is similar to one suggested by Andrew Blair, was in use several years by the author with excellent results. These blanks are put up in tablet form, and are filled in, in the presence of the customer, or the back of the prescription may be used for noting the points when it is handed in.

MEMORANDUM

Name.
Address.
Is it paid for?
Is it to be charged?
Is it to be called for?
Is it to be sent?
Received by
Compounded by
Number of ℞ *and Price.*

It is the custom in some pharmacies, when a number of prescriptions are being compounded at one time, to use what is known as the check system. Brass or nickel plated checks or disks, numbered or lettered, are used. The customer upon handing the prescription is given a check, which he holds until the prescription is ready; the receiver marks the corresponding number or letter upon the prescription, and when he delivers the bottle or package receives back from the customer the original check containing the same number or letter. This system is not without faults; indeed, unceasing vigilance is absolutely necessary, and it is not safe to place faith in any system.

The prescription should be received with becoming dignity by the compounder, and questions answered with cheerful politeness, especial care being taken to do or say nothing that would impair confidence. Unseemly jesting, loud conversation, or boisterous mirth is entirely out of place here, while especial regard should be paid to the feelings of those who may have just left the sick chamber or the bed side of one who is dear to them. In such cases every word and movement of the dispenser is often carefully watched, and, while ordinarily the customer may be disposed to judge seeming slowness or indifference leniently, at such times these faults become unbearable to the impatient and anxious messenger.

Reading the Prescription.—The prescription should be read over carefully, and judgment mentally pronounced, first upon the safety of the doses of the respective ingredients, and then upon their compatibility. If this reading be done in the presence of the patient, especial care should be taken that the countenance reveal nothing whatever of what may be going on in the mind of the receiver. A shrug of the shoulders, an elevation of the eyebrows, a contemptuous toss of the scrap of paper on the prescription desk, may convey to the mind of the patient a more lasting impression of the opinion of the receiver as to the merits of the prescription than open criticism. Questions are frequently asked by patients and requests made for opinions. These should always be skilfully parried. An apothecary has no right to reveal to a patient the character or the medicinal effect of the ingredients which enter into a prescription. When the names of the ingredients in the prescription are persistently demanded by the patient, the dispenser can fall back upon the expedient of frankly stating that it is a breach of etiquette to reveal the character of the ingredients, and intimating that it shows a lack of confidence in the prescriber on the part of the patient; but, if further insisted upon, the offer to send to the physician a written request to get his permission to disclose the ingredients is generally answered by the patient with a gracious "no matter." The pharmacist, as a coworker with the physician in the healing art, is ethically bound to sustain him and cheerfully cooperate with him, and there should be at all times a spirit of mutual respect between the members of both professions, and a feeling that each is in duty bound to protect the other from unjust censure.

In order to gain time in case of doubtful procedure, it is often good practice to write the label for the prescription as soon as it is received, and this will usually afford an opportunity to study the prescription while reading it. The only objection to this is that the patient very frequently misunderstands this manœuvre, and imagines that the dispenser is neglecting him and not proceeding at once to compound his prescription.

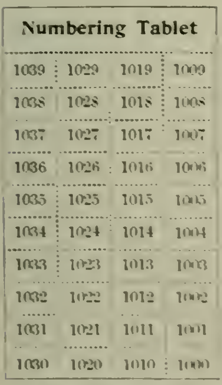
Compounding the Prescription.—The greater part of the succeeding chapter will be devoted to the details of this very important duty; in this place it is merely necessary to consider the general features. After thoroughly understanding the prescription and clearly deciphering it, a method must be quickly formulated for compounding it. In this connection, if there is any doubt about safety, the well known aphorism, "When you do not know what to do, do nothing," has great force. The work of compounding must not go on in any feeling of uncertainty; the chance of causing death or serious consequences is too great to warrant the running of risks, and there is nearly always more safety in delay than in pushing forward doubtfully.

When a clearly outlined plan of procedure is decided upon, the ingredients should be carefully weighed or measured and the process witnessed by a colleague. *The system of double checking prescriptions should be invariably followed wherever possible;* over confidence and an indisposition to recognize the possibility of making a mistake have probably occasioned more loss of life in this responsible work than any other cause. Not only should the junior assistant cheerfully submit to having his work witnessed, but even the *preceptor* should insist upon one of his assistants checking off the ingredients and quantities which he has weighed or measured out himself, as a matter of principle and method. If this is not always possible, on account of there being but one present in the store, the system of single checking should be invariably practised. This is, briefly, to arrange upon the counter the shop bottles or packages from which were taken the ingredients which entered into the prescription, and place the weights which were used immediately in front, then, when the preparation is finished, to check off from the prescription each ingredient in order, noting the weight or measure. Before permitting a prescription which is at all complicated to advance further in the process of compounding, each ingredient should be numbered in lead pencil on the margin in the order in which it has been added. This memorandum becomes valuable when the prescription is to be renewed, because there will then be no likelihood of the renewed prescription differing from the original.

Additions or Alterations to Prescriptions by the Pharmacist.—At the present time it is the custom among physicians to hold the pharmacist responsible for the proper compounding of prescriptions intrusted to his care, and to depend upon him. Such details as the choice of the excipient, method of straining or filtering, etc., are usually not specified. Indeed, with many it is a frequent practice simply to direct a solution or mixture of definite strength and rely upon the pharmacist to make it palatable. In all cases of this kind, care must be taken to make a note upon the prescription of each addition, so that in the event of renewal there may be no difference between the preparation then obtained and the original. The confidence which physicians place in pharmacists in this respect should be most sedulously guarded and every effort made to deserve and retain it. This can be done only by adhering strictly to the rule of *not permitting an alteration or addition to be made to a prescription which would affect or vitiate its proper medicinal action or interfere with the obvious intention of the prescriber.*

Numbering the Prescription.—It is the universal practice to number the prescription, and to place a corresponding number upon the label, the object being to identify the bottle or package in case of renewal and connect it with the original prescription. This apparently simple matter requires upon the part of the compounder concentration of thought to avoid errors,—one of the most frequent lapses being that of duplicating the number of the last prescription, instead of numbering it consecutively. This, in case of renewal, may lead to serious consequences, particularly if one prescription happens to be a four ounce aconite liniment and the other a four ounce solution of similar appearance for internal use. The duplication of the numbers is particularly liable to occur when several prescriptions are being compounded at the same time by two or more assistants. Various expedients have been proposed to obviate mistakes of duplication. One is to have a strip of paper about an inch wide numbered consecutively, rolled with the highest number inside, and placed in a round tin ointment box which has a slit in the side to permit the end of the strip to appear: this may be hung in a convenient place and the number cut off and pasted on the prescription, or, if the location is one having a dry atmosphere, a gummed strip may be used. Another method is to arrange the numbers upon gummed sheets and bind them in book form, or glue the edges and use as tablets (see Fig. 608); in the latter case the numbers are printed in perpendicular columns, and the margins are perforated so that the outer strip from 1000 to 1009 may be torn nearly off, and each number then cut off with scissors or gently torn off as it is wanted.

Fig. 608.



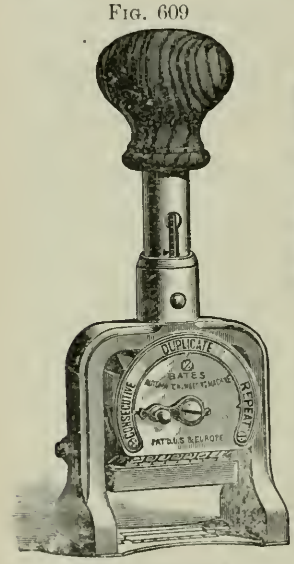
Numbering Tablet			
1039	1029	1019	1009
1038	1028	1018	1008
1037	1027	1017	1007
1036	1026	1016	1006
1035	1025	1015	1005
1034	1024	1014	1004
1033	1023	1013	1003
1032	1022	1012	1002
1031	1021	1011	1001
1030	1020	1010	1000

Numbering tablet

Consecutive numbering machines are also used; these are very convenient, and serve excellent purposes if they are properly and durably constructed. The best machine known to the author until recently was made in Vienna, and can be adjusted to number *automatically* either consecutively, repeatedly, in duplicate or in triplicate.

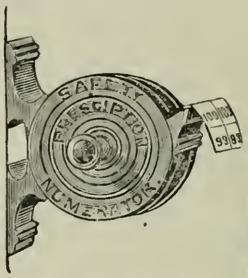
The usefulness of this machine to the pharmacist consists largely in the fact that it can be made to *number consecutively in duplicate* (13428, 13428; 13429, 13429, etc.), so that if a proper sized machine is chosen (letter *b* is preferred) the number may be clearly and neatly printed upon *both prescription and label;* the machine may then be locked and set, so that there is not the slightest danger of variation or change in the method of numbering while in use. The Bates automatic numbering machine (see Fig. 609) is the best of those made in America, and, in some respects, it is better than the one just described. It can be set so that the numbers will be consecutive, repeated indefinitely, or repeated in duplicate. The value of using a mechanical contrivance of this kind consists in its numbering in duplicate with absolute freedom from mistakes, and in the entire elimination of chances of error from defective handwriting, the figures being printed from hardened steel disks, invariably producing clear and distinct impressions.

Fig. 609



Numbering machine

Fig. 610



Safety prescription numerator

Fig. 611

Rubber dating machine

Fig. 610 shows a very simple and practical apparatus for numbering prescriptions and checking mistakes in numbering. It may be obtained from E. T. Ellis, Philadelphia, and consists of a rolled strip of paper (gummed or ungummed), fastened at one end upon an axis which is free to revolve in a cylindrical box. A double row of consecutive numbers is printed on the strip, and a slit in the edge of the box permits the unrolling of the strip over a knife edge fastened on the outside.

Rubber numbering stamps are also in use; these are much cheaper and smaller than the consecutive numbering machines, and are very convenient. They are not automatic, however, and mistakes are liable to occur through the operator forgetting occasionally to turn one of the bands, and thus the main reason for using a numbering machine is lost. The numbers are cast upon endless rubber strips, and resemble the daters (see Fig. 611).

Dating.—This also serves to fix the identity of a prescription, and it should never be omitted. The physician usually appends the date, but the prescription is frequently held by the patient and not presented for compounding upon the day on which it is written. As in the case of numbering, the date is most frequently written upon the face of the prescription by the pharmacist; and this should not be omitted, even though the date written by the physician be visible. The habit of dating should be firmly established, because it may prove of vital importance in case of a subsequent discussion or difference of opinion. *Rubber daters* are largely used now. Fig. 611 shows one which may be obtained at any stationers. It is inexpensive, not liable to get out of order, and so convenient for prescription work that it soon pays for itself.

Pricing.—The price of the prescription must always be marked upon it. This is necessary in order to fix the sum in case of renewal. The price is usually not subject to variation, except in the case of a patient ordering a larger or smaller quantity of the prescription. In renewals, in all cases the increase or decrease should be noted distinctly, if future annoyance is to be avoided. Few occurrences are apt to create more distrust in the mind of the patient than a neglect of this precaution, the reasoning being that if the pharmacist is so careless as to have two prices for the same prescription, he probably has been careless in compounding it. The greatest objection arises, however, when the price asked is *greater* than that originally demanded.

It is usual for the pharmacist to adopt a cipher to show the price of the prescription, some word or combination of characters being selected and memorized. If a word is selected, it should have ten letters, and there should be no duplicate letters, thus:

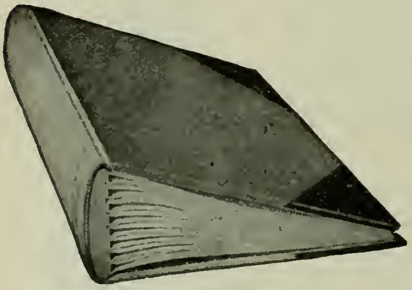
COME AND BUY 1 2 3 4 5 6 7 8 9 0	C.YY—$1.00; OA—25 cents, etc.

The following words or phrases may be used as price marks: Behaviour, chemistry, complaints, no mistake, volumetric, duplicates, republican, democrats, epistolary. A word with nine letters requires an odd letter, usually X. Sometimes a repeater, like X, is employed; thus, in come and buy, $1.00 would be C.YX.

It frequently happens that physicians desire to indicate that a patient is poor and is a proper subject for charity. This is usually done by writing the letter P in the lower corner, or, if very poor, PP. It is customary and humane to regard these marks, if assured of their genuineness.

Filing, Binding, and Preserving.—There is very little uniformity of practice among pharmacists in the particulars of filing, binding, and preserving prescriptions. The usual practice is one which is most inconvenient,—*i.e.*, that of simply filing them away upon a long brass wire yearly, half yearly, or quarterly. By this plan they are sure to become in time torn, dirty, dusty, and fly-specked, and the pile is very unsightly. The method of pasting them daily into a large invoice book is an improvement. The objection to this plan is, however, that the backs of the prescriptions cannot be examined readily, and in an active business the unwieldy books soon accumulate so as to be an inconvenience. A ready method of binding prescriptions is furnished by the use of *Mann's binder*. This consists of two durable stiff covers having a wrought iron strip riveted to the edge of each; two long screws are fastened to one of the strips; these pass through two screw holes in the other strip, and the covers are kept in place by two adjustable brass cylinders split longitudinally in the centre, having a solid disk at the top with a screw hole in the centre, and at the bottom the same kind of disk cut in two. The split cylinders are flared somewhat at the bottom, and are made to approach each other by a ring; by slipping this ring down, the edges of the bisected disks are brought together, and these can then be screwed down so as to hold securely; they can be instantly released, however, by pushing the ring up. The advantage of this binder is that it can be so readily converted into a temporary or a permanent binder. One month's prescriptions can be placed upon one screw by punching out a hole in the side of the prescription with a circular punch, and another month's upon the other screw; then, if the solid disks are screwed to the ends of the screws projecting from the screw holes, the brass cylinders can be broken off, and the volume for two months is completely bound; a stout piece of muslin should now be glued to the backs, and a finish given to the binding by gluing upon this a strip of red leather, labelled distinctly with the first and the last number of the prescriptions.

Fig. 612



Empire prescription book

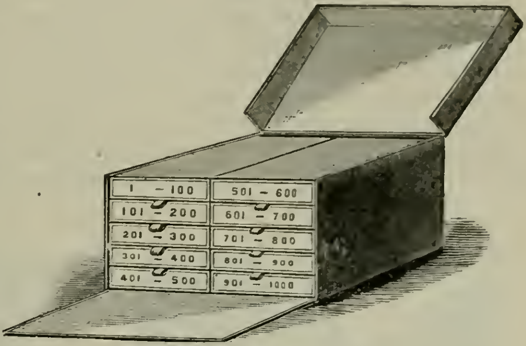
Many pharmacists copy their prescriptions into a book kept for the purpose. This plan is not always a judicious one. The chances of making errors are increased, and, in case of dispute, proof of the correctness of the copy would have to be produced. Others paste the prescriptions into a book. This is a better plan, but open to the objection that memorandums, addresses, etc., which are often written on the back, are rendered useless, unless the prescriptions are pasted only on the edge.

Fig. 613

Empire prescription book (open)

Fig. 612 shows the *Empire prescription book* made by Fox, Fultz & Co., of New York and Boston. It opens easily and lies flat upon the counter. The sections of leaves are securely held by copper rivets through the wooden back. Fig. 613 illustrates the open book and method of binding.

FIG. 614

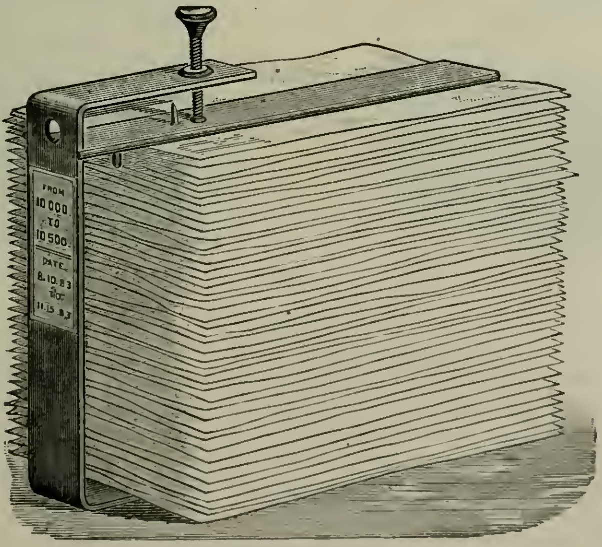


Lawrence's prescription box

Fig. 614 shows a box for holding cases containing numbered prescriptions made by J. F. Lawrence, of Chicago. The cases are numbered on the edge so that their contents can be easily referred to.

Fig. 615 represents a prescription file devised by R. H. T. Nesbitt, of Leavenworth, Kansas. The presciptions are retained in place by the movable flat iron bar which is represented upon the top of the file. A pointed wire passes upward from the bottom of the frame, and the prescriptions are filed upon it in the ordinary way; the movable iron bar may be screwed down upon the pile, and they are thus kept in place. When a prescription is to be renewed and access to one of those in the pile is desired, the bar is raised by means of the screw, and the prescription turned sideways and read. The hole seen in the frame near the top of the side is for hanging the file on a nail.

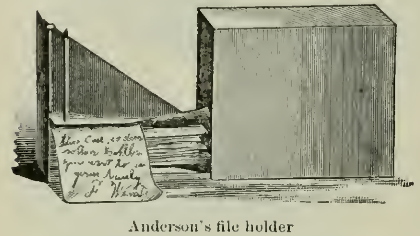
FIG. 615



Nesbitt's prescription file

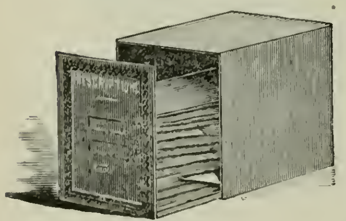
Anderson's prescription file, box file, and cabinet are shown in Figs. 616, 617, and 618. The object of this invention is to provide a means for collecting, protecting, and preserving prescriptions. In Fig. 616 the file holder is shown; this is intended to serve for the collection of the prescriptions as they are received. It is represented as partly filled with prescriptions. The bottom of the slide is of wood and is securely fastened to the tin front and side. In the corner is placed a hollow pin, on which the prescriptions are filed. Each file is supplied with ten index cards, numbered from "100" to "1000." These cards are intended to be placed between each hundred prescriptions, to facilitate the finding of a prescription when it is to be refilled. If it should be desirable to remove a prescription from the file, it may be readily done by inserting the transfer wire into the hollow pin and removing on the wire all prescriptions from above the one desired, which can then be removed by itself. When a prescription is to be renewed, it is turned to the left, as shown in the illustration, thus exposing it thoroughly for reading. The case is preferably made of tin in order to protect the prescriptions from dust, moisture, mice, and insects.

Fig. 616



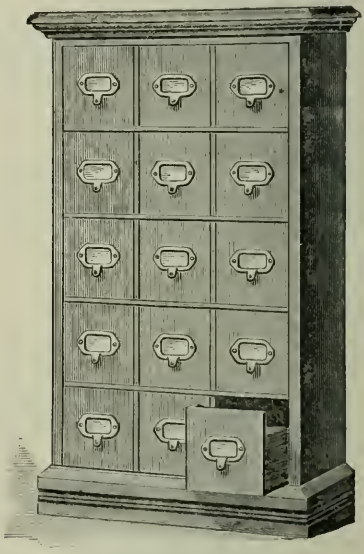
Anderson's file holder

Fig. 617



Anderson's box file

Fig. 618



Anderson's filing cabinet

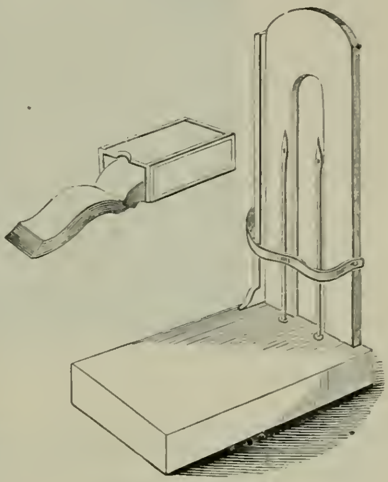
Fig. 617 represents a front and side view of the file. A punch is used to cut a clean, round hole in each prescription. A perforation without ragged edges constitutes one of the most important details in filing prescriptions, for it permits the prescriptions to lie flat upon each other, thus taking up less room, and the prescriptions are not likely to be mutilated if they are free to slip easily around the filing wire. A place is provided upon the top of the cover for the punch, so that it may always be kept within reach.

Fig. 618 shows a cabinet which is designed to permanently store the prescriptions after the box files are full. Upon the front of each box file there are two depressions, intended to hold blank cards to be used for the numbers of the first and last prescription.

The cabinet will accommodate fifteen box files, and as each file is capable of holding 1000 prescriptions, it will be seen that the capacity of the cabinet is 15,000 prescriptions. The drawers are of wood, and are of the same design as the slide in the single file.

Naulty's prescription file is shown in Fig. 619. The prescriptions are held securely upon two needles in such a position that for reference they can be found quickly and an unobstructed view obtained while compounding, the band shown in the cut being used for holding the succeeding prescriptions up. When a month's prescriptions, or any desirable number, have been filed, the needles are threaded with strong twine, and the pile pulled carefully off, the twine passing through the holes; the ends of the twine are now secured and a piece of thick muslin glued upon the back, and the back dated and numbered. The books are then placed in boxes, which are likewise numbered and dated distinctly. The cut also illustrates the method of keeping the bound book open while compounding a prescription.

Fig. 619



Naulty's prescription file

Card Index Prescription File.—The card index system, so valuable for many purposes, is used for prescriptions, but it is not as generally satisfactory as the Anderson file, which permits reference to the *original prescriptions,* which are easily and quickly consulted.

LABELS

It should be an invariable rule, in dispensing, that *every medicinal substance* sent out from the store *must have* a neat and distinct label upon it. It is necessary to establish this rule as a fixed custom or habit, for neglect of this precaution will often result in serious consequences. In addition, every package *should be labelled at once,* particularly in the case of prescriptions. The habit of permitting unlabelled packages to remain about, liable to substitution, will inevitably cause doubt, and give rise to some grave mistake, sooner or later. A very great diversity of opinion and taste is apt to prevail with regard to the most suitable style of label to select for general use. Formerly the home printer was exclusively depended upon, but the principle of division of labor has led to the establishment of "druggists' printing houses" in several sections of the country; this has resulted in cheapening labels, and the labor seems to have been largely expended in this direction, and toward elaborating gaudy designs, very few attempts having been made as yet toward attaining that simplicity and elegance in design which the principles of good taste clearly dictate. Lithographed labels are sought for principally because the designs more closely approach those of engraved labels; but engraved labels cannot be used generally, because of their costliness.

Fig. 620

Sweet Spirit of Nitre.

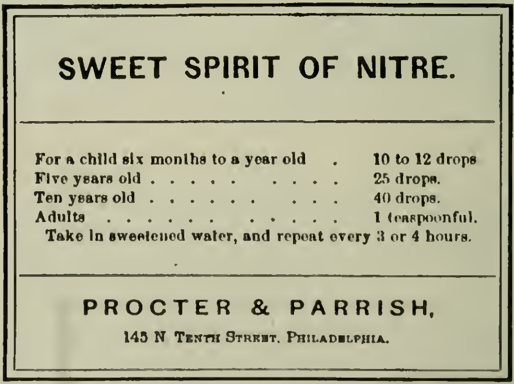
For a child six months to a year old, 10 to 12 drops; five years old, 25 drops; 10 years old, 40 drops; Adults, 1 teaspoonful. Take in sweetened water, and repeat every 3 or 4 hours.

PROCTER & PARRISH,
145 N. 10th St., Philada.

Fancy, obscure, and pretentious label

Bronze, green, and red bordered labels are seen in label catalogues in great profusion, and in one a sentimental moonlight Venetian scene in colors is conspicuously displayed on one end of a castor oil label! One leading principle will probably be of service in this connection, and that is to avoid loud, striking designs of all kinds. The appetite of all, patient, pharmacist, and physician, soon becomes satiated with such, and the notion that they influence business in any good way is soon proved to be a delusion. The almost universal

Fig. 621



SWEET SPIRIT OF NITRE.

For a child six months to a year old .	10 to 12 drops
Five years old	25 drops.
Ten years old	40 drops.
Adults	1 teaspoonful.

Take in sweetened water, and repeat every 3 or 4 hours.

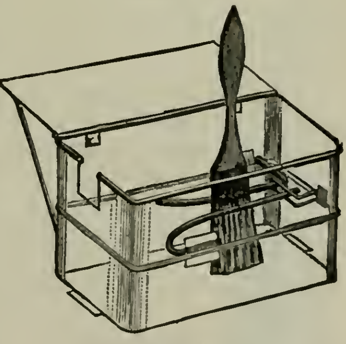
PROCTER & PARRISH,
145 N Tenth Street, Philadelphia.

Plain, old fashioned, and inexpensive label tendency of printers in selecting type for a label is to choose the largest that can possibly be used to get the subject matter inside the border. The effect is exactly opposite to that which is usually desired, for it adds nothing to the neatness of the label, certainly sacrifices distinctness, and the general impression conveyed is that of a confused mass of letters, which is more difficult to decipher than letters of the proper size and breadth of face appropriately set off by *sufficient blank space.* Plain black letters on a white ground are preferable. (See Figs. 620 and 621.)

Neatness, distinctness, and simplicity are cardinal principles in designing labels, and the reputation of many establishments is frequently judged from the character of the outward signs of neatness and care. For this reason particular attention should be paid to prescription labels, not only to have the printed address plain, clear, and neat, but to have the handwriting to correspond. In these important particulars patients are exceedingly apt to form an estimate of the qualifications of the compounder of a prescription from the style of his penmanship, reasoning that if he is careful, clean, and neat in the *one particular* of which they are competent to judge,—*i.e.*, the handwriting on the label,—the compounder must exercise similar qualifications in the more vital operations involved in compounding and dispensing, for upon the technicalities of the latter they cannot hope to pass judgment.

Labelling Poisonous Substances.—Whenever a poison is dispensed to customers upon an order, without being prescribed by a physician, the word poison should be distinctly written upon the label. If solid, and wrapped in paper, it should have two wrappers upon it, and both should be labelled poison. In the case of prescriptions, the word poison *should not appear upon the package or bottle unless the physician has so directed.* A careful pharmacist will be sorely tempted to prevent possible accident by pasting a poison label upon the package, but he is relieved entirely of responsibility if the dose is not excessive and if the physician has not directed it, because there is usually a special reason *for omitting it* from the label,—namely, that of avoiding the possibility of frightening the patient and thus defeating the object of the prescription. When a poison label is to be used upon a bottle it should be pasted on above the prescription label, so that it will be more likely to be seen, without possibility of failure through being covered by the hand holding the bottle.

Fig. 622



Sabin's mucilage can

Pasting Labels.—Few of the minor operations in dispensing are more important than this. Although frequently the subject of remark and criticism, there have been comparatively few real improvements in this direction. Sabin's mucilage can is a convenience which many appreciate, particularly the advantages of the simple device for avoiding an excess of paste on the brush. The label is laid upon the back of the lid of the can, which is thrown back for the purpose, and held in position. The can should be closed when not in use (see Fig. 622). An excellent paste for prescription use is made from flour by the following process:

FLOUR PASTE

Flour (wheat)	4 oz. troy
Water	16 fl. oz.
Nitric Acid	1 fl. dr.
Oil of Cloves	5 minims
Boric Acid	10 grains

Thoroughly mix the flour, boric acid, and water, and strain the mixture through a sieve; add the nitric acid; apply heat, with constant stirring, until the mixture has thickened; when nearly cold, add the oil; strain it through coarse muslin if not perfectly smooth. This paste keeps well, and is much superior to tragacanth mucilage and ordinary paste. When it is required for pasting labels on tinned surfaces, the addition of 10 percent. of glycerin will prevent the labels from falling off after drying.

For some purposes a more adhesive paste is desirable, and a dextrin paste is recommended (see below).

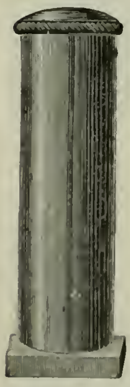
DEXTRIN PASTE

White Dextrin	1 lb.
Syrupy Glucose	2 oz. av.
Aluminum Sulphate	1 oz. av.
Sodium Benzoate	20 grains
Water	24 fl. oz.

Mix the White Dextrin, Aluminum Sulphate, and Sodium Benzoate with a portion of the water, rubbing to a smooth paste; add the Glucose and the remainder of the water, and heat the mixture on a water-bath, with occasional stirring, until it has become translucent; strain if necessary.

In applying a label which has been pasted, to a box, bottle, or can, care should be used not to touch with the fingers the portion of the label which has been recently written upon, even if it has the appearance of being dry. A piece of blotting pad or filtering paper, slightly larger than the label, should be laid upon it, and pressed gently, smoothly, and evenly, so that the excess of paste which has exuded upon the edges may be absorbed. If a label has had too much paste applied, and the excess has not been pressed out as described, it will have a wrinkled appearance. Labels should be neatly trimmed, showing a very slight but uniform margin around the border. They should be pasted upon bottles just above the centre, and never over the seams or mould marks, but half way between them.

Fig. 623

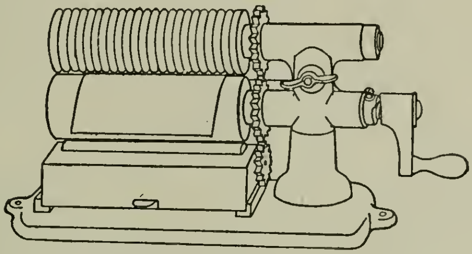


Label dampener

Gummed labels, or labels printed on paper coated with a solution of dextrin, or gum, on one side, are used largely in some sections of the country. They appear to answer a good purpose in some localities where there is a dry atmosphere, but when used on the seaboard or in damp atmospheres considerable loss is often experienced from their sticking together. Fig. 623 shows a label dampener. It is a brass cylinder, having a tightly fitting screw cap, with a slightly perforated bottom covered with felt. The cylinder is filled with water, sufficient of which oozes through the perforation to keep the felt moist. Fig. 624 shows a hand machine for moistening gummed labels.

Arranging and preserving Labels.—A method of classifying labels must be adopted by each pharmacist which will be suited to his own requirements. The general rule is to arrange them in label drawers in the most convenient place in the store. The label drawers are preferably shallow, made of wood, and having compartments to receive the labels. Considerable space may be saved by having the compartments made of tinned iron instead of wood. The bottom of the drawer may be lined with cotton flannel, to prevent the labels from slipping underneath the tin divisions and becoming mixed by the continuous opening and closing of the drawer. It will be found convenient to separate the plain labels required constantly for articles in daily request from those of larger size or special design; and the former may be classified into labels for solids and labels for liquids. These may be arranged alphabetically in each drawer, so that they shall be quickly found. *A regular system should be adopted and rigidly carried out; and when a place has been once fixed for a label, it should never be changed,* as few trifles give more annoyance than inability to find a label in a pressing rush of business.

Fig. 624



Machine for moistening gummed labels

The upright label cabinets which have been contrived answer an excellent purpose where upright space can be spared.

CHAPTER LXV

EXTEMPORANEOUS LIQUID PREPARATIONS

Solutions, Mixtures, and Emulsions

OFFICIAL liquid preparations have been treated of in Part II. They will therefore not be considered in the present chapter, which will be confined to the extemporaneous compounding of liquids. It will soon be realized by the student that this branch of practical pharmacy involves some of the most intricate questions of physical and chemical science. The knowledge which he has heretofore acquired of the solubilities of solids in various solvents, simple and compound, the solubility of liquids with one another, chemical decompositions, reactions between acid and alkaline salts, precipitation through single and double decomposition, etc., will often be of great service. This, coupled with practical experience, together with the exercise of original ingenuity, must be depended upon to meet the perplexing questions which continually arise. See autograph and facsimile prescriptions, pages 1099 to 1132.

Extemporaneous liquid preparations may be classified as follows: 1. *Solutions*, by which are meant liquid preparations containing dissolved solid substances. 2. *Mixtures*, liquids in which the solution is but partial, insoluble particles being held in suspension. 3. *Emulsions*, preparations containing oily or resinous substances mixed with water so as to form homogeneous liquids. These will be considered *seriatim.*

SOLUTIONS

The methods generally employed in making official and other solutions have been treated of in the preceding chapters, and it must be presumed that the reader is familiar with them. Most of the difficulties encountered in effecting solutions required by prescriptions arise from the want of knowledge on the part of prescribers of the solubilities and of the physical and chemical characteristics of the medicinal agents which they order to be compounded. It is necessary, therefore, for the pharmacist to be well grounded in these particulars, while therapeutical knowledge must not be neglected either, lest the addition of some apparently inert substance, intended to improve the preparation pharmaceutically, be injurious therapeutically.

Incompatibility.—The subject of incompatibility must be thoroughly comprehended, and, inasmuch as it occurs in solid preparations as well as liquids and is of far reaching importance, it will be considered at length and under a separate head (see Chap. LXVI).

COMPOUNDING EXTEMPORANEOUS SOLUTIONS

Use of Heat in compounding Extemporaneous Solutions.—As a general rule, it is not advantageous to aid the solution of a solid by heating it in contact with the solvent, except where the quantity of liquid is known to be in excess of what is required to form a solution, and such a liquid should never be dispensed until it has become cool. If the solid be crystalline, the excess will surely separate in crystals when the liquid cools, and the patient will become uneasy and suspicious, fearing lest some mistake has occurred. It frequently happens that more of a solid has been prescribed than can be dissolved in the amount of liquid desired; indeed, it is entirely too much to expect that every practitioner should carry in his mind the exact solubilities of all the solids that he prescribes in the respective liquids in which he may wish to dissolve them. This gives the pharmacist another opportunity to use his knowledge and judgment, and the problem

When to filter is oftentimes perplexing, although one simple rule should govern the practice: *A solution may be filtered and dispensed as a transparent liquid when the removal of the excess does not interfere with the medicinal properties and action of the medicine, nor conflict with the obvious intention of the prescriber.*

Solutions of potassium chlorate, to be used as gargles, are good illustrations:

℞ Potassii Chlorat. ʒiv
Phenolis gtt. xv
Infus. Salviæ f℥vi.
Sig.—Use as a gargle.

The quantity of the salt here is about twice too much, and, as the solution is intended as a gargle to inflamed surfaces, the undissolved particles of potassium chlorate would probably act as irritants. They can be of no use in the solution, and in this case filtration is perfectly admissible. The following prescription should not be filtered, and the pharmacist is compelled to rely solely upon his judgment and knowledge of the therapeutical action and properties of the ingredients:

℞ Magnesiæ Pond. ʒiss
Massæ Hydrarg. ʒss
Sacch. Alb. ʒi
Spt. Ammon. Arom. fʒii
Aq. Menth. Pip. ℥ii
Aq. Calcis f℥iii
Sig.—A tablespoonful every two hours.

The reasoning here would be direct and simple. The prescriber evidently intends this to be an alkaline cholagogue mixture, although the directions to "shake the bottle" have been omitted. Heavy magnesia and blue mass are both practically insoluble in the liquids, and if they are filtered or strained out the mixture is deprived of its most important constituents. It should be dispensed as a mixture, and a "shake" label used.

Aids in effecting Solution.—The use of solvents which are not directed in the prescription, for the purpose of effecting the complete solution of the ingredients, requires probably the greatest amount of good judgment. The practice is one which is liable to great abuse, and a strict rule should be enforced that no addition is admissible under any circumstances except one which is absolutely demanded by necessity and which will in nowise impair the therapeutical effect. The prescriber should have reason to place implicit reliance upon the compounder and feel satisfied that the patient has received exactly what was ordered. The following is a good illustration of a case requiring an addition; a physician prescribed it as an application for dry, excoriated nipples:

℞ Acidi Carbolici gr. xl
Aquæ f ℥ss.
Sig.—Solution Carbolic Acid. Use with a camel's hair brush.
Dr. W.

Phenol or carbolic acid is not soluble in water in the proportions named, only about 1 part dissolving in 20 parts of water. The pharmacist dispensed the prescription just as it was written, with the excess of phenol in the bottom of the bottle. The patient inserted the camel's hair brush and permitted it to remain in the bottle, so that it reached the bottom and became saturated with the undissolved phenol. The application produced severe pain and alleged serious injury, and became the ground for a civil suit for damages against the pharmacist, brought by the patient. If the pharmacist had added a small quantity of glycerin, all difficulty would have been avoided, and he could then have dispensed a perfect solution. It is hardly necessary to say that the physician should not have omitted prescribing the glycerin; but, as he failed to do so, it was the duty of a careful pharmacist to inform him of the facts, or, failing to find him, to supply the deficiency and subsequently notify him of the addition.

The order to be followed in mixing the ingredients is frequently very important, and many prescriptions which at first sight appear to contain incompatibles will be easily compounded by observing the proper order in mixing. As has been shown, precipitation frequently takes place when one liquid or solution is added to another, and this annoyance is much more apt to occur when concentrated solutions are brought together. Hence the dilution of the solution is recommended as one method of avoiding precipitation. An illustration is afforded in the following:

℞ Liq. Ammon. Acet. f ℥iv
Acidi Acetici f ʒi
Tinct. Ferri Chloridi f ℥ss
Glycerini f ℥ss
Mucilaginis Acaciæ ad f ℥viii.
Sig.—A teaspoonful every three hours.

If the tincture of ferric chloride be mixed with the acetic acid and glycerin, and then added to the solution of ammonium acetate, and this solution mixed with the mucilage of acacia, no gelatinization will occur; but if the tincture of ferric chloride be added to the mucilage, undiluted, a gelatinous precipitate will form, and, although the subsequent addition of the other ingredients will, in time, dissolve the precipitate, this time could be saved by following the proper order. Then, again, in the following:

℞ Hydrarg. Chlor. Corros. gr. iii
Mucilag. Acaciæ f ℥i
Aquæ
Aquæ Calcis āā f ℥ii

If the corrosive mercuric chloride be dissolved in the water and then mixed with the mucilage, and the lime water added subsequently, no precipitation will occur; but if the corrosive mercuric chloride be added to the lime water and then to the other ingredients, the yellowish red mercuric oxide will be formed, which is insoluble in the liquid.

The following rule should be insisted upon: *Whenever a difference in the appearance of a liquid is produced by a variation in the order of mixing, a memorandum noting the order should be made upon the prescription at the time it is compounded, so that in case of renewal the same order may be followed.*

MIXTURES

Mixtures, properly speaking, are aqueous preparations intended for internal administration, containing some insoluble substances, with frequently viscid or sweet liquids to aid in suspending them. The official mixtures have been already noticed (see page 304). The term mixture, however, is indiscriminately applied in extemporaneous pharmacy and in prescriptions to aqueous solutions of all kinds. For instance, solution of potassium citrate is frequently termed "fever mixture," although it is a perfectly transparent solution.

Most of the remarks made upon solutions will be found to apply to the preparation of mixtures. Especial care must be taken to obtain the precipitate in as light a form as possible, so as to avoid impaction and partial solidification in the bottle; this may be best done by avoiding the mixing of concentrated solutions. For further information concerning mixtures the reader is referred to Chapter LXVI, on Incompatibility.

EMULSIONS

Emulsions are aqueous liquid preparations in which oily or resinous liquids are suspended by the agency of gummy or viscid substances. They may be conveniently divided into two classes: 1. Natural emulsions. 2. Manufactured emulsions. They are opaque liquids, generally of a thick consistence. (See Emulsa, page 301.)

1. **Natural emulsions** are those which are found in nature, ready formed, as the milky juices of plants, the milk of animals, yolk of egg, etc.

2. **Manufactured emulsions** are those which are made artificially by various processes. The art of producing them is termed *emulsification.*

Manufactured emulsions are usually made from two classes of substances: 1. Those which contain an oily or a resinous compound associated *naturally* with either gum or some other emulsifying agent. 2. Oils, fatty and resinous bodies containing no emulsifying substance.

Gum resin emulsions and seed emulsions are included in the first class. These are usually made by simple trituration in contact with water.

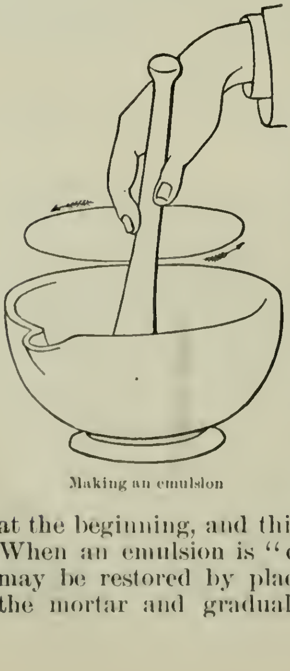
Gum resin emulsions are made by reducing to a coarse powder, in a mortar, selected pieces of the gum resin, triturating with a small quantity of water so as to form a smooth, uniform paste, and then adding the remainder of the water, finally straining the mixture through a cloth strainer or a plug of absorbent cotton contained in a funnel. (See Emulsum Asafœtidæ, page 302.) Powdered gum resin should never be used for making emulsions, because of the loss or deterioration of the volatile constituents which always takes place when the substance is dried so that it may be powdered.

Seed emulsions are so termed because they are made by rubbing seeds or the kernels of fruits which contain fixed oils with water, the emulsifying agent being a gummy or albuminous substance found naturally in the seed or kernel associated with the oil. Emulsions of almond, castor oil bean, croton oil bean, etc., are examples of this kind. (See Emulsum Amygdalæ, page 302.)

The theory of emulsification is based upon a study of the best type of a natural emulsion,—namely, milk. This liquid is found, on examination, to consist of innumerable globules of a fatty substance (butter) enveloped in a thin membrane of viscid matter (casein) suspended in water. The object sought by the pharmacist in making emulsions is first to thoroughly divide the oily or resinous liquid into minute globules, and then to surround each globule with an adhesive envelope (mucilage of acacia, yolk of egg, etc.). The globules, when completely enveloped, are suspended in water, and if the emulsion is properly made, there will be no tendency on the part of the oily or resinous liquid to recombine. Several methods are employed in making emulsions, the most important of which, however, may be grouped under *two* typical methods, named from the geographical locations where they are used most frequently: 1. The English method. 2. The Continental method. Both are equally useful, and should be employed according to circumstances.

1. **The English Method.**—In this mode of making emulsions the emulsifying agent, consisting of mucilage, yolk of egg, etc., is first placed in a dry mortar, and small quantities of the oil and water are gradually and alternately added at intervals. The pestle is rapidly and lightly rotated in the direction of the arrows (see Fig. 625), with the effect of dashing the oil into globules, which are at once enveloped by the viscid emulsifying agent. If the oil or water is added too rapidly at the beginning, or the mucilage has not been thick enough, the accident of "*cracking*" the emulsion occurs. This may be known by the "pearly" appearance assumed by the mixture, and on close examination the globules of unenveloped oil may be seen floating about. If each stage of the process is successful, the emulsion presents, upon thorough mixing after each addition, a smooth, opaque, glistening appearance like cream. Success depends largely upon the care exercised in forming the nucleus at the beginning, and this, therefore, should not be too hastily made. When an emulsion is "cracked," it need not be thrown away. It may be restored by placing an additional quantity of mucilage in the mortar and gradually adding the "cracked" emulsion to it,

Fig. 625



Making an emulsion

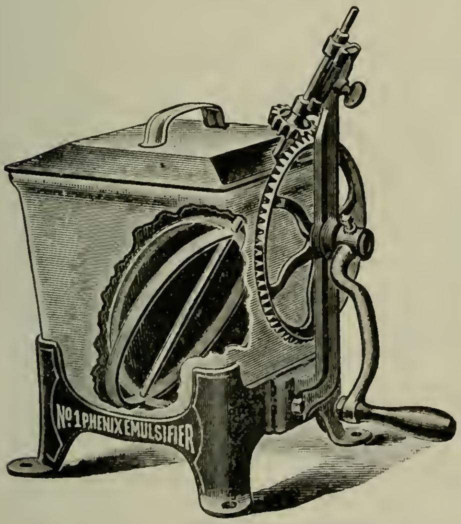
triturating after each addition, when finally the satisfaction of seeing the uncombined globules disappear will generally be experienced.

The English method of making emulsions is the best to use in general prescription practice, where the proportions of gum, oily or resinous liquids, and water must necessarily vary. A typical formula is appended :

℞ Olei Morrhuæ f℥ii
Pulv. Acaciæ ℥ss
Aquæ q. s. ft. f℥iv.

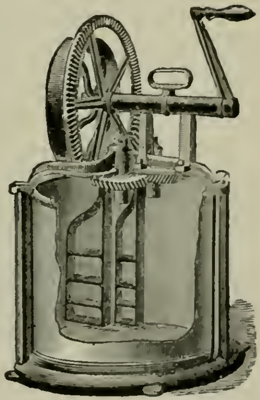
Place the acacia, which should not be finely powdered, but granulated, in a mortar with one fluidounce of water. This should be triturated until the mucilage is perfectly smooth and free from lumps. The oil should be added at first in quantities not greater than half a fluidrachm at a time, stirring rapidly with the pestle after each application, care being taken not to add a fresh portion of oil until the last has been thoroughly emulsified. When the liquid becomes too thick to be easily stirred, a fluidrachm of water should be mixed with it, and the gradual additions of oil continued until the whole quantity has been used. The larger quantity of water may be added rapidly after the nucleus is once properly formed, without risk.

Fig. 626



Emulsifier

Fig. 627



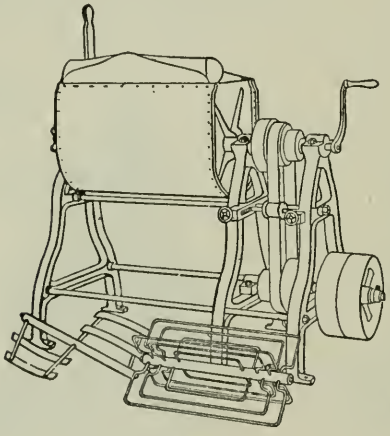
Sparrow mixer

2. **The Continental Method.**—This has the great merit of never failing to produce a good emulsion if the proper proportions are used to form the nucleus, and if the directions are strictly followed. The most satisfactory proportions may be easily remembered. Half as much water is taken as of oil, and half as much gum as of water; or it may be expressed as oil, 4; water, 2; gum, 1. The four parts of oil must be placed in a dry mortar and one part of finely powdered gum added to it, stirring with the pestle; when a uniform mixture is made, two parts of water are added, not gradually, but all at once, when, upon stirring, the emulsion is quickly

made. An additional quantity of water may be added to this nucleus without risk. The explanation of making an emulsion by this method is, that the particles of gum, being insoluble in the oil and surrounded by it, are prevented from separating and dissolving in the water so as to form lumps; by stirring the mixture actively the water *gradually* dissolves the gum, the oil becomes incorporated at the same time, and a homogeneous mixture is produced, the quantities of oil, gum, and water being in exactly the right proportions to form an emulsion.

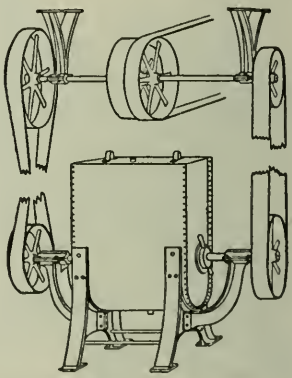
In making large quantities of emulsions some mechanical device must be used to facilitate the rapid stirring and agitation necessary to form the nucleus. Fig. 626 represents an emulsion apparatus or egg beater made by the Whitall Tatum Company. The principle of action is so well shown here that a description is unnecessary. If emulsions are to be made in still larger quantities, the sifter and mixer shown in Fig. 256 can be used by taking out the sieves and lining the receiving box with tinned copper or otherwise making it waterproof, thus using only the mixer.

Fig. 628



Clipper emulsifier

Fig. 629



Hall's emulsion machine

The Sparrow mixer is shown in Fig. 627. In this ingenious apparatus two stirrers are made to revolve by turning the gear wheel, and a very rapid and effective motion may be imparted.

Fig. 628 shows the Clipper emulsifier made by the J. H. Day Company of Cincinnati. The tank is mounted on a strong frame, and can be easily tilted to remove the emulsion when finished; the agitators are shown in the foreground. With this machine a large quantity of emulsion can be made quickly. Fig. 629 shows another form, an emulsion machine made by A. B. Hall, of Indianapolis; it is capable of making from a barrel to a barrel and a half of emulsion at each charge, the power being conveyed by a shaft, belts, and pulleys from above.

Casein Emulsions.—The use of casein as an emulsifier has been developed by Léger, a Parisian pharmacist. He recommends the preparation of *saccharated casein*, a fine white powder, which is used for emulsifying just as is powdered acacia. The advantages claimed for casein are that its emulsions are more readily retained by the stomach, and that greater stability and perfection are secured through its use.

Saccharated casein is prepared by heating one gallon of cow's milk to 104° F., adding two fluidounces of ammonia water, allowing the whole to stand a day, and separating the lower milky liquid from the oily liquid on top. The milky liquid (*lactoserum*) is treated with acetic acid until the casein is precipitated. After washing the precipitate thoroughly with water at 104° F. it is collected on a muslin strainer, pressed, and dried ; a weighed portion of the casein is dried and the percentage of moisture ascertained ; the damp cake of casein is then triturated with three and a half ounces of powdered sugar and eight parts of sodium bicarbonate for every one hundred parts of dry casein.

Prolonged trituration and the addition of more powdered sugar, until it amounts to nine parts in one hundred, result in the formation of a paste, which must now be dried by a gentle heat not above 86° to 90° F. After complete drying, it is powdered and sifted. To make a casein emulsion of a fixed oil, fifteen parts of the oil are gradually incorporated with a mucilage previously made with fifteen parts of saccharated casein and five parts of water. When a perfect emulsion is formed the other ingredients are added.

Chondrus Emulsions.—Since acacia is sometimes subject to fluctuations in price and is often expensive, various substitutes have appeared which have been tried as emulsifying agents, one of the most successful being the gelatinous substance obtained from chondrus or Irish moss. (See page 746.)

In the Formulary, Part VI, under the heads of Gelatinum Chondri, Mucilago Chondri, and Emulsio Olei Morrhuæ, full information as to the methods of using it will be found. In this place it will only be necessary to say that a gummy substance in scales is produced by evaporating and desiccating a decoction of chondrus, and that a mucilage may be made from this Irish moss gelatin by heating eight grains of it in contact with one ounce of boiling water until it is completely dissolved. The mucilage, after being cooled, is then used for preparing emulsions exactly as is mucilage of acacia.

Quillaja Emulsions.—*Quillaja*, or *quillaya bark* (see page 898), contains the principle saponin, a glucoside which is capable of emulsifying oils. Senega contains an analogous principle. The property which both possess, of causing frothing in aqueous solutions, suggested the use of quillaja as an emulsifier. It has not come into extensive use, and care is necessary in employing it, as it is not without medicinal and irritating properties. One of the essentials of a good emulsifier is that it should be inert. Quillaja has been adopted in the National Formulary. (See Emulsio Olei Morrhuæ, Part VI, which illustrates the method of using it.) Where an active medicine is to be made into an emulsion, and its properties are not antagonized by the quillaja, it may be judicious to employ it. Another disadvantage that it possesses is that a large quantity of tincture is required to be effective.

Compound Emulsions.—As a general rule, the addition of alcoholic liquids to emulsions destroys their homogeneity. When it is necessary to add them in compounding prescriptions, they should be diluted, if possible, with a portion of the water, and added after the emulsion is nearly finished. Alkaline solutions generally aid emulsification, by forming soaps with the resinous or oily liquids; volatile oils make better emulsions if they are first mixed with an equal volume of fixed oil.

THE DISPENSING OF LIQUIDS

Every convenience should be adopted to facilitate quick and accurate dispensing. The sink should be close to the prescription counter. A good draining surface for graduates to rest upon is made by fastening sheets of corrugated rubber (a piece of rubber matting) to the slightly inclined shelves above the sink (see Fig. 142), and a brush for quickly cleaning graduates should be accessible (see Fig. 629*a*). In addition to the retort stand already referred to, the very convenient little funnel support may find a place upon the prescription counter (see Fig. 629*b*). The long rod which is screwed to an upright part of the counter fixtures permits the ring to be adjusted to any desired height. For larger filtering operations the funnel board (Fig. 630) will prove useful.

Fig. 629*a*

Graduate brush

Fig. 629*b*

Funnel support

Fig. 630

Funnel board

Bottles.—The size and shape of the bottles used in dispensing liquids are largely matters of individual taste. The tendency at present is toward oval bottles for prescriptions, because they afford proportionately more space for the label than either round or square bottles. This is noticeable to a greater extent in the smaller sizes than in the larger ones. In addition to this, oval bottles are more

Fig. 631

Oval metric bottle

Fig. 632

Poison bottle

Fig. 633

Poison bottle

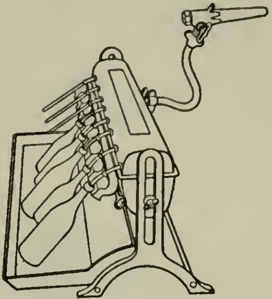
convenient to carry in the pocket than those of any other shape. Fig. 631 shows an oval metric bottle.

Prescription bottles are now frequently made of amber glass, to protect the contents from the effects of the actinic rays of light. For poisonous liquids, or for liquids intended for external application, blue bottles studded at regular intervals with pyramidal points are used. These are designed to attract attention through their peculiar color and shape, and thus prevent errors; the points render them easily distinguishable from ordinary bottles by the sense of touch, so that the patient can recognize a poisonous liquid in the dark. Figs. 632 and 633 show two sides of this bottle.

Fig. 634

Turntable rinser

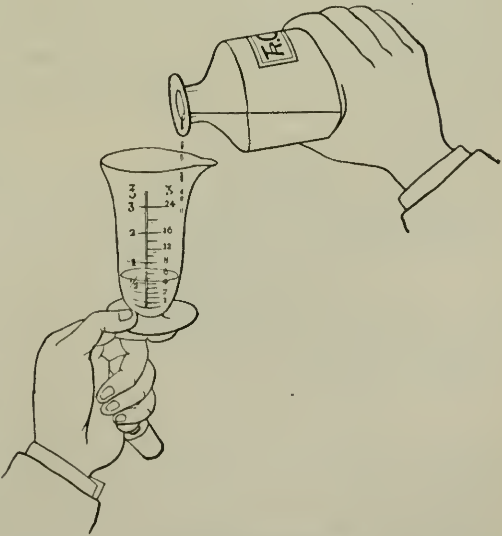
Fig. 635



Bottle filler

Washing Bottles.—The cleaning of bottles is generally a despised occupation. Where a large number of bottles of one kind and shape are to be washed, the machine shown in Fig. 634, made by the J. H. Day Company, of Cincinnati, known as the turntable rinser, may be used with advantage. The water is supplied automatically, and may be shut off by a quarter turn of the rinser; this permits continuous rinsing without undue waste of water.

Fig. 636

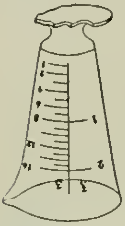


Pouring from shop bottle

Bottle Fillers.—In Fig. 635 a bottle filler made by the J. H. Day Company, of Cincinnati, is shown which automatically fills a bottle placed on one of the tubes, and when the bottle is full the liquid stops flowing. It is obvious that a continuous filling may be carried on by connecting a bottle with the first tube, and then another with the second, and so on until the last tube is reached. The first bottle may then be removed (filled), and if an empty one be slipped over the tube, and this repeated in turn with the others, they can all be filled rapidly and easily.

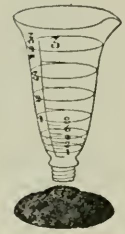
Pouring Liquids.—In pouring liquids from the dispensing bottles, it is well to establish the habit of extracting the stopper with the left hand, holding it with the little finger. The graduate is held between the forefinger and thumb of the left hand, the bottle is grasped by the right hand with the label uppermost (see Fig. 474), and the liquid should be poured down the side of the graduate to avoid splashing (see Fig. 636). Fox, Fultz & Co. have placed upon the market a graduate with a hard rubber base (see Fig. 638). The base of an ordinary graduate is apt to be chipped or broken by use (see Fig. 637), but if the hard rubber base, which is detachable, is used, this inconvenience is remedied. If the graduate is broken, another can be screwed into the base, which is practically indestructible.

Fig. 637



Graduate (chipped and broken base)

Fig. 638



Graduate, with hard rubber base

Fig. 639

Dropping from shop bottle

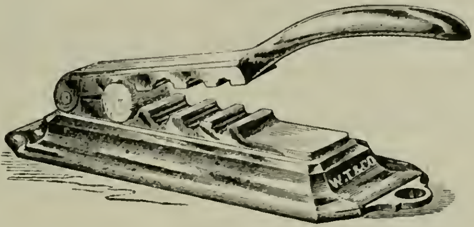
Dropping Liquids.—Fig. 639 shows the method of dropping liquids from a dispensing bottle. The stopper is loosened, prevented from dropping out by holding it with the finger, and the bottle inclined so that the rate of dropping may be controlled. Fig. 640 shows a very convenient bottle for dispensing liquids which are to be administered by drops. It was originally made in Germany, but is now made by the Whitall Tatum Company. The glass stopper has a deep conical depression extending nearly half way up the side, while the neck of the bottle is furnished with an aperture having a slightly projecting lip. When the stopper is turned so that the upper part of the depression is opposite the little aperture in the side, the liquid may be dropped very uniformly. A corresponding depression on the opposite side of the stopper communicates with a little channel running down from the lip upon the opposite side of the bottle, so that air is supplied during the dropping. By turning the stopper half way around, both apertures in the neck of the bottle are closed.

Fig. 640

Dropping bottle

Corks are indispensable for stoppering bottles. They should be selected with great care. There is a wide difference in price between the best quality and the common grades, but it is true economy to use only the best. Short corks, which, when inserted tightly, so as to secure the contents from leakage, do not project above the lip sufficiently to furnish a good grasp for the fingers when extracting them, should never be used for prescription bottles. Brittle, hard, or dry corks, which break off when the attempt is made to remove them, are an especial annoyance. To avoid this, corks should not be kept in a warm, dry place, but if very dry, they should be moistened by dipping them in water for an instant, and then they should be well pressed. "Taper" corks are now invariably preferred to the "straight" form.

Fig. 641



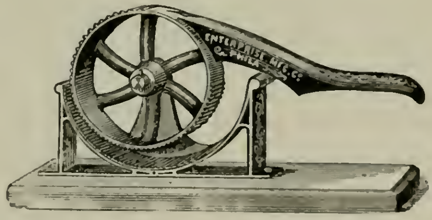
Cork press

Pressing Corks.—Fig. 641 shows a modern form of cork press which is largely used. The motion by which the pressure is affected is direct and simple. Pharmacists who incline to the grotesque in their tastes may prefer the kind shown in Fig. 642, but the practical dispenser will generally choose Lochmann's cork press (see Fig. 643), because the process of pressing the cork is more effectual, and there is less likelihood of breaking it or cracking the surface in this press than in any other, for the cork is revolved while the pressure is gradually increased. The press consists of a cast iron base, the upper portion of which is hemispherical, with the upper surface slightly corrugated; a corrugated cast iron wheel is placed upon an axle slightly out of the centre of the curve of the base, so as to afford a gradually diminishing space between the curved surfaces. The wheel has a handle, which is raised when the tapered end of the cork is inserted between the surfaces; the handle is lowered, and the cork revolves while being pressed.

Fig. 642

French cork press

Fig. 643

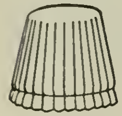


Lochmann's cork press

Gummed Cork Tops.—A finish may be given to corks by the use of "gummed cork tops." These are circular in form, made of paper, and the name of the pharmacist, or his monogram, is generally printed upon them in colors. These tops have largely supplanted the sealing wax finish so much used a few years ago.

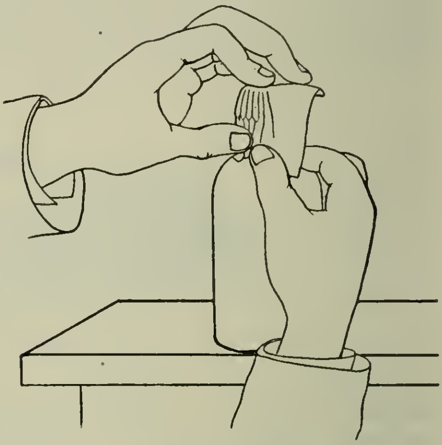
Capping Bottles.—The practice of capping bottles with paper, kid, baudruche, or other material is a good one, principally because of the feeling of security it gives to the patient that the contents of the bottle have not been tampered with after being dispensed. Hunt's bottle caps (see Fig. 644) are largely employed. These consist of fluted caps of colored paper, of various sizes, which are used by adjusting the proper sized cap to the corked bottle and tying it on. An equally neat effect may be secured, with a little practice, by capping a bottle with a piece of fancy paper, as shown in Figs. 645 and 646. The paper is held in the centre upon the cork by the forefinger of the left hand, while the flutes are made by "plaiting" them in with the forefinger and thumb of the right hand. It is then secured by tying with twine, a knot with short ends being preferred, because it is less likely to be interfered with by a messenger, on account of the difficulty of retying it. After tying, the "excess" of paper is trimmed off by using scissors with sharp points.

Fig. 644



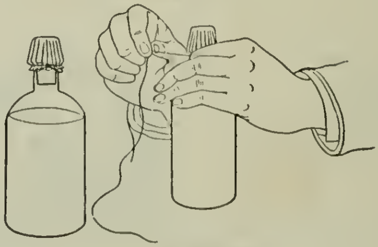
Hunt's bottle cap

Fig 645



Capping bottles

Fig. 646



Tying the cap

CHAPTER LXVI

INCOMPATIBILITY

INCOMPATIBILITY may be defined as a term used to express the effects produced in pharmaceutical mixtures by chemical decomposition, physical dissociation, incomplete solution, or therapeutical opposition. For the purposes of study the subject may be considered under two heads, according as it occurs in *liquids* or in *solids*, and these divided into three classes,—*chemical incompatibility, physical incompatibility*, and *therapeutical incompatibility.*

CHEMICAL INCOMPATIBILITY OCCURRING IN LIQUIDS

Chemical incompatibility is that form which is the result of chemical action and which invariably results in the decomposition of one or more of the ingredients entering into the prescription. It must not be assumed, however, that this decomposition is always unintentional on the part of the prescriber.

Chemical incompatibility occurring in solutions, mixtures, lotions, liniments, etc., may result in: I. Production of a precipitate. II. Evolution of a gas. III. Changes in color. IV. Decomposition caused by chemical action producing heat. V. Immiscible liquids formed by reaction between chemical substances.

I. Production of a precipitate.—When a precipitate is formed in a prescription the first thought must be, Is the precipitate active or inert? then, Has the physician intended to produce the precipitation? for incompatibility may be either intentional or unintentional.

Chemical incompatibility is a condition which is very likely to be misunderstood. It does not follow that because precipitation ensues when two transparent liquids are mixed, or in any other way, the decomposition was not intended. Cases of this kind demand good judgment on the part of the pharmacist. This may probably be best illustrated by the following examples:

℞ Plumbi Acetat. ʒss
Zinci Sulphat. gr. xv
Aq. Rosæ f℥iv
M.
Sig.—Use as an injection.

The novice would be very apt to imagine that the doctor had made a mistake in writing this, or was sadly deficient in chemical knowledge not to be aware that decomposition would take place here, that the insoluble lead sulphate would be formed, and that the astringency of the salts would be destroyed; but the experienced pharmacist would know at once that he must not filter this prescription, but dispense it with a "shake" label, because the precipitated lead sulphate is the really important agent. A very different case is presented in the following, which may be cited as an illustration of chemical incompatibility arising from lack of knowledge of the solubilities of the salts on the part of the prescriber :

℞ Quininæ Sulph. gr. x
Potassii Acet. gr. xx
Acid. Sulph. Dil. gtt. v
Aquæ Cinnamomi f ℥ i
M.
Sig.—A tablespoonful every three hours.

The usual procedure would be either to dissolve the quinine salt in the cinnamon water with the aid of the diluted sulphuric acid, and then add the potassium acetate, or to make separate solutions of each, and then mix them. In either case the result would be the formation of a voluminous precipitate of quinine acetate, preventing the possibility of carrying out the directions to the patient of taking a tablespoonful, because it could not be poured. Although this precipitate could be dissolved in acetic acid or alcohol, so much would be required of either that the character of the prescription would be materially altered ; hence quinine sulphate and potassium acetate should never be prescribed together in solutions.

Precipitates may be produced in several ways, as follows :

1. An insoluble salt resulting from reaction between two salts in solution. 2. Reduction of salts by chemical reaction. 3. Insoluble hydroxides resulting from the action of a soluble salt upon a carbonate or hydroxide. 4. Precipitation of alkaloids or alkaloidal salts by alkalies, alkaline salts, general alkaloidal precipitants, or substances producing insoluble compounds. 5. Precipitation of a weak acid from its salt by the addition of a stronger acid. 6. Separation of a gelatinous precipitate.

1. *An insoluble salt resulting from reaction between two salts in solution.*—This form of precipitation is very common. A knowledge of the properties of many chemical compounds is necessary to deal with incompatibility of this kind. The prescription given below illustrates this fact.

℞ Magnes. Sulph.
Pot. et Sod. Tart., āā ʒ i
Sodii Phosph. ʒ ss
Tinct. Capsici ♏ xx
Aquæ ad f ℥ ii

A white, flocculent precipitate of magnesium phosphate at once appears. If permissible, the addition of a small quantity of tartaric acid will dissolve the precipitate.

The following list of incompatible combinations are classed under this head :

Arsenic trioxide when in solution is precipitated by ferric hydroxide or dialyzed iron as an insoluble arsenite.

Benzoates.—The soluble benzoates precipitate ferric salts when in neutral or nearly neutral solutions.

Borates.—Sodium borate and other alkaline borates precipitate salts of several of the metals when in neutral solution, as mercuric chloride, silver nitrate, lead acetate, barium chloride, calcium chloride, alum, zinc sulphate, and ferric salts.

Chromates and Bichromates.—The soluble chromates and bichromates precipitate salts of lead, silver, mercury, and bismuth when in aqueous solution.

Hydriodic acid and the soluble iodides produce precipitates in aqueous solutions of lead and silver salts and with mercurous and mercuric compounds, the precipitate usually being soluble in an excess of either substance.

Hydrobromic acid and the soluble bromides produce precipitates with soluble lead, silver, and mercurous salts. The precipitate formed with mercuric compounds is soluble in an excess of either salt.

Hydrochloric acid and the soluble chlorides precipitate the soluble lead, silver, and mercurous salts, from their solutions, as chlorides.

Hypophosphites.—The alkaline hypophosphites when added to solutions of ferric salts produce a precipitate of ferric hypophosphite, which is soluble in the presence of sufficient alkaline citrate.

Lead acetate is precipitated from solution by the soluble carbonates, sodium borate, soluble sulphates, bromides, iodides, chromates, sodium phosphate, and tannic acid.

Mercuric chloride (corrosive sublimate) is precipitated when in solution by the fixed alkaline hydroxides. The precipitate, if the alkali be in excess, is yellow mercuric oxide, as in the case of "yellow wash," in which lime water is the precipitant. Ammonia water and ammonium carbonate precipitate ammoniated mercury when added to solution of corrosive sublimate. It is also precipitated by potassium or sodium carbonate or bicarbonate and by sodium borate.

Mercurous chloride (calomel).—A precipitate of black mercurous oxide results from the addition of potassium, sodium, or calcium hydroxides to calomel. The well known "black wash" is an example of this reaction.

Mercuric iodide (*red*).—Its incompatibilities are similar to those of corrosive mercuric chloride.

Mercurous iodide (*yellow*).—Its incompatibilities are similar to those of mild mercurous chloride.

Methylthionine hydrochloride (methylene blue) is precipitated from solution by potassium iodide or potassium dichromate.

Potassium or sodium carbonates precipitate many soluble salts, producing insoluble carbonates, hydroxides, or oxides. Soluble salts of the following are so precipitated : silver, mercurous and mercuric compounds, ferrous and ferric iron, manganese, barium, strontium, calcium, tin, aluminum, chromium, antimony, lead, nickel, copper, zinc, and magnesium.

Salicylic acid and salicylates produce a precipitate with ferric salts if in nearly neutral solutions ; the alkaline acetates and citrates, if present in sufficient amount, will prevent this precipitate.

Silver nitrate in aqueous solution is precipitated by the alkaline hydroxides, the alkali carbonates, the soluble chlorides, bromides, iodides, cyanides, sodium phosphate, chromates, soluble arsenites and arsenates, and by potassium permanganate if the solution is not too dilute. Tannic acid and the soluble citrates and salicylates also precipitate solutions of silver nitrate.

Sodium thiosulphate (hyposulphite) is decomposed by acids, when in aqueous solution ; sulphur being precipitated and sulphur dioxide liberated.

Sulphuric acid and soluble sulphates precipitate soluble salts of lead, barium, strontium, and calcium when in sufficiently concentrated solution.

2. *Reduction of salts by chemical reaction.*—Solutions of salts of silver and of mercury furnish the best illustrations of this kind of incompatibility. Exposure to light aids in the reduction of such salts to the metallic condition. In the following prescription for an eye wash, silver chloride would be precipitated and reduction would speedily follow. If the prescription were filtered, the filtrate would contain practically no silver.

℞ Argent. Nit. gr. xxv
Sodii Chlorid. gr. xv
Aquæ f ℥ vi

The following list is appended as showing some of the more common forms of this kind of incompatibility :

Mercuric chloride (*corrosive*).—Corrosive sublimate is reduced to calomel and then to metallic mercury by metallic zinc, copper, or iron when water is present.

In alkaline mixtures the reduction occurs in the presence of the soluble arsenites, antimony and potassium tartrate, ferrous salts, and is also caused by light.

Mercurous chloride (*mild*).—Calomel is reduced to metallic mercury by nitrous compounds, as spirit of nitrous ether, and by the hypophosphites and in alkaline mixtures by arsenites and antimony and potassium tartrate.

Mercuric iodide (*red*) is reduced under conditions similar to those of corrosive mercuric chloride.

Mercurous iodide (*yellow*) is reduced to metallic mercury under conditions similar to those of calomel.

Silver nitrate is reduced to metallic silver by metallic zinc, copper, tin, mercury, or lead, by the soluble hypophosphites and sulphites, and in alkaline solution by arsenites, manganous and antimonous salts, and also by ferrous sulphate.

3. *Insoluble hydroxides resulting from the action of a soluble salt upon a carbonate or hydroxide.*—This form of incompatibility is common, the precipitates usually being flocculent. If the solutions are strong, they are gelatinous.

℞ Sodii Bicarbonatis ℥iiss
Potassii Sulphidi ℥ii
Sodii Chloridi ʒiv
Aluminis ʒi
Aquæ Oii
M. ft. sol.

It is impossible to produce a clear solution with the foregoing ingredients, since the sodium bicarbonate decomposes the alum, giving rise to insoluble aluminum hydroxide. The following list illustrates some of the more common incompatibilities in this class:

Adrenaline.—The addition of alkalies will precipitate adrenaline from its solution as an hydroxide.

Aluminum, ferric iron, chromium, and tin.—The soluble salts of the metals given are precipitated as hydroxides by potassium or sodium carbonate.

Alumnol (aluminum naphthol disulphonate) yields a precipitate of aluminum hydroxide with the alkaline hydroxides. An excess of the hydroxide renders the precipitate soluble.

Ammonia water precipitates salts of the metals like the fixed alkaline hydroxides.

Cerium oxalate is slowly precipitated as an hydroxide by the alkaline hydroxides.

Fixed alkaline hydroxides precipitate insoluble hydroxides or oxides when added to solutions of salts of all common metals.

4. *Precipitation of alkaloids or alkaloidal salts by alkalies, alkaline salts, general alkaloidal precipitants, or substances producing insoluble compounds.*—In all cases where prescriptions showing this kind of incompatibility are compounded, even when no signs of precipitation are visible to the compounder, a "shake" label should be pasted on the bottle so that the patient cannot take all of the poisonous alkaloid in the last dose.

This form is one of the most dangerous that is likely to be encountered. The alkaloids are very largely used, and are nearly all violent poisons; they are usually combined with acids in order to present them in forms which are soluble. Strychnine sulphate, for instance, is soluble in about 30 parts of water, while strychnine requires 6400 parts of water to dissolve it; the combination of an alkali or an alkaline salt with the strychnine sulphate would throw the strychnine out of solution.

℞ Strychninæ Sulph. gr. i
Potassii Bromid. ʒvii
Aquæ q. s. ft. f℥viii

An inexperienced pharmacist would unhesitatingly proceed to compound the above prescription. A transparent solution would be obtained without difficulty, which would be dispensed without the slightest misgiving, but which in all probability would produce disastrous results. This solution deposits in a few hours the greater part of the strychnine salt as an insoluble bromide, which quickly subsides in transparent crystals. A lady in England lost her life by taking a similar mixture. She carefully refrained from shaking the bottle, the strychnine precipitate formed in the bottom, and in taking the last dose she swallowed nearly all of it. A similar case of dangerous chemical incompatibility occurred in the author's personal experience, the following having been prescribed by a physician who had overlooked the fact that the salts of most alkaloids are decomposed by alkaline solutions, and the alkaloids, being less soluble than the salts, are precipitated :

℞ Morph. Sulph. gr. ii
Potass. Bicarb. gr. xc
Aquæ q. s. ft. f℥ii
Sig.—Take a teaspoonful mixed with half a teaspoonful of lemon juice.

The morphine was precipitated by the alkaline carbonate, and if the bottle had not been shaken before pouring out the teaspoonful which was mixed with the lemon juice, the last dose would have contained nearly all of the morphine.

The following list shows some of the more common forms of incompatibility in this class :

Acetanilide possesses most of the incompatibilities of alkaloids.

Borates.—Sodium borate and other alkaline borates, being alkaline in reaction, may precipitate the alkaloid from a solution of its salt.

Bromides.—The soluble bromides precipitate some of the alkaloids forming insoluble compounds. This is true of strychnine, morphine, and codeine. The alkalinity of the salt may in some instances produce precipitation.

Carbonates of the alkalies precipitate many alkaloids from solutions of their salts.

Cyanides.—The alkaline cyanides may produce precipitates of an alkaloidal character from solutions of their salts.

Gold and sodium chloride is a general alkaloidal precipitant, producing insoluble double compounds with most of the alkaloids.

Hydroxides.—The fixed alkaline hydroxides as well as ammonia water precipitate free alkaloids from solutions of almost all of the salts of alkaloids.

Ichthyol.—The salts of alkaloids are precipitated from solution by ichthyol ir a resin like mass.

Iodides.—The soluble iodides form insoluble compounds with many alkaloids ; the combination with strychnine is especially dangerous. Alkalinity of the salt may sometimes account for the precipitation.

Iodine is a precipitant for most of the salts of alkaloids.

Mercuric chloride is a general alkaloidal precipitant, producing insoluble compounds.

Mercuric potassium iodide (Mayer's reagent) is a well known alkaloidal precipitant, producing insoluble combinations with almost all of the alkaloids or their salts.

Potassium dichromate will precipitate many alkaloidal salts, as morphine, strychnine, quinine, atropine, codeine, and hydrastine, if their solutions are sufficiently concentrated.

Salicylates.—The soluble salicylates, when added to an aqueous solution of quinine sulphate, produce insoluble quinine salicylate.

Sodium benzoate.—Quinine sulphate when not in too dilute solution is precipitated by sodium benzoate.

Solution of arsenous and mercuric iodides (Donovan's solution) is a general alkaloidal precipitant.

Solution of lead subacetate (Goulard's extract), and *lead acetate* precipitate most of the alkaloids as well as other plant principles from their aqueous solution, forming an insoluble compound.

Solution of potassium arsenite (Fowler's solution).—The solution being alkaline from an excess of potassium bicarbonate may precipitate alkaloids.

Tannic acid forms insoluble compounds with most of the alkaloids, and some glucosides and other plant principles.

5. *Precipitation of a weak acid from its salt by the addition of a stronger acid.*—This form of incompatibility is often encountered, particularly since the prescribing of salicylates has become so general.

℞ Sodii Salicyl. gr. xl
Acid. Citric. gr. xv
Syr. Limon. f℥ii
Aquæ q. s. ft. f℥iii

Salicylic acid is only slightly soluble in water, and citric acid added to sodium salicylate will decompose the latter, and cause the salicylic acid to be thrown out as a flocculent precipitate.

Benzoates.—The soluble benzoates are decomposed when in solution by strong acids, benzoic acid separating.

Salicylates.—The mineral acids and some organic acids liberate the but slightly soluble salicylic acid when added to solutions of the soluble salicylates.

6. *Separation of a gelatinous precipitate.*—Although gelatinization in prescriptions is often the result of physical dissociation, chemical decomposition sometimes accounts for this form of incompatibility. The following list shows some illustrations :

Gambir (*catechu*), as well as many other substances containing large amounts of tannin, as *kino*, *krameria*, *hematoxylon*, *geranium*, and *oak bark*, produce precipitates similar to those of tannic acid.

Phenol causes a gelatinous precipitate when added to solutions of gelatin, albumin, etc.

Tannic acid will produce a precipitate when added to solutions of gelatin, albumin, gluten, or starch.

II. Evolution of a gas.—Chemical action often results in the evolution of gaseous products, and this is often intentional and desirable, as in the exhibition of effervescing solutions, but many cases occur in practice where untoward results are experienced through the ignorance of the prescriber, and sometimes explosions with serious consequences have occurred.

This kind of chemical incompatibility may be considered under the following heads :

1. Liberation of carbon dioxide by the action of a stronger acid upon a carbonate. 2. Liberation of ammonia gas by the action of an alkali or alkaline salt upon an ammonium salt. 3. Explosive compounds produced by reducing or deoxidizing agents, or as the result of chemical action. 4. Reaction between strong acids and alcoholic solutions. 5. Reaction of esters upon tannin or similar principles. 6. Production of a gas having a disagreeable odor. 7. Liberation of gases due to chemical combination not included under the preceding heads.

1. *Liberation of carbon dioxide by the action of a stronger acid upon a carbonate.*—The intentional decomposition of an alkaline carbonate

by citric, tartaric, or acetic acid is very common, and most agreeable and successful febrifuge solutions are made in this way. Unlooked-for decomposition most frequently arises from the use of the vinegars or syrups containing acetic acid in the same prescription with alkaline carbonates, the presence of the acid being generally lost sight of by the prescriber. The following is a good example:

℞ Ammon. Carb. gr. xx
Ammon. Chlor. gr. xxx
Syr. Scillæ f℥i
Aquæ q. s. ft. f℥ii
Sig.—A half-teaspoonful as required.

Explosions have occurred in compounding this prescription, when the syrup of squill has been placed in the bottle and the solutions of the ammonium salts added, and the cork inserted securely. The only way to compound it safely would be to mix the solution of the ammonium salts with the diluted syrup of squill in a mortar, and to allow all the carbonic acid gas, produced by the action of the acetic acid in the syrup on the ammonium carbonate, to escape, assisting the evolution by stirring with the pestle.

Another example is appended, showing a form of incompatibility which is very common:

℞ Phenolis gr. xxv
Sodii Bicarb.
Sodii Borat. āā ʒi
Glycerini f℥i
Aquæ ad f℥iv

In this case the sodium borate is partially decomposed by the glycerin liberating some boric acid, which reacts upon the sodium bicarbonate, setting free carbon dioxide.

Inorganic acids, as well as *organic acids*, with the exception of hydrocyanic acid and hydrosulphuric acid (hydrogen sulphide), liberate carbon dioxide from carbonates or bicarbonates when in solution; carbonates are also decomposed by many of the acid salts of the metals.

2. *Liberation of ammonia gas by the action of an alkali or alkaline salt upon an ammonium salt.*—This form of incompatibility in prescriptions is not very common, and the liberation of ammonia gas is often hidden, because it is absorbed by the liquid present; but if an ammonium salt is rubbed in a mortar with a strong alkali, like sodium or potassium hydroxide, ammonia gas is at once liberated.

℞ Ammon. Chlor. ʒii
Potass. Bicarb. ʒiss
Mist. Glycyrrh. Comp. f℥iii

In this prescription free ammonia gas can be detected by tasting, although the odor may not at first be very perceptible.

3. *Explosive compounds produced by reducing or deoxidizing agents, or as the result of chemical action.*—Incompatibility of this kind is a frequently occurring form of decomposition. Permanganates, chlorates, etc., are deoxidized by glycerin, syrup, solutions of the hypophosphites and other liquids of this character, as in the following prescription:

℞ Potass. Permang. ʒss
Syr. Tolut.
Aquæ āā f℥i

Sometimes detonating chemical compounds are produced and serious injury may occur. The following prescription looks harmless, but one well versed in chemical knowledge would scent danger :

℞ Iodi ʒii
Lin. Camph. Comp. (B.P.)
Lin. Sapon. Comp. (B.P.) āā f℥i

Compound camphor liniment of the British Pharmacopœia contains 25 percent. of strong solution of ammonia, and nitrogen iodide would be found on the filter. This is a powerful explosive.

The following list may be of service in this connection :

Adrenaline.—Being a reducing agent, is incompatible with all reducible substances.

Chromium trioxide.—When added to strong alcohol, glycerin, ether, or volatile oils, or other substances that may be easily oxidized, is apt to cause fire or explosion.

Glycerin.—When rubbed with dry oxidizing agents, as potassium permanganate, potassium chlorate, etc., is apt to cause an explosion.

Iodine may combine with oil of turpentine with sufficient force to produce an explosion.

Nitric acid.—When mixed with strong sulphuric acid and glycerin produces nitroglycerin, a powerful explosive ; it also produces explosive compounds with cotton, or other forms of cellulose, and if mixed, when concentrated, with silver or mercuric nitrate and concentrated alcohol, explosive fulminate will be formed.

Sulphuric acid.—When mixed with chlorates produces an explosion.

4. *Reaction between strong acids and alcoholic solutions.*—This form of incompatibility is not rare, and it is sometimes attended with serious results. Strong acids react upon alcohol producing ethers or esters which often have low boiling points and are easily volatilized. The following prescription caused much trouble :

℞ Tinct. Nuc. Vomicæ f℥i
Acid. Nitromur. f℥ss
Misce

The pharmacist's assistant mixed the liquids, corked the bottle securely, and handed it to the messenger, who placed the bottle in his vest pocket, and, mounting his horse, galloped away toward home. The reaction soon set in, and he soon became conscious that all was not well, for the liquid was running out of the bottle, and he thought he had broken the latter ; he returned to the pharmacy and this time the assistant used a stronger bottle and a rubber cork, which was tied down securely. On his arrival at home, the lady who was to take a few drops of the mixture, cut the string, whereupon the accumulated gaseous products forced the cork out violently, and her eye was seriously injured.

5. *Reaction of esters upon tannin or similar principles.*—Prescriptions of the kind shown below have caused much trouble and speculation ; the reaction which occurs has never been satisfactorily explained. The nitrous radical in the spirit of nitrous ether undoubtedly slowly reacts upon the tannin in the fluidextract of uva ursi, and gas accumulates, which, if confined, results in explosion. Instances are on record where prescriptions containing fluidextract of buchu (alone), with spirit of nitrous ether, have produced an explosive mixture.

℞ Ext. Buchu. Fld. f℥ii
Ext. Uvæ Ursi Fld. f℥iiss
Spt. Ætheris Nitrosi f℥ss

Another illustration of a more complex character is appended. This liquid exploded violently five minutes after it was compounded.

℞ Quininæ Sulphat. ʒ i
Tinct. Rhei
Tinct. Capsici
Sp. Æth. Nitrosi
Liq. Arseni et Hydrarg. Iodidi
Syr. Ferri Iodidi āā f ℥ i
Spt. Frumenti
Aquæ āā f ℥ ii
Misce fiat solutio

6. *Production of a gas having a disagreeable odor.*—This form of incompatibility is occasionally met with. The disagreeable feature is one which would not be likely to lead to a repetition of the offence, for it makes a profound impression upon the patient and physician.

℞ Quininæ Sulph., gr. xl
Sodii Hyposulph. ʒ i
Acid. Sulph. Arom. f ʒ i
Aquæ q. s. ft. f ℥ iv

The acid in this prescription decomposed the sodium thiosulphate (hyposulphite), hydrogen sulphide being liberated and sulphur precipitated.

7. *Liberation of gases due to chemical combination not included under the preceding heads.*—Many illustrations of this kind of incompatibility could be furnished, but the following will show two forms of decomposition on one prescription :

℞ Aquæ Hydrogenii Diox. f ℥ ii
Potass. Permang. gr. xl
Aquæ f ℥ iv

Oxygen is liberated, both ingredients suffering in this respect. Solution of hydrogen dioxide usually contains sufficient free acid to effect decomposition. The solution will be decolorized at the same time.

The following illustrations of this form are given :

Hydrochloric acid.—When added to a chlorate liberates chlorine (see Liquor Chlori Compositus U. S. P.).

Solution of hydrogen dioxide.—Reduces potassium permanganate and is itself decomposed ; if sulphuric acid is present, oxygen is freely liberated. It is also decomposed by the following, yielding oxygen : some organic substances, manganese dioxide, sodium sulphate, potassium bromide, potassium chloride, and charcoal.

III. Change in color.—Under this head may be included the following : 1. Decolorization. 2. Inky compounds resulting from the action of ferric salts upon substances containing tannin. 3. Colors changed by acids or alkalies. 4. Colored solutions produced by chemical combination with synthetic substances. 5. Colored solutions produced by chemical action not included under the preceding heads.

1. *Decolorization.*—Decolorization is not always a fault, but it usually indicates chemical decomposition. In the case of iodine preparations intended to be used externally, it may be assumed that when

decolorization results, the value of the application is reduced to "nil," as shown in *colorless tincture of iodine*, which, as usually prepared, has been shown to be a solution of ammonium iodide with other salts. The solution does not have the properties of a solution of iodine in alcohol. The following prescription illustrates this:

℞ Iodi
Sod. Hyposulph. āā ʒ iiss
Aquæ f ʒ iii
Aq. Ammon. Fort. f ʒ ii
Alcohol. q. s. ft. f ℥ iv

An instance of decolorization may be cited in which the chemical action which results forms a desirable product. If equal parts of tincture of ferric chloride and diluted phosphoric acid are mixed together, the liquid should be clear and colorless if official liquids are used. This is due to the formation of ferric phosphate which is retained in solution.

2. *Inky compounds resulting from the action of ferric salts upon substances containing tannin.*—This form of incompatibility is not of such frequent occurrence as formerly. Physicians are, as a rule, careful to avoid such combinations. The following prescription is one of the usual type:

℞ Tinct. Ferri. Chloridi f ʒ ii
Tinct. Cinchon. Comp. f ℥ ii
Tinct. Gentianæ Comp. q. s. ad f ℥ iv

Tannic acid produces a dark blue-black color with solutions of most ferric salts, the depth of color depending upon the degree of concentration. The color of a solution of ferric phosphate is not changed by tannic acid. With ferrous salts, if pure, a white, gelatinous precipitate is first produced, which rapidly becomes blue through oxidation to ferric. Usually, the ferric salt is present, and a blue colored precipitate is produced at once.

Gambir (*catechu*), *kino*, *krameria*, *oak bark*, and other drugs containing a large percentage of tannic acid may be expected to produce reactions similar to tannic acid.

3. *Colors changed by acids or alkalies.*—Surprises are sometimes experienced when liquids containing coloring matters from the animal or vegetable kingdoms are brought into contact with acids or alkalies. Compound tincture of cardamom contains cochineal, and when this is used in prescriptions containing alkalies, the color is deepened. The following prescription caused some surprise when a green color was produced instead of a red, due to the action of the alkaline salts upon the coloring matter in the infusion of rose:

℞ Magnes. Carb. ʒ i
Magnes. Sulph. ℥ i
Glycerini f ʒ ss
Infus. Rosæ Acidi ad f ℥ viii

These color changes, as a rule, are harmless, but the pharmacist often has much difficulty in satisfying patients that the changes are due to causes which are natural.

4. *Colored solutions produced by chemical combination with synthetic substances.*—This is a frequent form of coloration, and the cause is usually difficult to explain, as the synthetic bodies are often complex in composition; in fact, so much complaint has been heard about

some of the color changes, when these are in solution, that many physicians prefer to always give them in substance. The following prescription has been the subject of much comment:

℞ Antipyrinæ ʒii
Spt. Æth. Nit. f ʒiv
Syrupi ad f ℥iv.

The green color produced is due to the formation of iso-nitroso-antipyrine. Experiments seem to show that the change does not produce poisonous compounds.

The following list shows some of these color changes:

Acetanilide.—In solution with spirit of nitrous ether produces a yellow color, changing to red in time. With tincture of ferric chloride a red color develops.

Antipyrine.—In solution with ferric chloride a red color is developed.

Resorcinol.—Solutions of resorcinol are colored violet by ferric chloride and by chlorinated lime or soda, the latter changing to yellow. Spirit of nitrous ether produces a dark red color.

Phenyl salicylate in alcoholic solution produces a violet color with ferric chloride if the latter is in dilute solution.

5. *Colored solutions produced by chemical action not included under the preceding heads.*—Prescriptions containing guaiac in solution, when brought into contact with oxidizing agents like nitric acid, spirit of nitrous ether, etc., are colored blue, or bluish green. The following prescription for rheumatism furnishes a good example:

℞ Potass. Nit. ʒv
Vin. Colch. Rad. f ʒv
Spt. Æth. Nit. f ℥ii
Tr. Guaiaci f ℥iii
Ol. Gaultheriæ f ʒss
Aquæ q. s. ad f ℥viii

Prescriptions containing salicylates with ferric salts always have a red color:

℞ Sodii Salicylat. ℥ss
Glycerini f ℥i
Ol. Gaultheriæ ♏xx
Tr. Ferri Chloridi f ℥ss
Spt. Ammon. Aromat. f ℥ii

The following list shows some of the more common color changes:

Hydrochloric acid produces with an alcoholic solution of myrrh a red to violet color.

Salicylic acid and salicylates, including oil of wintergreen, produce with ferric salts in solution a deep blue to violet red color.

Aloes or aloin, in solution, is colored almost black with ferric chloride and red with spirit of nitrous ether, the intensity of color depending upon the degree of concentration.

Starch.—Starch paste is colored blue by free iodine, the depth of color depending upon the concentration. This color is dissipated by heat, but returns upon cooling.

Solution of hydrogen dioxide and phenol darkens within a few hours, the phenol being oxidized.

Creosote in alcoholic solution produces a bluish green color with ferric chloride in alcoholic solution.

Guaiacol causes a similar color change with ferric chloride (see Creosote).

Guaiac.—The addition of oxidizing substances to an alcoholic solution of fresh guaiac resin will rapidly develop a blue color, changing to green and red; nitric acid, chromium trioxide, chlorine, potassium ferricyanide, potassium permanganate, ferric chloride, gold chloride, spirit of nitrous ether and others, will produce this effect. Mucilage of acacia also develops a blue color.

IV. Decomposition caused by chemical action producing heat.—When either iodine or bromine is added to some of the volatile oils, violent reaction, accompanied by heat, ensues; indeed, this fact has been used to detect adulterations, or prove the purity of some of the oils. The following prescription shows the effects of iodine on oil of turpentine.

℞ Iodi 5 Gm.
Alcohol 15 Cc.
Ol. Terebinth 100 Cc.

If the iodine is added to oil of turpentine, violent reaction occurs; if, however, it be dissolved in the alcohol, the solution slowly added to the oil, and the liquid cooled occasionally, the reaction is moderated.

V. Immiscible liquids formed by reaction between chemical substances.—This form is not common. The following prescription is interesting on this account:

℞ Potassii Bromid.
Chloral. Hydrat. āā ʒ v
Elixir Calisayæ f ℥ iv

A colorless layer made its appearance on the surface after standing a short time. Prof. Markoe determined that this colorless layer in prescriptions having potassium bromide and hydrated chloral in concentrated solutions in the presence of alcohol is due to the formation of chloral alcoholate. If the bottle is not shaken before taking, an overdose of the alcoholate may be swallowed, and, though not poisonous, it is quite irritating in its action.

PHYSICAL INCOMPATIBILITY OCCURRING IN LIQUIDS

Physical incompatibility may be defined as the condition arising from the admixture of pharmaceutical preparations which results in the *physical* dissociation of one or more constituents. It differs from chemical incompatibility by the absence of *chemical* action, and is often produced by adding one liquid or substance to another, which results in the precipitation of solid matter or the separation of a portion of liquid; hence the solubilities of substances in liquids and the relative solubilities of various liquids with one another determine to a very great extent the condition of physical incompatibility.

One important consideration that must be kept in view upon the general subject is whether the separated matter is *active*, or *important*, or whether it is *inert*.

Physical incompatibility resulting in the separation of active or important constituents.

This condition is one which usually demands skilful treatment. It is seen most frequently in the precipitation produced by mixing resinous tinctures or oily liquids with aqueous liquids, or alcoholic solutions containing volatile oils, chloroform, ether, or similar substances with aqueous liquids, or by the addition of acids to solutions containing quinine with a preparation of licorice. The addition of acacia, so as to form an emulsion with the resinous tincture and the aqueous liquid, is necessary in the first case, and will be considered under the head of emulsions. Aqueous liquids mixed with alcoholic solutions containing volatile oils can usually be made transparent by filtering them through an absorbent powder like magnesium carbonate, as in the case of the medicated waters or elixirs. A frequent source of doubt arises in the case of prescriptions like the following :

For Willie.
℞ Quininæ Sulph. gr. xxx
Acid. Sulph. Dil. q. s.
Fluidextract. Glycyrrh. f ʒ ii
Syrupi, f ℥ iv
Sig.—Give a teaspoonful three times a day.

The indications are clear that this is a quinine mixture intended for a child, and that the prescriber has directed the fluidextract of licorice with the view of making it more palatable. The habit of ordering acid in connection with quinine clings to him still, and in all probability he is not aware of the fact that the sweet principle of licorice, (glycyrrhizin), is precipitated by the acid, so that the object of using the preparation of licorice is entirely defeated by the addition of the acid. Solutions of quinine should be administered either as transparent liquids when the presence of acid is relied upon to effect the solution, or as mixtures with syrups or with thick liquids containing licorice ; in the latter case the object is to *prevent* solution as much as possible, and frequently a trace of solution of potassium hydroxide is added, with this end in view,—the principle being, that the smaller the quantity of *dissolved* quinine present in the liquid the less bitter will be the taste. The mixture should be thoroughly shaken before administration.

Physical incompatibility resulting in the separation of inert constituents. This condition is most frequently seen when fluidextracts are diluted with liquids which differ in composition from those used in making the fluidextract, such as alcohol, diluted alcohol, syrup, aqueous liquids, etc. The gummy, albuminous, resinous, or mucilaginous constituents are often thrown out of solution. After proving that the precipitate is inert, the remedy is simple in such cases, and filtration is all that is necessary.

With the object of classifying the different forms, the subject may be considered under the following heads : Physical incompatibility which results in I. Precipitation. II. Immiscibility. III. Incomplete solution. IV. Gelatinization. V. Cloudiness due to the separation of volatile oil from its solution in aqueous liquids.

I. Precipitation.—Under this head will be considered : 1. The separation of a precipitate due to difference in menstrua. 2. The separation of a precipitate due to difference in solvents.

1. *The separation of a precipitate due to difference in menstrua.*—This is a very frequent form of physical incompatibility. Frequently the dispenser will be required, in compounding prescriptions, to mix two or more galenical preparations which have been made by extracting drugs with alcoholic menstrua, but the strength of the alcohol has not been the same in each. In most instances some constituents will be precipitated, owing to their insolubility in the alcoholic liquid formed by the mixture of the combined liquids. The precipitate may

consist of active substances, and its character must determine the course taken by the dispenser in attempting to correct the incompatibility. Frequently the adding of small amounts of glycerin or syrup will prevent precipitation or dissolve a precipitate which may have formed ; or, on the other hand, the use of mucilage of acacia or some binding agent may be indicated to uniformly suspend the separated matter.

The following examples may serve to illustrate this form :

℞ Tinct. Cannabis Ind.
Tinct. Aurantii Amar. āā f ℥i
Tinct. Rhei f ℥ii
Misce

In this case it will be most satisfactory to use some acacia to make a homogeneous mixture, because the resinous matter from the tincture of cannabis indica is active.

℞ Tinct. Nuc. Vomicæ, f ℥ss
Inf. Gentianæ Comp. f ℥iiss
Tinct. Cinchonæ Comp. f ℥iii

In this case the precipitate is composed of inert constituents, mainly gummy and mucilaginous substances, which may be filtered out.

2. *Separation of a precipitate due to difference in solvents.*—This form furnishes constant annoyance to the pharmacist. The following prescription affords a good type :

℞ Magnes. Sulph. ℥i
Tinct. Zingib. f ℥i
Tinct. Aurantii Dulc. f ℥i
Aquæ Menth. Pip. f ℥ii

Magnesium sulphate will dissolve in peppermint water, and if the solution be poured into a bottle and the tinctures then added, a mass of crystals of magnesium sulphate will separate, due to their insolubility in alcoholic liquids. The prescription is really unfit for administration.

Mucilage of Acacia.—If alcohol or alcoholic solutions be added to this mucilage, the acacia, being insoluble, will be precipitated. Dilution with water, of either the mucilage or the alcohol, will prevent precipitation.

Alcohol.—Albumin, acacia (as has already been mentioned), and many chemical salts, in aqueous solutions, are precipitated by the addition of alcohol or alcoholic preparations, owing to their insolubility in hydro-alcoholic solution.

Water.—When alcohol has been used as the solvent for many substances, such as free alkaloids, glucosides, neutral or bitter principles, salicylic or benzoic acids, volatile oils, resins, oleoresins, balsams, or camphors, the addition of water or aqueous liquids to the alcoholic solutions will cause complete or partial separation of the dissolved substances, owing to their insolubility in hydro-alcoholic liquids ; the amount of separation depending upon the degree of dilution.

II. Immiscibility.—It is impossible to expect physicians to always remember the physical characters of all solids and liquids that they desire to use in prescriptions, and the pharmacist is repeatedly called upon to harmonize discordant elements. When the intention of the prescriber can be fathomed, or when he can be consulted, a way out of the difficulty can generally be devised. No general plan can be laid down to meet all conditions. Often the addition of a little alcohol, glycerin, or water will suffice ; sometimes a binding agent like acacia must be used; in every case where any important change is necessary the physician should be notified, and the dose altered to suit the case. The following metric prescription affords an illustration of a gross fault:

℞ Bromoformi 2
Syrupi 20
Aq. Foeniculi 40

In this case sufficient alcohol should be used to replace a portion of the water, or a better plan would be emulsification with mucilage of tragacanth and a little oil of almond.

III. Incomplete Solution.—Probably no form of incompatibility occurs more frequently than this, and the problem that at once presents itself is, shall the prescription be filtered, some addition made, or dispensed with a "shake label"? This question is considered upon page 1151, under the paragraph, "When to filter." The following prescription furnishes a good example:

℞ Ferri Phosph. ʒiss
Quininæ Sulph. ʒi
Strychninæ gr. i
Acid. Phos. Dil. fʒiii
Syr. Aurantii f℥ii
Spt. Frumenti q. s. ad f℥vi

Official ferric phosphate, while soluble in aqueous liquids, cannot be dissolved in alcohol, and whisky usually contains sufficient of the latter to prevent the complete solution of all of the solid ingredients in this prescription.

IV. Gelatinization.—This form of incompatibility is not rare, and very often annoys the dispenser. Mucilage of acacia is frequently used to obtund the taste of saline substances, but when used in combination with a number of solutions it forms gelatinous liquids. It has been shown that gelatinization sometimes occurs in prescriptions containing galenical preparations, due to the presence of an enzyme, as in the case of tincture of kino (see page 355). In these cases the gelatinization occurs only after the prescription has been compounded several days, and the patient may return the prescription with the statement that the liquid cannot be poured out of the bottle. The following prescription illustrates the action of sodium borate on mucilage of acacia:

℞ Sodii Brom. ʒii
Sodii Borat. ʒiii
Muc. Acaciæ f℥ii
Aq. Camph. f℥i
Aquæ q. s. ft. f℥viii.

Further illustrations are appended.

Acacia.—The mucilage is gelatinized by the solution and tincture of ferric chloride, solutions of ferric sulphate, ferric subsulphate, and iron and ammonium acetate, if they are added in concentrated form. A saturated solution of sodium borate, and solution of lead subacetate likewise produce gelatinization. If the mucilage be diluted with several volumes of water or the addition of small amounts of glycerin or syrup, gelatinization may in most instances be prevented.

V. Cloudiness due to the separation of volatile oil from its solution in aqueous liquids.—Under this head is included a form of incompatibility which is often seen. The lack of transparency in liquid prescriptions may be due to the separation of very slight precipitates of various kinds. These are considered in the previous pages, but cloudiness is often due to the separation of a volatile oil or allied product from an aromatic or medicated water, when a very soluble salt is dissolved in such waters in sufficient quantity. It must be remembered that medicated waters are intended to be saturated solutions of oils or allied products in water. The following prescription illustrates this :

℞ Potassii Brom. ʒiv
Aq. Menth. Pip. f℥i
M. ft. solutio

There would be no objection in cases of this kind to using half the quantity of the medicated water and diluting it with an equal volume of water, as it is very difficult to "filter out the cloudiness."

INCOMPATIBILITY IN SOLIDS

This subject has not been considered in the previous editions of this work under a separate head, but inasmuch as there are many forms of incompatibility in solid pharmaceutical preparations in which the problems are similar to those occurring in liquids, and as the chapters on solid extemporaneous preparations immediately follow this, it was believed that the subject should be inserted here.

Incompatibility will be considered as occurring in various forms in powders, troches, capsules, pills, suppositories, cerates, ointments, and plasters.

CHEMICAL INCOMPATIBILITY IN SOLID PREPARATIONS

This subject will be treated under the following sub-divisions: I. Chemical decomposition producing insoluble compounds. II. Evolution of a gas. III. Development of a change in color. IV. Mixtures of solids apt to explode during trituration. V. Liberation of water of crystallization due to chemical action.

I. Chemical decomposition producing insoluble compounds.—In powders this form rarely causes trouble for the pharmacist. Owing to the substances being in a dry condition, chemical action is limited. In troches and pills there may be cases in which insoluble compounds are produced, as the liquids necessary to form a mass may be in sufficient quantity to facilitate chemical decomposition. In suppositories, cerates, and ointments, the production of insoluble compounds due to chemical action is often in evidence. Judgment, skill, and experience should be used by the compounder to avert bad results; by enveloping separately the active agents in a small portion of the fatty vehicle and incorporating this with the rest of the ingredients, good results may be attained.

℞ Ichthyolis, ʒi
Morph. Sulph. gr. xii
Ac. Tannici ʒii
Ol. Theobromatis ℥iss
Fiat. suppos. No. xxiv

If moulded suppositories are made there is danger, in heating the mass, of throwing out an insoluble compound. They can, however, be made by a cold process by hand, by rubbing the ichthyol and tannic acid separately with a portion of the vehicle and mixing this with the other ingredients.

II. Evolution of a Gas.—In preparing powders where there is a liability of gas being evolved, as in the effervescent powders, care should be taken to dry the ingredients thoroughly and prevent access of moisture by using waxed paper for each powder. Ammonium salts should not be rubbed with alkaline salts, or a portion of ammonia gas will be evolved. In preparing capsules or pills, liberation of carbon dioxide may be illustrated by the following prescription:

℞ Sodii Bicarb.
Hydrarg. Chlor. Mit., āā gr. v
Ext. Rham. Pursh. gr. xv
Aloes Pulv. gr. iv
Ft. pil. No. x

The acid resins in the extract will react on the sodium bicarbonate, and cause an evolution of gas with subsequent swelling of the pills.

In suppositories, an illustration is afforded in the preparation of glycerin suppositories. If the mass is not heated gently to prevent the escape of carbon dioxide produced by the reaction between the stearic acid and sodium carbonate, the suppositories will be opaque instead of translucent. In cerates and ointments an example is furnished by citrine ointment, where, if the ointment is cooled before the reaction is completed, a porous, spongy product results.

III. Development of a change in color.—Probably the most frequent instance of this form, occurring in powders, pills, and capsules, is that of the change in color of calomel when mixed with alkaline salts and other bodies. A portion of the calomel is reduced to metallic mercury, which causes a darkening. In ointments, when potassium iodide is prescribed in combination with acids or acid salts, discoloration is due to the partial decomposition of the potassium iodide with liberation of iodine. Rancid lard, when used as a vehicle, will often cause slight decomposition of the potassium iodide and a change in color. The process for the official ointment of potassium iodide guards against darkening by using a small quantity of potassium carbonate. Unprotected steel spatulas should not be used in preparing ointments containing tannic acid, owing to the danger of producing a darkening in color in the product due to the formation of the inky ferric tannate. Steel spatulas should not be used with ointments which contain acids like citrine ointment or with any substance which acts upon iron, like iodine. The following prescription shows the reducing action of a hypophosphite upon a salt of bismuth with the production of a yellow color, passing to brown and then to black, the reaction occurring in the presence of moisture, which is almost always present in the hypophosphites:

℞ Bismuthi Subnit. ʒi
Potass. Hypophosph. ʒss
Pepsinæ, ʒi
M. fiat chart. No. xii

Yellow Mercuric Oxide.—The ointment darkens if kept for some time, due to reduction to other oxides or metallic mercury. Reducing agents rubbed with it will also produce this effect.

Red Mercuric Oxide.—Its incompatibilities in the ointment are similiar to those of the yellow oxide

Potassium hypophosphites and other hypophosphites when rubbed with calomel cause it to turn dark at once from reduction to metallic mercury. Calomel is also said to be reduced in the presence of moisture by cocaine, pilocarpine, antipyrine (especially in the presence of sugar), cane sugar, and milk sugar. It has been suggested that some mercuric chloride is formed.

IV. Mixtures of Solids apt to explode during trituration.—Many illustrations can be given of this kind of incompatibility. The trituration of substances, which readily part with oxygen, with reducing agents constitutes the most frequent cause of trouble, and serious accidents have occurred. In the compounding of powders, capsules, troches, and pills, especial watchfulness is necessary. Illustrations are appended :

℞ Potass. Chlor.
Ac. Tannici, āā ʒii
Ft. chart. No. iv

℞ Sulph. Præcip. ʒi
Argent. Oxidi gr. xii
Ft. chart. No. xii

℞ Argent. Nit. gr. xii
Creosoti gtt. xxiv
Ft. pil. No. xxiv

Explosion can sometimes be avoided or postponed by powdering each ingredient separately and mingling carefully the powders upon a piece of paper, but the dispenser, by this method, runs even a greater risk through explosion taking place at the house of the patient. The safe plan is to decline to compound such mixtures.

The following illustrates some dangerous combinations :

Chlorates.—When triturated or heated with the following substances may cause an explosion : sulphur, tannic acid, sulphides, sulphites, cyanides, hyposulphites, hypophosphites, nitrites, iodine, phenol, charcoal, sugar, honey, glycerin, and many other oxidizable substances.

Potassium cyanide, when rubbed with potassium nitrate or chlorate, is apt to produce a violent explosion.

Potassium nitrate produces readily oxidizable compounds, which may explode, if mixed with sulphur, charcoal, phosphorus, sugar, or sulphides.

Potassium Permanganate.—When triturated with readily oxidizable substances, as sulphur, the hypophosphites, charcoal, sugar, glycerin, etc., is apt to occasion an explosion.

Silver nitrate, with many organic substances, as glucose, aromatic oils, tartrate, creosote, etc., is oxidized, being changed to metallic silver, oftentimes with explosive violence.

Silver oxide produces an explosive mixture with many substances, as sulphur, tannic acid, creosote, and many organic substances.

V. Liberation of water of crystallization due to chemical action.—The development of moisture during the preparation of powders, capsules, and pills, due to the liberation of water of crystallization in one or more of the ingredients, is often an annoying form of incompatibility. The following prescription is given as an illustration :

℞ Lithii Citrat. gr. xxx
Sodii Phosph. ʒi
Ft. chart. No. x

When these salts are reduced to powder, a portion of the water of crystallization in the sodium phosphate is liberated, lithium phosphate and sodium citrate being formed as a result of the partial decomposition.

PHYSICAL INCOMPATIBILITY OCCURRING IN SOLIDS

Physical incompatibility in solid preparations may be defined as the condition arising from the admixture of medicinal substances in prescriptions, which makes the product unfit or unsuited for administration in the form prescribed by the physician. Much annoyance is often experienced by the pharmacist, caused by the ignorance of the physician as to the physical properties of the substances prescribed. Since the introduction of the flood of synthetics, the exploiters of many of the new products, recognizing the condition, issue descriptive circulars or pamphlets explaining the best methods of dispensing their wares. Judgment, skill, knowledge, and experience must all be brought into use to successfully cope with these. It is needless to say that some prescriptions must be returned to the physician for modification, but the fully equipped pharmacist may often find a means of overcoming the difficulties. It will be impossible to indicate here more than the most frequent forms. They will be considered under the following heads: I. Development of excessive moisture. II. Combinations resulting in products of a consistence unfitted for dispensing in the form prescribed. III. Immiscibility. IV. Lack of desired adhesiveness,

I. Development of excessive moisture.—This form is very annoying when powders are to be compounded, especially when the amount of developed moisture is so great as to make nearly liquid products, as in the combination of hydrated chloral and camphor. When the powders are merely damp they can be folded in waxed paper. Sometimes inert absorbent powders may be incorporated so as to permit the dispensing of the product. It is better, however, for the physician to avoid complications by directing the offending ingredient to be dispensed separately. The liberation of water of crystallization has been considered on page 1180. In making pills and capsules the development of excessive moisture can usually be offset by the addition of a "filler" of inert absorbent powder. This can also be done occasionally in the case of powders. Illustration:

℞ Phenacetin. gr. xv
Camphoræ gr. v
Phenyl. Salicyl. gr. xv
Ft. chart. No. x

Illustrations of combinations to be avoided:

Acetanilide.—When triturated with phenol, resorcinol, or thymol, a liquid or wet mass is produced; with hydrated chloral only dampness occurs.

Antipyrine, triturated with crystals of phenol, produces a liquid which is odorless and is known as phenopyrin; when rubbed with hydrated chloral, they form a liquid. A moist mass or a liquid (depending upon conditions) results from its trituration with sodium salicylate. A liquid results from its trituration with the following: acetanilide, pyrogallol, resorcinol, thymol, or ethyl carbamate.

Betanaphthol produces a damp powder or mass or a liquid when triturated with antipyrine, camphor, phenol, exalgin, menthol, or ethyl carbamate.

Camphor, menthol, resorcinol, and *phenyl salicylate* (*salol*), when rubbed with each other in about equal proportions, or when mixed with about equal weights of phenol, hydrated chloral, betanaphthol, pyrogallol, thymol, or ethyl carbamate (urethane) will produce a soft mass or liquid.

Diuretin (sodio-theobromine salicylate), when triturated with phenol or hydrated chloral, forms a liquid.

Exalgin (methyl acetanilide) produces a liquid or soft mass under conditions similar to those of camphor.

Phenacetin (acetphenetidin), when triturated with phenol or hydrated chloral, will produce a liquid.

Salicylic acid produces a damp powder or a liquid when rubbed with exalgin, lead acetate, sodium phosphate, or ethyl carbamate.

Sulphonal, when triturated with hydrated chloral, produces a liquid.

Trional, when triturated with hydrated chloral or phenyl salicylate, produces a liquid.

II. Combinations resulting in products of a consistence unfitted for dispensing in the form prescribed.—The consistence of pills, capsule masses, cerates, ointments, suppositories, or plasters, is a very important physical condition, which, if not duly taken into account, may defeat the object desired by the physician. It is necessary for the pharmacist to know, as soon as he glances at the prescription, whether the pill or capsule ordered contains too much liquid to permit incorporation so that it can be made into a pill or capsule ; or whether a cerate or an ointment, when made as directed by the prescription, will be too hard or too soft ; or whether a suppository will be too soft to retain its form or too hard to be of any use whatever. Lastly, a plaster may be ordered which cannot be made to adhere to the skin (see illustrations below).

℞ Ext. Ergotæ gr. xxx
Ol. Erigeron. gtt. x
Misce ft. pil. No. x

℞ Gallæ pulv. ʒii
Opii. pulv. ʒi
Cerati, ʒv
Misce ft. unguent.
Use at bedtime.

℞ Ung. Stramonii ʒiv
Glycerit. Ac. Tannici ʒii
Misce ft. unguent.

℞ Ext. Opii gr. i
Phenolis gr. xxiv
Salolis ʒss
Ol. Theobrom. ʒiii
Ft. suppos. No. xii

The pills can be made by using sufficient powdered althea to absorb the excess of liquid. The first ointment is fitted for a pile ointment after being softened by using a small quantity of oil of sweet almond ; the second ointment will be too soft, and the physician should direct the glycerite to be replaced by tannic acid and a little glycerin ; the suppository will be too soft to handle conveniently.

III. Immiscibility.—This form of incompatibility is frequently found, and considerable difficulty will be encountered in successfully dealing with it. Oil and water can be compelled to associate together through emulsification, and in making masses, suppositories, cerates, and ointments it is possible to incorporate considerable water ; but prescriptions are sometimes presented which defy combination unless recourse is had to undesirable expedients.

℞ Ferri Citrat. ʒi
Quin. Sulph. gr. xii
Ol. Carui gtt. xxx.
Misce ft. pil. No. xii

℞ Liq. Plumb. subacet. ʒi
Petrolati ʒiii
Misce ft. unguentum

In this pill, which is large, if sufficient "filler" is added, they become boluses, and if the ointment is compounded as directed, the liquid may be combined to pass the final inspection of the pharmacist only to be returned by the patient, for upon standing the liquids will separate.

IV. Lack of desired adhesiveness.—This kind of incompatibility is not so common as many of the previous forms. In pills and capsule masses, a little mucilage of acacia or other binding agent may be used. In suppositories, to prevent crumbling, a little bland of fixed oil may be employed. Whenever additions are made, the rule must be remembered : nothing should be used except inert substances, for the operator must not interfere with the obvious intention of the prescriber.

THERAPEUTICAL INCOMPATIBILITY

Therapeutical incompatibility may be defined as the condition arising from the combination of remedies which are mutually opposed to one another in therapeutical effect. This form of incompatibility does not often require the aid of the pharmacist. It results from an injudicious combination of remedial agents, and the correction of the fault lies solely within the province of the physician.

But some knowledge of therapeutics is necessary for the pharmacist, if he is required to recognize when he is combining agents which are antagonistic. It does not follow, of course, that the physician does not know that he is prescribing substances which are theoretically incompatible. For these reasons the pharmacist should be very careful in diagnosing a case of therapeutical incompatibility. An illustration of the combination of therapeutic antagonists is given below :

℞ Atropinæ Sulph. gr. ⅛
Morphinæ Sulph. gr. ii
Aquæ Dest. f ℥ii
Misce ft. solutio
Sig.—For hypodermic use.

This prescription is frequently ordered with excellent results.

The following list is appended, with the view of offering suggestions of what should be avoided :

Aloes.—Its cathartic principle, emodin, is decomposed and rendered inert by the action of alkalies in excess.

Pepsin is rendered inactive by alkaline substances ; its action is retarded in the presence of strong alcohol.

Pancreatin.—Acids destroy the activity of this enzymatic body.

Spirit of nitroglycerin is decomposed in the presence of alkalies and carbonates, forming glycerin and nitrates.

CHAPTER LXVII

SOLID EXTEMPORANEOUS PREPARATIONS

Powders, Cachets, Troches, Pills, and Suppositories

Pulveres *Powders*

POWDERS often furnish a convenient and agreeable mode of administering medicines which are not bitter, nauseous, or otherwise offensive to the taste, are not corrosive, nor deliquescent, nor given in large doses. Pulverization facilitates the solution or the extraction of the soluble principles of a substance by extending the surface exposed to the action of the solvent. (See Comminution, page 168.) With the view of establishing a standard and encouraging uniform practice in prescribing certain forms of powders which have become well known, a limited number of compound powders have been admitted to the Pharmacopœia. The following tables give in a condensed form the processes for official and some unofficial powders, and immediately after these will be found the working formulas.

Official Powders

Pulvis Acetanilidi Compositus	Made by powdering and thoroughly mixing 70 Gm. of Acetanilide, 10 Gm. of Caffeine, and 20 Gm. of Sodium Bicarbonate
Aromaticus	Made by triturating 15 Gm. each of Cardamom (freed from the pericarps) and Myristica, in coarse powder, with a portion of the 35 Gm. of Saigon Cinnamon, until the whole is finely powdered, then adding the remainder of the Saigon Cinnamon and 35 Gm. of powdered Ginger and thoroughly mixing
Cretæ Compositus	Made by intimately mixing 30 Gm. of Prepared Chalk, 20 Gm. of powdered Acacia, and 50 Gm. of powdered Sugar
Effervescens Compositus	Made by intimately mixing 31 Gm. of Sodium Bicarbonate and 93 Gm. of Potassium and Sodium Tartrate, dividing the mixture into 12 equal parts and wrapping each part in a separate blue paper, then dividing 27 Gm. of Tartaric Acid into 12 equal parts and wrapping each in a separate white paper. All powders should be dry and finely powdered
Glycyrrhizæ Compositus	Made by thoroughly triturating 4 Gm. of Oil of Fennel with 250 Gm. of powdered Sugar, then adding 250 Gm. more of the Sugar, 180 Gm. of powdered Senna, 236 Gm. of powdered Glycyrrhiza, and 80 Gm. of Washed Sulphur, and mixing the whole intimately
Ipecacuanhæ et Opii	Made by finely powdering and intimately mixing 10 Gm. of Ipecac, 10 Gm. of Powdered Opium, and 80 Gm. of Sugar of Milk
Jalapæ Compositus	Made by thoroughly mixing 35 Gm. of powdered Jalap and 65 Gm. of powdered Potassium Bitartrate
Morphinæ Compositus	Made by triturating 1.5 Gm. of Morphine Sulphate with 33.5 Gm. of Precipitated Calcium Carbonate, until they are thoroughly mixed, then powdering 32 Gm. of Camphor with the aid of a little Alcohol, and intimately mixing the triturate first prepared with the powdered Camphor and 33 Gm. of powdered Glycyrrhiza
Rhei Compositus	Made by thoroughly mixing 25 Gm. of powdered Rhubarb, 65 Gm. of Magnesium Oxide, and 10 Gm. of powdered Ginger

Unofficial Powders

Name	Ingredients	Preparation
Pulvis Amygdalæ Compositus. Br.	200 Gm. Sweet Almonds; 100 Gm. powdered Sugar; 25 Gm. powdered Gum Acacia	Blanch the Almonds, dry them thoroughly with the aid of a gentle heat, then triturate them in a mortar to a smooth paste, add the Gum Acacia and Sugar, and rub the whole to a uniformly coarse powder
Antimonialis. U. S. P. 1890	33 Gm. Antimony Oxide; 67 Gm. Precipitated Calcium Phosphate	Mix them intimately
Catechu Compositus. Br.	100 Gm. powdered Catechu; 50 Gm. powdered Kino; 50 Gm. powdered Krameria Root; 25 Gm. powdered Cinnamon Bark; 25 Gm. powdered Nutmeg	Mix them
Cretæ Aromaticus. Br.	80 Gm. Cinnamon Bark; 60 Gm. Nutmeg; 30 Gm. Cloves; 20 Gm. Cardamom Seeds; 500 Gm. Sugar; 220 Gm. Prepared Chalk, all in fine powder	Mix them
Cretæ Aromaticus cum Opio. Br.	39 Gm. Aromatic Powder of Chalk; 1 Gm. powdered Opium	Mix them
Elaterini Compositus. Br.	1 Gm. Elaterin; 39 Gm. Milk Sugar	Triturate them, in a mortar, until a fine powder is produced
Kino Compositus. Br.	75 Gm. Kino; 5 Gm. Opium; 20 Gm. Cinnamon Bark, all in powder	Mix them
Opii Compositus. Br.	30 Gm. Opium; 40 Gm. Black Pepper; 100 Gm. Ginger; 120 Gm. Caraway Fruit; 10 Gm. Tragacanth, all in powder	Mix them
Scammonii Compositus. Br.	100 Gm. Scammony Resin; 75 Gm. Jalap; 25 Gm. Ginger, all in powder	Mix them
Tragacanthæ Compositus. Br.	25 Gm. Tragacanth; 25 Gm. Gum Acacia; 25 Gm. Starch; 75 Gm. Sugar, all in powder	Mix them

PULVIS ACETANILIDI COMPOSITUS. U. S. Compound Acetanilide Powder

	Metric	Old form
***Acetanilide**	**70 Gm.**	2 oz. av. 350 gr.
Caffeine	**10 Gm.**	175 grains
Sodium Bicarbonate	**20 Gm.**	350 grains
To make	**100 Gm.**	4 oz. av.

Reduce the ingredients separately to a fine powder and mix them thoroughly.

This powder is used as an analgesic often in the treatment of headache.

Average dose.—8 grains (0.500 Gm.).

PULVIS AROMATICUS. U. S. Aromatic Powder

	Metric	Old form
***Saigon Cinnamon,** in No. 60 powder	**35 Gm.**	7 oz. av.
Ginger, in No. 60 powder	**35 Gm.**	7 oz. av.
Cardamom, deprived of pericarps and crushed	**15 Gm.**	3 oz. av.
Myristica, in No. 20 powder	**15 Gm.**	3 oz. av.
To make	**100 Gm.**	20 oz. av.

Triturate the Cardamom and Myristica with a portion of the Saigon Cinnamon, until they are reduced to a fine powder; then add the remainder of the Saigon Cinnamon and the Ginger, and rub them together until they are thoroughly mixed. This powder is used in making Aromatic Fluidextract (see page 383).

Average dose.—15 grains (1 Gm.).

PULVIS CRETÆ COMPOSITUS. U. S. Compound Chalk Powder

	Metric	Old form
* **Prepared Chalk**	30 Gm.	1½ oz. av.
Acacia, in fine powder	20 Gm.	1 oz. av.
Sugar, in fine powder	50 Gm.	2½ oz. av.
To make	100 Gm.	5 oz. av.

Mix intimately. This powder is used in making Chalk Mixture (see page 305).

Average dose.—30 grains (2 Gm.).

PULVIS EFFERVESCENS COMPOSITUS. U. S. Compound Effervescing Powder

[SEIDLITZ POWDERS]

	Metric	Old form
* **Sodium Bicarbonate,** dried and in fine powder	31 Gm.	480 grains
Potassium and Sodium Tartrate, dried and in fine powder	93 Gm.	3 oz. av. 125 gr.
Tartaric Acid, dried and in fine powder	27 Gm.	420 grains

Mix the Sodium Bicarbonate intimately with the Potassium and Sodium Tartrate, divide the mixture into *12 equal parts,* and wrap each part in a separate *blue* paper.

Then divide the Tartaric Acid into *12 equal parts,* and wrap each part in a separate *white* paper.

Keep the powders in well-closed containers, in a dry place.

These powders are aperient and refrigerant.

Average dose.—1 set of two powders.

PULVIS GLYCYRRHIZÆ COMPOSITUS. U. S. Compound Powder of Glycyrrhiza

[COMPOUND LICORICE POWDER]

	Metric	Old form
* **Senna,** in No. 80 powder	180 Gm.	315 grains
Glycyrrhiza, in No. 80 powder	236 Gm.	413 grains
Washed Sulphur	80 Gm.	140 grains
Oil of Fennel	4 Gm.	5 minims
Sugar, in fine powder	500 Gm.	2 oz. av.
To make	1000 Gm.	4 oz. av.

Mix the Oil of Fennel thoroughly with about one-half of the Sugar, then add the remainder of the Sugar and the other ingredients, and mix thoroughly. Finally, pass the powder through a No. 80 sieve, pulverize the residue if any should be left on the sieve, add to the sifted powder, and mix thoroughly. Keep it in well-closed vessels.

This powder is an agreeable laxative.

Average dose.—60 grains (4 Gm.).

PULVIS IPECACUANHÆ ET OPII. U. S. Powder of Ipecac and Opium

[Compound Powder of Ipecac Dover's Powder]

	Metric	Old form
* **Ipecac,** in No. 60 powder	10 Gm.	175 grains
Powdered Opium	10 Gm.	175 grains
Sugar of Milk, in No. 30 powder	80 Gm.	1400 grains
To make	100 Gm.	4 oz. av.

Triturate them together thoroughly and reduce to a very fine powder.

This powder is anodyne and diaphoretic.

Average dose.—8 grains (0.500 Gm.).

PULVIS JALAPÆ COMPOSITUS. U. S. Compound Powder of Jalap

[Pulvis Purgans]

	Metric	Old form
* **Jalap,** in No. 60 powder	35 Gm.	1 oz. av. 176 gr.
Potassium Bitartrate, in fine powder	65 Gm.	2 oz. av. 262 gr.
To make	100 Gm.	4 oz. av.

Rub them together until they are thoroughly mixed.

Compound Powder of Jalap is a hydragogue cathartic.

Average dose.—30 grains (2 Gm.).

PULVIS MORPHINÆ COMPOSITUS. U.S. Compound Powder of Morphine

[Tully's Powder]

	Metric	Old form
* **Morphine Sulphate**	1.5 Gm.	6½ grains
Camphor	32.0 Gm.	140 grains
Glycyrrhiza, in No. 80 powder	33.0 Gm.	144 grains
Precipitated Calcium Carbonate	33.5 Gm.	147 grains
Alcohol, a sufficient quantity,		
To make	100 Gm.	1 oz. av.

Rub the Morphine Sulphate with the Precipitated Calcium Carbonate, added in portions of about 5 *grammes* [old form 20 grains] each, until it is thoroughly mixed, then rub the Camphor with a little Alcohol until it is reduced to a powder, and mix intimately with the Glycyrrhiza and the other powders. Finally, pass the powder through a No. 40 sieve, pulverize the residue if any should be left on the sieve, add to the sifted powder, and mix thoroughly. Transfer it to well-stoppered bottles.

This powder is anodyne and diaphoretic.

Average dose.—8 grains (0.500 Gm.).

PULVIS RHEI COMPOSITUS. U.S. Compound Powder of Rhubarb

	Metric	Old form
* **Rhubarb,** in No. 60 powder	25 Gm.	1 oz. av.
Magnesium Oxide	65 Gm.	2 oz. av. 263 gr
Ginger, in No. 60 powder	10 Gm.	175 grains
To make	100 Gm.	4 oz. av.

Rub the Rhubarb and Ginger together, and finally the Magnesium Oxide, gradually added, until they are thoroughly mixed.

This powder, sometimes known as *Gregory's powder*, is used as a laxative and antacid.

Average dose.—30 grains (2 Gm.).

Triturationes *Triturations*

Triturations constitute a very small class of powders recognized by the Pharmacopœia, but one trituration being official. The intention of forming them into a distinct class is to fix a definite relation between the active ingredient and the diluent. Unless otherwise directed, Triturations are to be prepared according to the following formula:

Take of	Metric	Old form
* **The Substance**	10 Gm.	6 grains
Sugar of Milk, in moderately fine powder	90 Gm.	54 grains
To make	100 Gm.	60 grains

Weigh the Substance and the Sugar of Milk, separately; then place the Substance, previously reduced, if necessary, to a moderately fine powder, in a mortar; add about an equal measure of Sugar of Milk, mix well by means of a spatula, and triturate the powders thoroughly together. Then add fresh portions of the Sugar of Milk, from time to time, until the whole is added, and continue the trituration after each addition until the Substance is intimately mixed with the Sugar of Milk and reduced to a fine powder.

TRITURATIO ELATERINI. U.S. Trituration of Elaterin

	Metric	Old form
* **Elaterin**	10 Gm.	6 grains
Sugar of Milk, in moderately fine powder	90 Gm.	54 grains
To make	100 Gm.	60 grains

Mix them thoroughly by trituration.

This trituration is used to replace elaterium, which is often deficient in quality. It is an efficient purgative.

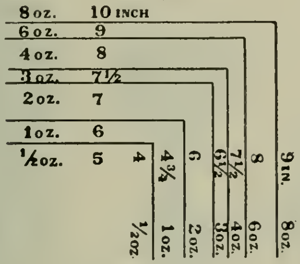
Average dose.—$\frac{1}{2}$ grain (0.030 Gm.).

DISPENSING OF POWDERS AND SOLIDS

Many of the manipulations required in dispensing powders and solids, such as weighing, measuring, labelling, etc., have been described in previous chapters; therefore only those operations which are peculiar to them, or which have not been considered, will be treated in this chapter.

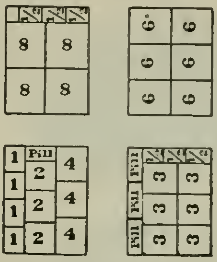
Folding Packages.—This is one of the first operations taught to the tyro. White paper, of good quality, should be used. It is most economical to buy the paper in quantity (several reams) and have it cut by the dealer into such sizes as the demands of the business require. The edges of paper which is cut by a machine are much neater than those of hand cut paper. The size of the sheet of white wrapping paper is about 36 × 24 inches; this may be cut into halves, quarters, sixths, eighths, and twelfths, or a definite size suited to the bottles and packages adopted may be employed. Jacoby's gauge is useful in this connection; it is illustrated by Figs. 647 and 648. The rectangular lines in Fig. 647 represent the sizes of paper which are suitable for wrapping packages of the sizes indicated,—viz., 8 oz., 10 × 9 in.; 6 oz., 9 × 8 in.; 4 oz., 8 × 7½ in.; 3 oz., 7½ × 6½ in.; 2 oz., 7 × 6 in.; 1 oz., 6 × 4¾ in.; ½ oz., 5 × 4 in. In Fig. 648 the numbers indicate the method of *cutting a sheet of paper without waste;* the figures 8, 6, 4, 3, 2, etc., refer to the sizes in Fig. 647, and represent papers for 8 oz., 6 oz., 4 oz., 3 oz., etc. packages; the small pieces being used for wrapping pill boxes.

Fig. 647



Gauge for cutting paper

Fig. 648



Gauge for cutting paper

Rolls of Paper.—For general use, when packages of various and irregular sizes are to be made, wrapping paper of various qualities can now be had in cylindrical rolls. These are mounted on frames having a weighted knife, by which paper of the desired size can be easily and quickly torn off.

In folding a package, the proper sized paper is selected and laid upon a flat surface, the substance is deposited in the centre, and the edge nearest the operator is laid against the opposite edge, and a fold made with the thumb and forefinger. The width of the package will depend upon the width of this fold. The end of the partly formed package on the left hand is now temporarily tucked in, so that the contents shall not fall out, and the package is lifted into an upright position, with the fold toward the operator; the open upper end is then neatly creased and folded into a wedge shaped flap. The package is now reversed, and the first partly formed tuck is loosened and folded into a flap of the same size and shape as the one just made at the other end. The edges of the package are squared and gently pinched into shape, the label is pasted on so that the edge coincides with the edge of the fold, and the package is tied, as shown in Fig. 649.

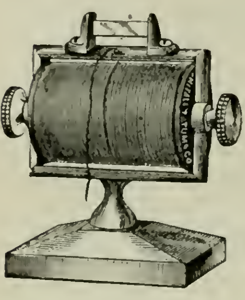
Fig. 649

Paper package

Fig. 650 shows a very convenient twine reel. A glass twine holder, made by the Whitall Tatum Company, is shown in Fig. 651. Where large quantities of powders having a uniform weight are needed, the powder measure shown in Fig. 652 may be used. This is made of hard wood, and consists of two ovoid cups of different sizes, joined like an egg cup. This measure is largely used in preparing seidlitz powders, the larger sized cup holding the requisite quantity for the alkaline mixture, the smaller cup being intended for the acid.

The measure should never be used without carefully testing its accuracy beforehand. This is done by heaping upon a piece of glazed paper the powder which is to be measured, and then pressing the cup downward through the powder until its edge rests uniformly upon the paper and the measure is evenly filled. The powder will usually have enough cohesive and adhesive properties to cause it to remain in the measure in any position in which it is held. The edge of the cup is then placed upon the powder paper and slightly tapped, when the contents readily drop out. The weight should be noted, and the operation repeated several times, until the average weight is correctly determined. It will soon be possible, with a little judicious practice, so to regulate the pressure and height of the powder that the variation from the proper weight will practically amount to nothing. This method should not be employed where great accuracy is necessary, and the measure should be repeatedly tested. By use, the edge wears off and the measure holds less. It may be enlarged, however, in the inside by sand papering it. With due precautions, excellent results may be had by measuring powders, and valuable time saved. Fig. 653 shows a useful little covered sieve which may be found convenient for sifting small quantities of powders when wanted in compounding prescriptions. It is nickel plated and made in three parts.

Fig. 650



Twine reel

Fig. 651

Twine holder

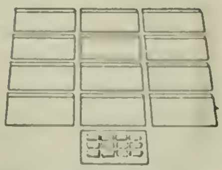
Fig. 652

Seidlitz powder measure

Fig. 653

Prescription sieve

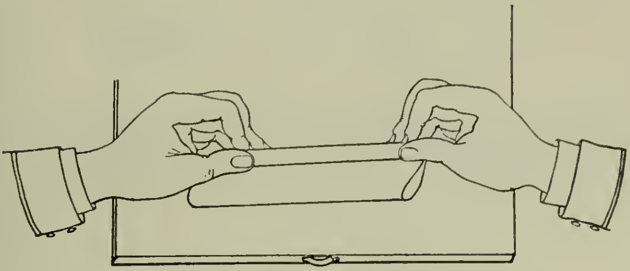
Fig. 654



Arrangement for powder papers

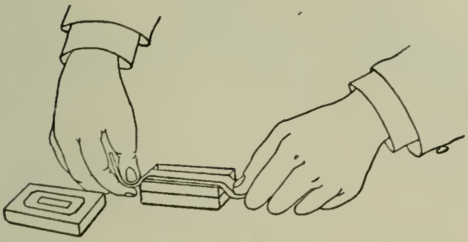
Folding Powders.—This operation is a frequent one, and the practice of accurately dividing powders is one which must be quickly acquired. The best method of attaining proficiency in this respect is to weigh out a definite quantity of a powder (120 grains), and, after dividing it into twelve equal portions, to weigh each portion separately and note the weight, so that any deviation from the proper weight (10 grains) will be discovered. Through practice it will soon be realized that very accurate division may be secured. All the powder papers should be creased at once, by folding down a margin on the side, so that they shall be uniform. They should be placed regularly and as close to one another as is convenient. In Fig. 654 the usual arrangement is shown. Where the operator has not sufficient practice to trust to his judgment of the quantity for each powder, the whole quantity may be collected upon a smooth card, flattened into a rectangular shape, and divided with a spatula into the exact number of equal portions required for the number of powder papers. Each portion may then be transferred to its appropriate paper from the card by the spatula.

Fig. 655



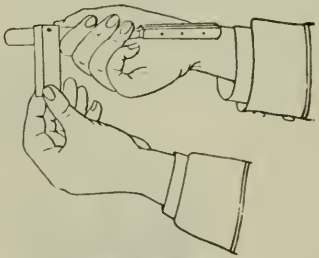
Folding the powder

Fig. 656



Making the end creases

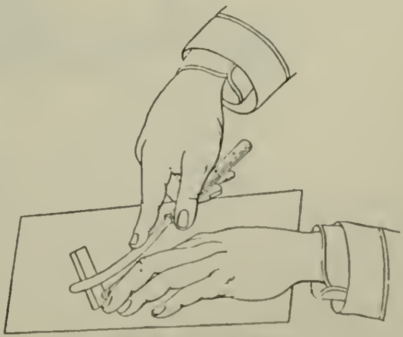
Fig. 657



Creasing with a spatula

The operation of folding the powder is illustrated in Figs. 655, 656, 657, and 658. The uncreased edge of the paper is brought over so that it lies exactly in the crease, and the fold turned down and folded over toward the operator, the depth of the fold determining the width of the powder.

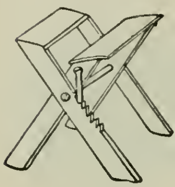
Fig. 658



Flattening the powder

When a number of powders are called for, it is best to dispense them in a shallow powder box (see Fig. 656). It is customary to use the sides of the box as a gauge. In the hands of an experienced operator neat results are easily obtained in this way, although the use of the powder folders shown in Figs. 659 and 660 give a more uniform edge to the powders. A cheap gauge may be made by tacking a piece of tinned iron underneath a convenient shelf, so that a portion having a width slightly less than that of the powder box will project. A very true edge may be made by folding the powder over a spatula, as shown in Fig. 657, while a smooth, flat appearance is given to the powder by pressing down the folds with the blade of the spatula, as shown in Fig. 658. The paper used for folding powders should be thin, glazed cap paper, and for deliquescent substances waxed or paraffin paper should be employed.

Fig. 659



Powder folder

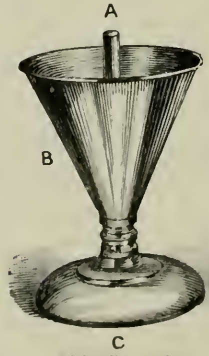
Fig. 660

Powder folder

Figs. 661, 662, and 663 illustrate a very simple and ingenious apparatus for dividing powders. It was devised by Jacob C. Michael, and consists of a metallic cup, shaped like a wineglass, into which the powder that is to be divided is dropped. The cup is in two parts, the base, C, and the body, B, these being joined together by a bayonet joint, which permits a ready separation or connection.

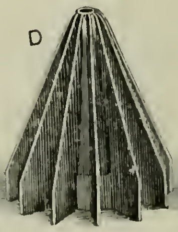
A central stem, A, is firmly attached to the base, C; the divider, D, consists of a heavy metallic cone, the sides having the same angle as

Fig. 661



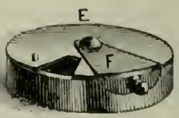
Michael's powder divider

Fig. 662



Divider

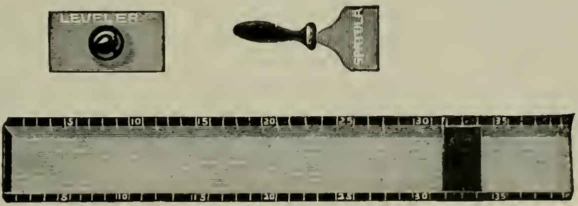
Fig. 663



Cover

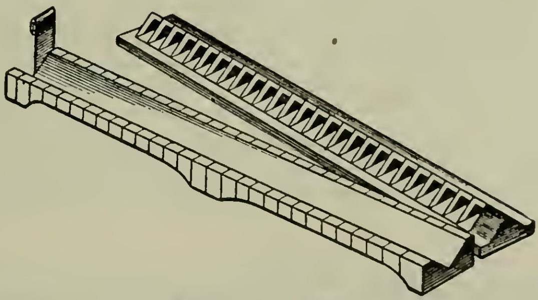
that of the body of the cup. There are several dividers accompanying the apparatus; the one shown in the cut has twelve wings, making twelve partitions; the other dividers have respectively ten and eight partitions. The cover to the cup is represented by E, and there is a little sliding door, F, to this cover. The powder having been thoroughly mixed, is dropped into the cup B, and the divider is placed on top by inserting the end of the stem A into the narrow end of the divider through the circular orifice which traverses the whole length and allowing it to work its way down to the bottom of the cup; this operation is promoted by slowly rotating the divider, when it will be found that the powder in the cup has been equally divided into twelve parts. The cover, E, is now placed upon the cup, care being taken to have the edge of one of the partitions of the divider correspond with the side of the door F. The whole apparatus is now turned upside down, and the stem A is removed by turning the base C and sliding it out of the orifice in the divider. The powder will be deposited upon the cover, and by holding the cover over the powder paper and opening the little door F over the centre of the paper the powder which was in one of the sections (one-twelfth of the whole) will drop out; the apparatus is then carried to the next paper, the

Fig. 664



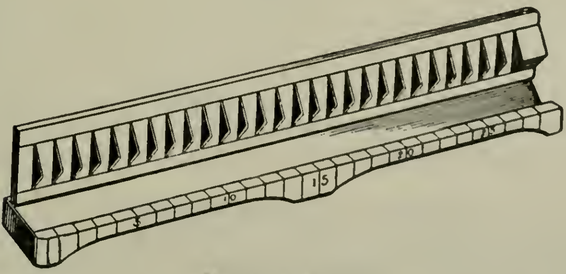
Diamond powder divider

Fig. 665



Weills's powder divider

Fig. 666

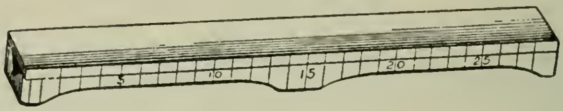


Weills's powder divider

divider rotated again until the contents of another section drop on the paper, and the process is repeated until twelve equal portions are upon as many papers. If eight or ten powders are wanted instead of twelve, the eight or ten divider is used, while if a smaller or greater number than eight, ten, or twelve be required, that divider is chosen which is a multiple of the number desired.

Fig. 664 shows the nickel plated diamond powder divider made by Fox, Fultz & Co. The powder is placed in the graduated trough and the bar (shown in black in the illustration) placed opposite the graduation denoting the number of powders into which the prescription is to be divided. The powder is then placed in the trough and levelled with the aid of the "leveller," after which the bar is removed and the powder divided by inserting the short handled spatula at the graduated marks; the separated portions of powder may be then, in turn, deposited upon the powder papers arranged as shown in Fig. 654.

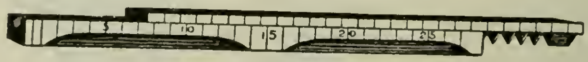
Fig. 667



Weills's powder divider

Figs. 665, 666, 667, and 668 illustrate a powder divider devised by Isaac M. Weills. Fig. 665 shows the base with its V-shaped groove, having a hinged gate at one end, which may be moved so as to open or close the end of the base; one edge of the latter is graduated as shown in the cut. In Fig. 666 the top is shown with its twenty-seven knife blades, a quarter of an inch apart. The edge of the top is graduated to correspond with the marks on the base. To use this divider, the gate is closed and the block end of the top placed at the graduated mark for the number of powders desired, and the powder placed in the groove, the top is now turned end for end and the knife blades pressed into the powder. The papers having been arranged as in Fig. 651, each paper is given its quota by gently pushing the top over the base so as to deliver the required quantity.

Fig. 668



Weills's powder divider

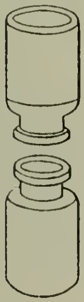
Cachets, or Wafer Capsules

The credit of bringing the *cachet*, or, as it is sometimes termed, *cachet de pain*, into use belongs to Limousin, of Paris. Wafers have been in use many years. Wafer sheet is made by pouring a mixture of flour and water upon hot greased plates, or between two hot, polished, revolving cylinders separated at a proper distance, so that the water is evaporated and a sheet of wafer produced. The properties of wafer sheet admirably fit it for administering nauseous powders. When dry, it is in non-adhesive, stiff, somewhat brittle sheets, slightly thicker than ordinary cardboard. It is tasteless, and harmless when taken into the stomach. When moistened with water, its character is entirely changed; it becomes soft, elastic, and slippery. Powders may be administered by Kollme's method, by floating a piece of wafer sheet upon water, and, when thoroughly softened, passing a tablespoon underneath and lifting it out, then depositing the powder in the centre and folding over the corners so as to thoroughly enclose it. If water is then poured into the spoon, the concealed powder may be swallowed without any disagreeable taste being perceived.

Little envelopes made of wafer sheet (Johann Schmidt's *Saccelli Amylacei*) can now be had which may be filled with bitter or nauseous powders, then sealed and moistened before swallowing; these are more convenient than the wafer sheet above described. The empty envelopes can be furnished to a patient, and he can transfer the powders from the papers which he has received from the pharmacist, and thus prepare each dose himself. The "saccelli" take up little room, and if the patient is travelling, they serve a useful purpose.

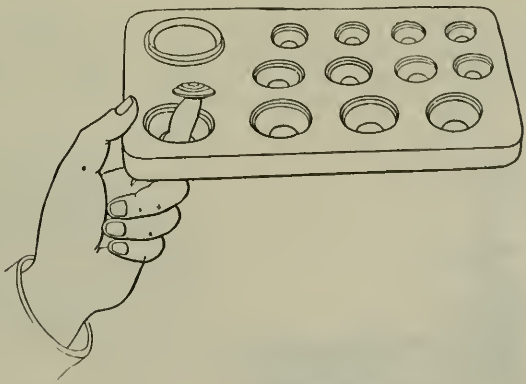
The cachet is an improvement on the above, because no more wafer sheet is used than is absolutely necessary to enclose the powder, and thus the bulk is diminished. Cachets are lenticular or spoon shaped disks of wafer sheet, of various sizes. The powder is deposited in the dry cachet, and the margin is moistened with water. An empty cachet of exactly the same size is placed on top, with the convexity upward, and pressure is made upon the margin, with the effect of tightly sealing the cachet and enveloping the powder. Elaborate apparatus—the necessity for which, however, is not apparent—has been devised to effect the sealing of the cachets. The simplest method upon the small scale is as follows: Two bottles are provided (a morphine bottle for the middle sized cachet answers very well), and, one of the cachets being placed upon the lip of one bottle, the

FIG. 669



Bottle for sealing cachets

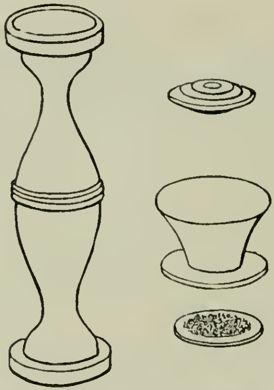
FIG. 670



Limousin's cachet board

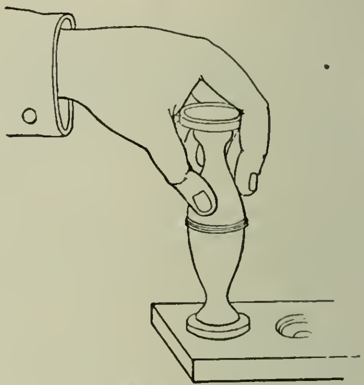
powder is carefully deposited in the centre without soiling the outside edge; the margin of an empty cachet of the same size is then moistened by quickly passing it over a piece of wet felt, and is laid upon the cachet containing the powder; the lip of the other bottle is now applied to the cachet with sufficient pressure to seal it effectually. The position of the bottles is shown in Fig. 669. Limousin's improved method is similar in principle, although, of course, more finished. A board, with depressed perforations for three sizes is shown in Fig. 670. Empty cachets are placed upon the depressions, and the powder is deposited in the centre with the aid of the small powder funnel (see Fig. 671). The "wetter and presser" is shown to the left of the funnel; this is of two kinds of wood, joined in the middle,—one end being hard, light colored, and highly polished, the other being dark colored and somewhat absorbent. The end of the latter is used to moisten the margin of the cachet by first placing it upon a piece of moist felt and then applying it to the cachet; an empty cachet is now laid upon the one containing the powder, and the "presser" end is applied with some force so as to seal the cachet (see Fig. 672); the sealed cachet is pushed up from below, as shown in Fig. 670.

Fig. 671



Cachet wetter, finished cachet, cachet funnel, and cachet containing powder

Fig. 672



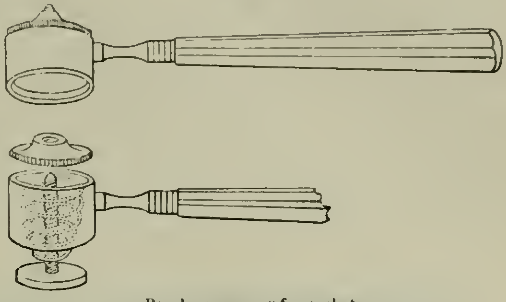
Sealing the cachet

Fig. 673

German cachet apparatus

A less expensive apparatus for filling and sealing cachets than that made by Limousin may be obtained from the German importing houses (see Fig. 673). A rectangular sheet of thick rubber cloth is perforated with twelve circular holes, each large enough to hold an empty cachet; the powder is deposited in the centre of the cachet through a small funnel; the inner edge of an empty cachet is dampened by rubbing it for a moment upon a piece of cotton flannel moistened with water, the moistened cachet is laid upon the one containing the powder so as to enclose it, and the presser, which is armed at its base with three needles and has a spring in the handle, is applied so that the cachet is sealed, and when the spring is released the needles penetrate the edge of the finished cachet sufficiently so that it can be lifted and dropped into the box without touching it with the hands.

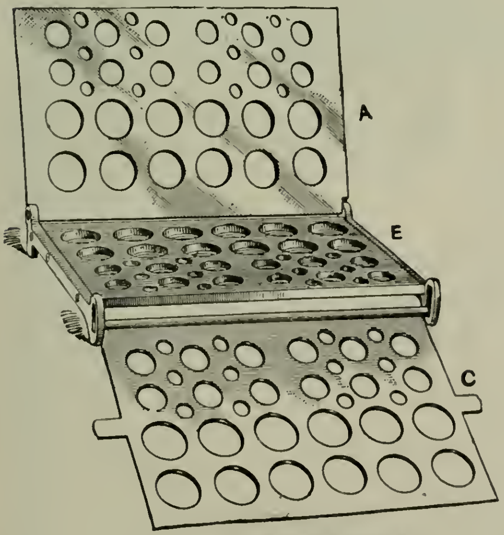
Fig. 674



Powder measurer for cachets

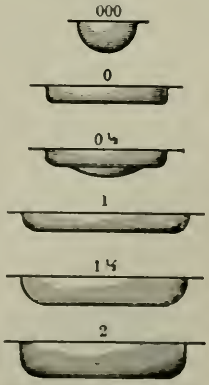
Limousin devised a powder measurer, the construction of which is shown in Fig. 674. The upper view shows the measurer closed, ready for use; the lower view shows how its capacity may be varied to suit the weight of the powder desired. This is done by turning the milled head, which revolves upon the screw which is attached to the disk forming the movable bottom of the cup. A coiled spring aids in pushing the disk outward when it is necessary to lessen the capacity, so that this can be regulated with great exactness. The value of this measurer lies in the fact that it can be used for delivering a more or less compact disk of powder in a cachet without soiling the edges of the latter, and when a large number of cachets of a definite weight are needed,—*i.e.*, one gramme guarana powders,—it can be used as is the seidlitz powder measure (see Fig. 652).

Fig. 675



Konseal apparatus

Fig. 676



Konseals (exact size)

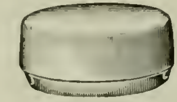
J. M. Grosvenor & Co., of Boston, have introduced an excellent apparatus for dispensing cachets. It is made in a very substantial manner, and consists of three nickelled metal plates hinged together as shown in Fig. 675. The cachets, which are termed "konseals," are made of thinner material than ordinary cachets, and the finished cachet is less bulky and neater in appearance.

The saucer shaped cachets are pressed with the fingers into the inner circles of plate E, and also into those on plate A; plate C is then laid upon plate E, and the medicated powder dropped through the funnel into the cachet. Large doses may be pressed with a thimble furnished for the purpose, and thus smaller cachets may be used than are possible in ordinary apparatus.

When the cachets are filled, the filling plate is lifted and a dampening roller passed over the edges of the empty capsules in plate A. The latter is then closed over the bottom plate, and a slight pressure seals the cachet. On opening the apparatus the filled cachets may be easily removed by pushing each one gently out with the finger.

Fig. 676 shows the exact sizes of the wafer konseals. No. 000 permits the administration of a cachet not larger than a large sized pill.

Fig. 677



Dry seal cachet

Fig. 678

Dry seal cachet apparatus

The name "konseals" was adopted by J. M. Grosvenor & Co. as shorter and better adapted for prescription use than "Morstadt's cachets," which was their original name. They were contrived by Karl Morstadt, of Prague, Austria.

Fig. 677 shows Johann Schmidt's dry seal cachet. The advantage of this form is that there are no "flanges," as in the ordinary cachet. They are made of very thin, elastic wafer sheet; the manner of closing the dry seal cachet resembles that used for "empty" gelatin capsules. The "cap" fits over the body, and no moistening is required, as the pressure forces the cap tightly over the edge of the body containing the powder. The apparatus shown in Fig. 678 is similar in construction to the "konseal" apparatus above described.

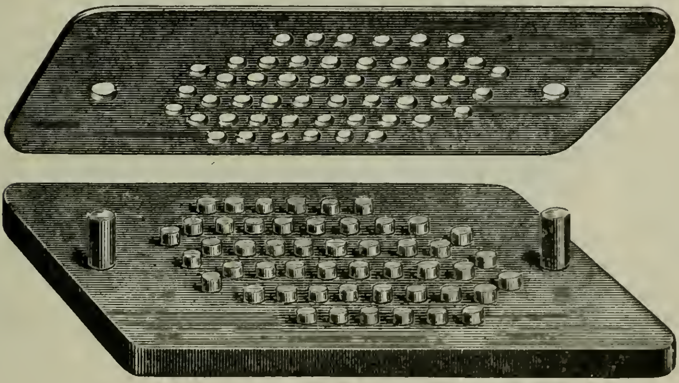
It is greatly to be regretted that wafer capsules are not more frequently prescribed. They have many substantial advantages. The substance is rendered tasteless by their use, and yet is easily liberated in the stomach in a pulverulent condition, and this is well known to be the most favorable solid form for solution in the gastric fluids; the knack of swallowing them is easily acquired; the pharmacist has the great advantage of furnishing preparations which are not ready made, and the purity of the ingredients can be personally vouched for.

Tabellæ *Tablets, Tablet Triturates*

Tablets, or tablet triturates, may be defined as minute disk like masses of medicinal powders, the basis usually consisting of powdered sugar. The powder is held together and the tablet retains its shape through the adhesion of the particles which is developed by the use of a volatile liquid like alcohol, thus differing from lozenges, which are usually made from a mass in which tenacity is communicated by a mucilage, adhesive paste, or a similar substance. (See Trochisci.)

Tablet triturates originated with Dr. Robert M. Fuller, and neither process nor apparatus is patented. Since his first communication on the subject, in 1878, they have been largely manufactured, and pharmacists owe a debt to Dr. Fuller for voluntarily giving them a very neat and ingenious process whereby many medicines can be satisfactorily administered.

Figs. 679, 680



Tablet triturate machine

The tablet is made by pressing a paste into perforations made in a plate of hard rubber, metal, glass, or other suitable material. These holes are of uniform diameter, and the plate must have a uniform thickness throughout. The number of holes in the plate is determined by their relative size, plates having been made with as many as three hundred perforations. The one shown in Fig. 679 has fifty. The tablets made by the use of various plates weigh from half a grain to four grains.

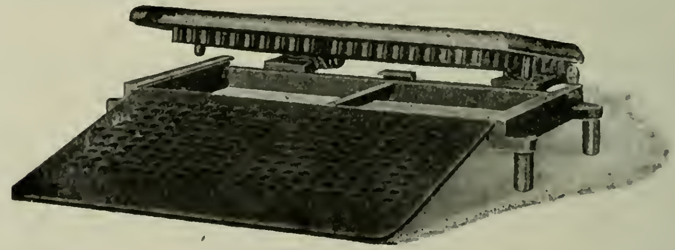
In order to remove the tablets from the holes in which they are made a plate is used which is studded with an equal number of pegs fastened securely in a base plate (see the lower plate shown in Fig. 680). These pegs are longer than the thickness of the upper plate, and they are so arranged that they exactly fit the perforations in the upper plate. Two pegs still longer and thicker are placed at the ends, so that when they are inserted in corresponding holes in the upper plate accurate registration is secured.

In using the apparatus, the upper plate is placed upon a pill tile or plate of glass, and the paste is spread upon the upper surface and rubbed into the small holes with a spatula. When all of the holes are filled, the excess of paste is brushed from the surface and the upper plate lifted over the lower plate and laid upon it so that the two long pegs enter the holes. Now, by pressing firmly but gently upon the upper plate the pegs are forced upward slowly until the plates come together and a tablet rests upon the top of each peg; the apparatus is then set aside to permit the tablets to dry sufficiently to be handled, when they are taken off, and the plates, after brushing, are ready for another operation.

It will usually be found desirable to have several sets of plates, so that they may be worked continuously, the tablets drying upon one while another is being used for forming the tablets. The paste may be made by adding the medicating ingredient in fine powder to finely powdered sugar or sugar of milk and moistening it with alcohol; in some rare cases a little powdered acacia may be needed, but care must be observed not to get the paste too tenacious nor too soft, as there may be difficulty in forcing the tablets out of the perforations, or they may take a long time to dry. Tablets used for hypodermic medication may be advantageously made by this process. Accurate adjustment of the ingredients and prolonged trituration, so that each tablet shall contain its due proportion of activity and thorough desiccation, are the important details in the manufacture of tablet triturates.

Fig. 681 shows Colton's No. 1 triturate machine. It is made with two hundred perforations in a plate. When the lower plate is filled with the triturate mass it is "slid" into position, and it registers accurately with the two hundred punches in the upper plate, which rests upon two coiled springs let into the lower frame; by pushing the upper plate downward suddenly the tablets are pushed out into a tray which is placed upon the table immediately under the apparatus.

Fig. 681

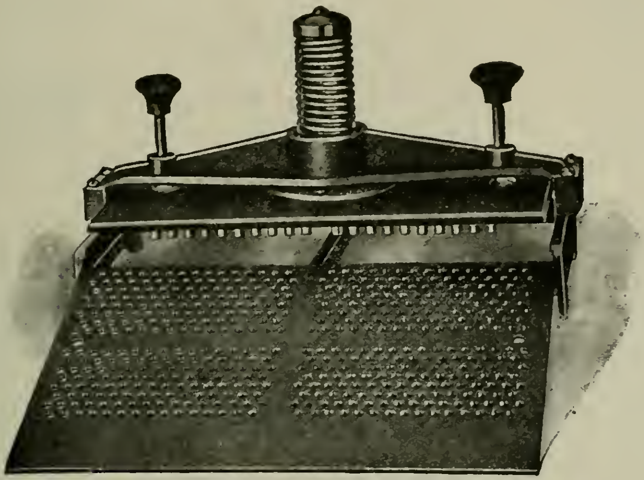


Colton's No. 1 triturate machine

Fig. 682 illustrates Colton's No. 2 triturate machine. This is adapted for making a larger number of tablets than either of the others above described. The principle of action is the same as that of the No. 1 machine, the pushing out of the tablets being effected by pressing suddenly upon the knobs shown in Fig. 682.

Tablet triturates have been made "in blank,"—that is, without medication,—from powdered sugar of milk, a little acacia, and 85 percent. alcohol, or with water alone; the object here is to medicate the blank tablets subsequently by dropping upon each a concentrated liquid medicine in definite quantity. Such tablets have been termed by Dr. Fuller *tablet saturates*. The mode employed in medicating tablet saturates is to arrange a number of blank tablets upon a glass plate, either in contact or separated. In the former case the concentrated liquid or fluidextract is poured upon the tablets in the proper proportion, and by permitting the liquid to remain in contact under cover long enough for each tablet to become saturated uniformly, and then exposing the tablets to the air until they are dry, they may be rapidly medicated; or if the tablets are arranged separately upon the plate, the proper quantity of the fluidextract may be dropped from a pipette upon each tablet.

Fig. 682



Colton's No. 2 triturate machine

Trochisci *Troches*

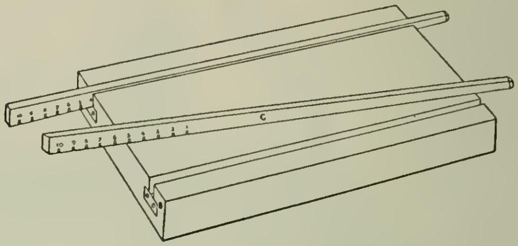
Troches, or lozenges, are solid, discoid or cylindrical masses, consisting chiefly of medicinal powders, sugar, and mucilage. They are intended to be used by placing them in the mouth and permitting them to remain until, through slow solution or disintegration, their purpose of mild medication is effected. It is obvious that very powerful or disagreeable remedies cannot be administered in this way. The formation of the "lozenge mass" is the most important part of the operation. The dry powders must be made into a tenacious mass which shall possess sufficient plasticity to enable it to be rolled into a flat cake without crumbling. It must not retain moisture so long as to occasion too much delay in drying the troches, and the troches must not be brittle through want of sufficient adhesiveness. Mucilage of tragacanth has been found best to serve the purpose of causing the adhesion of the powders.

Making the Mass.—The best method of making the mass is first to prepare the mucilage according to the formula, and, having mixed and sifted the powders, add sufficient mucilage to make a mass of the proper consistence. The quantity always depends upon the character of the powder. If the latter is absorbent, more mucilage is required than if the powder is made up largely of extracts. The usual method of mixing powdered tragacanth or acacia with the dry powders, and then trusting to the addition of the right proportion of water, is generally disappointing in the hands of the inexperienced, almost invariably producing too moist a mass. Upon the large scale the manufacturer employs a mixing machine to form the mass; upon the small scale the pharmacist uses the mortar and pestle. The mortar clamp, shown in Fig. 484, is very useful in this connection and in working tough masses. Hahn's pestle cap will save blistering the hands of the inexperienced. This device, shown in Fig. 683, consists of a brass cup shaped cap, A, perforated in the centre, and screwed to the top of the pestle at S, so as to permit of the slow revolution of the cap when the pestle is tightly grasped in the hand; the lower cut shows another view of the cap.

Fig. 683

Hahn's pestle cap

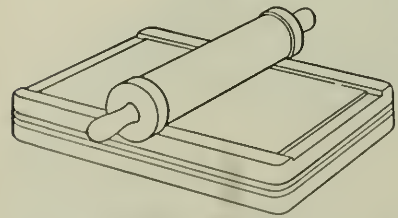
Fig. 684



Slocum's lozenge board

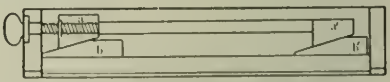
Rolling the Mass.—When the mass is made, it must be formed into a flat cake by placing it upon a hard, level, dusted surface and rolling it with a cylindrical roller. The thickness of the cake determines the weight of the lozenge, and hence it is more exact to have some means of adjusting the thickness. In Slocum's lozenge board (see Fig. 684) this is ingeniously effected by the use of tapering oak strips, C, which slide in inclined furrows; the handles of the strips are graduated, having saw kerfs at regular intervals; the brass plate, B, permits these to be accurately adjusted and held, so that both strips project uniformly above the board. By pushing both strips forward, greater thickness of the lozenge cake is secured.

Fig. 685



Harrison's lozenge board

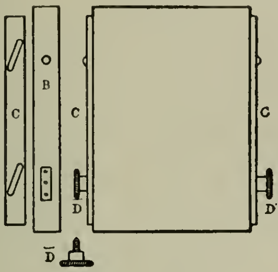
Fig. 686



Harrison's lozenge board (sectional view)

Harrison's lozenge board is shown in Figs. 685 and 686. The board is surrounded by a frame, and the former can be elevated or depressed uniformly by turning the screw shown in the sectional view in Fig. 686. The handles of the roller form one continuous piece, running through a longitudinal hole through its centre. This permits the handles to be grasped tightly while the roller revolves. Lozenge rollers should be true cylinders, and are generally made of hard wood. Steel rollers and glass rollers have been used, however. These are both made hollow, so that hot water can be introduced through the holes made where the handles are screwed in. Hollow lozenge rollers of this kind are used when heated for rolling stiff extractive masses.

FIG. 687



Procter's lozenge board

FIG. 688

Lozenge punch

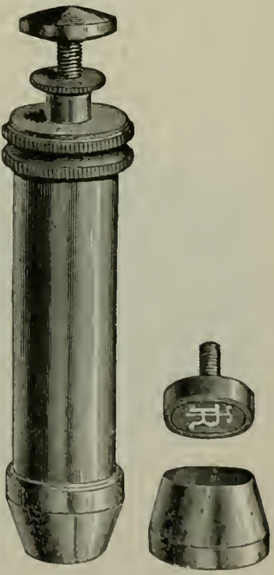
FIG. 689

Lozenge punch (steel cutter)

A convenient lozenge board was devised by Wallace Procter (see Fig. 687). The board, made of well seasoned wood, is 14 inches long, 10 inches wide, and 1½ inches thick. At each side, about 3 inches from each end, a plate, B, is let in and securely fastened; the brass plates, C, are movable, and are held in place by pins at one end and square shouldered screws, D, at the other end; the side plates, C, are raised or lowered and fixed at any height desired by the set screw, D.

Cutting the Troches.—Troches are cut by cylindrical or conical punches, often made of tinned iron, as shown in Fig. 688, but preferably of steel. Fig. 689 shows a very good punch, having a hardened steel octagonal cutter, C, soldered to a hollow conical handle, M. Fig. 690 represents a very complete lozenge cutter with a circular die, which stamps a letter upon a lozenge in addition to cutting it. It was obtained by the author from Chicago. It is made very substantially, and is accompanied by a cutter and a die for oval lozenges. Fig. 692 shows the Franciscus lozenge punch. The cutter is

FIG. 690



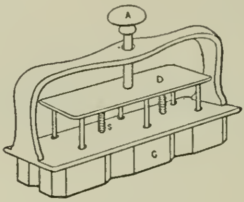
Lozenge cutter, with die

of steel and a coiled spring at the top of the handle pushes the lozenge out after it is cut. Fig. 693 shows an excellent cutter which accurately cuts six lozenges at once. It was devised by a Western pharmacist. Fig. 694 gives the end view. The cutter is placed upon the soft mass and pressed down until the edges touch the board. By pressing upon the handle, A, the lozenges are forced out of the cutters, the springs, S, causing the pushers to resume their original position.

Fig. 692

The Franciscus lozenge punch

Fig. 693



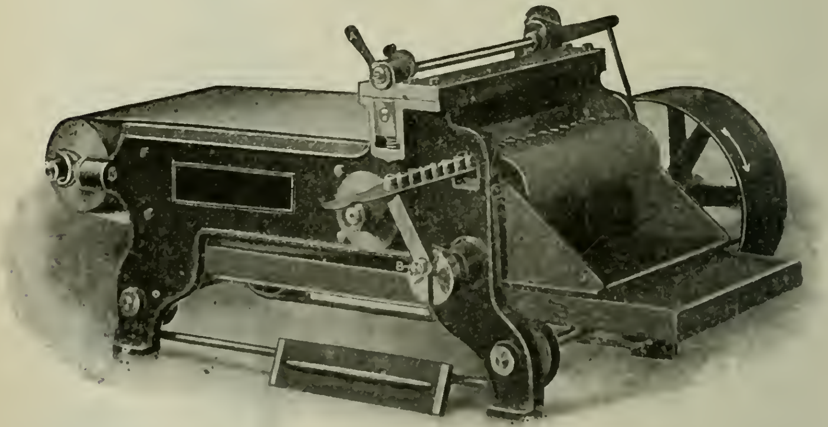
Lozenge cutter

Fig. 694

Lozenge cutter (end view)

Fig. 695 shows Colton's lozenge cutting machine. The mass, having been previously rolled into a flat cake of the desired thickness, is placed upon the moving rubber belt, which carries it forward to a finishing roller which gives it the necessary evenness of surface; it then passes under the tapering cutters, and the lozenges drop downward to a tray or receiver.

Fig. 695



Colton's lozenge cutting machine

Official Troches

Trochisci Acidi Tannici	Made by forming a mass, with the aid of Stronger Orange Flower Water, from 6 Gm. of Tannic Acid, 65 Gm. of Sugar, and 2 Gm. of Tragacanth, and dividing it into 100 troches
Ammonii Chloridi	Made by forming a mass, with the aid of Syrup of Tolu, from 10 Gm. of Ammonium Chloride, 20 Gm. of Extract of Glycyrrhiza, 2 Gm. of Tragacanth, and 40 Gm. of Sugar, and dividing it into 100 troches
Cubebæ	Made by forming a mass, with the aid of Syrup of Tolu, from 25 Gm. of Extract of Glycyrrhiza and 12 Gm. of Acacia, with which 2 Gm. of Oleoresin of Cubeb and 1 Cc. of Oil of Sassafras have been thoroughly incorporated, and dividing it into 100 troches
Gambir	Made by forming a mass, with the aid of Stronger Orange Flower Water, from 6 Gm. of Gambir, 65 Gm. of Sugar, and 2 Gm. of Tragacanth, and dividing it into 100 troches
Glycyrrhizæ et Opii	Made by forming a mass, with the aid of Water, from 15 Gm. of Extract of Glycyrrhiza, 0.5 Gm. of Powdered Opium, 12 Gm. of Acacia, and 20 Gm. of Sugar, with which 0.2 Cc. (about 4 drops) of Oil of Anise has been incorporated, and dividing it into 100 troches
Krameriæ	Made by forming a mass, with the aid of Stronger Orange Flower Water, from 6 Gm. of Extract of Krameria, 65 Gm. of Sugar, and 2 Gm. of Tragacanth, and dividing it into 100 troches
Potassii Chloratis	Made by forming a mass, with the aid of Water, from 15 Gm. of Potassium Chlorate, 60 Gm. of Sugar, and 3 Gm. of Tragacanth, and dividing it into 100 troches
Santonini	Made by forming a mass, with the aid of Stronger Orange Flower Water, from 3 Gm. of Santonin, 90 Gm. of Sugar, and 3 Gm. of Tragacanth, and dividing it into 100 troches
Sodii Bicarbonatis	Made by forming a mass, with the aid of Mucilage of Tragacanth, from 18 Gm. of Sodium Bicarbonate, 54 Gm. of Sugar, and 1 Gm. of Myristica, and dividing it into 100 troches

Unofficial Troches or Lozenges

Name	Ingredients	Preparation
Trochiscus Acidi Benzoici. Br.	0.0324 Gm. ($\frac{1}{2}$ grain) Benzoic Acid	Mix with Fruit Basis[4] to form a lozenge
Acidi Carbolici. Br.	0.0648 Gm. (1 grain) Phenol	Mix with Tolu Basis[2] to form a lozenge
Bismuthi Compositus. Br.	0.1296 Gm. (2 grains) each of Bismuth Oxycarbonate and Heavy Magnesium Carbonate; 0.2592 Gm. (4 grains) Precipitated Calcium Carbonate	Mix with Rose Basis[3] to form a lozenge
Trochisci Cretæ. U. S. P. 1890	25 Gm. Prepared Chalk; 7 Gm. Acacia; 3 Cc. Spirit of Nutmeg, 40 Gm. Sugar; Water sufficient to make 100 troches	Rub the powders with the Spirit of Nutmeg until thoroughly mixed, form a mass with Water, and divide into 100 troches
Trochiscus Eucalypti Gummi. Br.	0.0648 Gm. (1 grain) Eucalyptus Gum	Mix with Fruit Basis[4] to form a lozenge
Trochisci Ferri. U. S. P. 1890	30 Gm. Ferric Hydrate; 1 Gm. Vanilla, cut; 100 Gm. Sugar; Mucilage of Tragacanth, sufficient to make 100 troches	Rub the Vanilla with a portion of the Sugar to a fine powder, add the Ferric Hydrate and remainder of the Sugar, form a mass with Mucilage, and divide into 100 troches
Trochiscus Ferri Redacti. Br.	0.0648 Gm. (1 grain) Reduced Iron	Mix with the Simple Basis[1] to form a lozenge
Guaiaci Resinæ. Br.	0.1944 Gm. (3 grains) Guaiacum Resin	Mix with the Fruit Basis[4] to form a lozenge
Trochisci Ipecacuanhæ. U. S. P. 1890	2 Gm. Ipecac; 2 Gm. Tragacanth; 65 Gm. Sugar; Syrup of Orange to make 100 troches	Mix the powders intimately, form a mass with the aid of Syrup of Orange, and divide into 100 troches
Trochiscus Krameriæ et Cocainæ. Br.	0.0648 Gm. (1 grain) Extract of Krameria; 0.00324 Gm. ($\frac{1}{20}$ grain) Cocaine Hydrochloride	Mix with the Fruit Basis[4] to form a lozenge
Trochisci Menthæ Piperitæ. U. S. P. 1890	1 Cc. Oil of Peppermint; 80 Gm. Sugar; Mucilage of Tragacanth to make 100 troches	Thoroughly incorporate the Oil of Peppermint with the Sugar, form a mass with the aid of the Mucilage, and divide it into 100 troches

Unofficial Troches or Lozenges—*Continued*

Name	Ingredients	Preparation
Trochiscus Morphinæ. Br.	0.0018 Gm. ($\frac{1}{36}$ grain) Morphine Hydrochloride	Mix with the Tolu Basis[2] to form a lozenge
Trochisci Morphinæ et Ipecacuanhæ. U. S. P. 1890	0.16 Gm. Morphine Sulphate; 0.5 Gm. Ipecac; 65 Gm. Sugar; 0.2 Cc. Oil of Gaultheria; Mucilage of Tragacanth to make 100 troches	Thoroughly incorporate the Oil of Gaultheria with the mixed powders, form a mass with the aid of the Mucilage, and divide it into 100 troches
Trochiscus Sulphuris. Br.	162 Gm. Precipitated Sulphur; 32.4 Gm. Acid Potassium Tartrate; 259.2 Gm. Sugar; 32.4 Gm. Gum Acacia; 29.5 Cc. Tincture of Orange; 29.5 Cc. Mucilage of Gum Acacia	Thoroughly incorporate the Tincture of Orange with the mixed powders, form a mass with the aid of the Mucilage, and divide it into 500 lozenges
Trochisci Zingiberis. U. S. P. 1890	20 Cc. Tincture of Ginger; 4 Gm. Tragacanth; 130 Gm. Sugar; Syrup of Ginger to make 100 troches	Thoroughly incorporate the Tincture of Ginger with the Sugar, dry it in the air, add the Tragacanth, form a mass with the aid of the Syrup, and divide into 100 troches

1. **Preparation of Lozenges with Simple Basis.** Br.—Mix 500 times the quantity of drug ordered for one lozenge with 496 Gm. of powdered Sugar and 19.5 Gm. of powdered Gum Acacia, form a mass with the aid of 35.5 Cc. of Mucilage of Gum Acacia and sufficient Distilled Water, and divide it into 500 lozenges. Dry them.

2. **Preparation of Lozenges with Tolu Basis.** Br.—Take 500 times the quantity of drug ordered for one lozenge, dissolve alkaloids, if present, in 10.5 Cc. of Water, mixing the solution thoroughly with 482 Gm. of powdered Sugar and 19.5 Gm. of powdered Gum Acacia, then incorporate any other ingredients ordered and 10.5 Cc. of Tincture of Balsam of Tolu, form into a mass with 35.5 Cc. of Mucilage of Gum Acacia and sufficient Distilled Water, and divide it into 500 lozenges. Dry them.

3. **Preparation of Lozenges with Rose Basis.** Br.—Mix 500 times the quantity of drug ordered for one lozenge with 496 Gm. of powdered Sugar and 19.5 Gm. of powdered Gum Acacia, form into a mass with the aid of 17.5 Cc. of Mucilage of Gum Acacia and sufficient Rose Water, and divide into 500 lozenges. Dry them.

4. **Preparation of Lozenges with Fruit Basis.** Br.—Mix 500 times the quantity of drug ordered for one lozenge with 439.5 Gm. of powdered Sugar and 19.5 Gm. of powdered Gum Acacia, form into a mass with the aid of 35.5 Cc. of Mucilage of Gum Acacia and 56.75 Gm. of black-currant paste of commerce, softened with Distilled Water, and additional Water, if necessary, and divide into 500 lozenges. Dry them.

TROCHISCI ACIDI TANNICI. U. S. Troches of Tannic Acid

	Metric	Old form
* **Tannic Acid**	6 Gm.	93 grains
Sugar, in fine powder	65 Gm.	2 oz. av. 128 gr.
Tragacanth, in fine powder	2 Gm.	31 grains
Stronger Orange Flower Water, a sufficient quantity,		
To make one hundred troches	100	100

Rub the powders together until they are thoroughly mixed; then with stronger Orange Flower Water, form a mass, to be divided into 100 troches.

TROCHISCI AMMONII CHLORIDI. U. S. Troches of Ammonium Chloride

	Metric	Old form
* **Ammonium Chloride,** in fine powder	10 Gm.	154 grains
Extract of Glycyrrhiza, in fine powder	20 Gm.	309 grains
Tragacanth, in fine powder	2 Gm.	31 grains
Sugar, in fine powder	40 Gm.	1 oz. av. 180 gr.
Syrup of Tolu, a sufficient quantity,		
To make one hundred troches	100	100

Rub the powders together until they are thoroughly mixed; then with Syrup of Tolu, form a mass, to be divided into 100 troches.

TROCHISCI CUBEBÆ. U.S. Troches of Cubeb

	Metric	Old form
* **Oleoresin of Cubeb**	2 Gm.	31 grains
Oil of Sassafras	1 Cc.	16 minims
Extract of Glycyrrhiza, in fine powder	25 Gm.	386 grains
Acacia, in fine powder	12 Gm.	185 grains
Syrup of Tolu, a sufficient quantity,		
To make one hundred troches	100	100

Rub the powders together until they are thoroughly mixed; then add the Oleoresin and the Oil, and incorporate them with the mixture. Lastly, with Syrup of Tolu, form a mass, to be divided into 100 troches. The proportion of Oleoresin of Cubeb in *Cubeb lozenges*, as they are most usually called, has been reduced one-half in the U. S. P. (8th Rev.), as experience showed that the former official lozenges were unpleasantly strong.

TROCHISCI GAMBIR. U.S. Troches of Gambir

[To replace Trochisci Catechu, Pharm. 1890]

	Metric	Old form
* **Gambir,** in fine powder	6 Gm.	93 grains
Sugar, in fine powder	65 Gm.	2 oz. av. 128 gr.
Tragacanth, in fine powder	2 Gm.	31 grains
Stronger Orange Flower Water, a sufficient quantity,		
To make one hundred troches	100	100

Rub the powders together until they are thoroughly mixed; then with Stronger Orange Flower Water, form a mass, to be divided into 100 troches.

TROCHISCI GLYCYRRHIZÆ ET OPII. U.S. Troches of Glycyrrhiza and Opium

	Metric	Old form
* **Extract of Glycyrrhiza,** in fine powder	15.0 Gm.	231 grains
Powdered Opium	0.5 Gm.	7¾ grains
Acacia, in fine powder	12.0 Gm.	185 grains
Sugar, in fine powder	20.0 Gm.	309 grains
Oil of Anise	0.2 Cc.	3 minims
Water, a sufficient quantity,		
To make one hundred troches	100	100

Rub the powders together until they are thoroughly mixed; then add the Oil of Anise (equivalent to about 4 drops), and incorporate it with the mixture. Lastly, with Water, form a mass, to be divided into 100 troches.

TROCHISCI KRAMERIÆ. U.S. Troches of Krameria

	Metric	Old form
* **Extract of Krameria**	6 Gm.	93 grains
Sugar, in fine powder	65 Gm.	2 oz. av. 128 gr.
Tragacanth, in fine powder	2 Gm.	31 grains
Stronger Orange Flower Water, a sufficient quantity,		
To make one hundred troches	100	100

Rub the powders together until they are thoroughly mixed; then with Stronger Orange Flower Water, form a mass, to be divided into 100 troches.

TROCHISCI POTASSII CHLORATIS. U.S. Troches of Potassium Chlorate

	Metric	Old form
* **Potassium Chlorate,** in fine powder	15 Gm.	231 grains
Sugar, in fine powder	60 Gm.	2 oz. av. 51 gr.
Tragacanth, in fine powder	3 Gm.	46 grains
Water, a sufficient quantity,		
To make one hundred troches	100	100

Mix the Sugar with the Tragacanth by trituration, in a mortar; then transfer the mixture to a sheet of paper, and by means of a bone spatula mix with it the Potassium Chlorate, being careful, by avoiding trituration or pressure, to prevent the mixture from igniting or exploding. Lastly, with Water, form a mass, to be divided into 100 troches.

TROCHISCI SANTONINI. U. S. Troches of Santonin

	Metric	Old form
* **Santonin,** in fine powder	3 Gm.	46 grains
Sugar, in fine powder	90 Gm.	3 oz. av. 76 gr.
Tragacanth, in fine powder	3 Gm.	46 grains
Stronger Orange Flower Water, a sufficient quantity,		
To make one hundred troches	100	100

Rub the powders together until they are thoroughly mixed; then, with Stronger Orange Flower Water, form a mass, to be divided into 100 troches.

Troches of Santonin should be kept in dark amber-colored vials.

TROCHISCI SODII BICARBONATIS. U. S. Troches of Sodium Bicarbonate

	Metric	Old form
* **Sodium Bicarbonate**	18 Gm.	278 grains
Sugar, in fine powder	54 Gm.	1 oz. av. 396 gr.
Myristica, bruised	1 Gm.	15 grains
Mucilage of Tragacanth, a sufficient quantity,		
To make one hundred troches	100	100

Triturate the Myristica with the Sugar, gradually added, until they are reduced to a fine powder, and mix this intimately with the Sodium Bicarbonate; then, with the Mucilage of Tragacanth, form a mass, to be divided into 100 troches.

Confectiones *Confections*

Confections are saccharine, soft solids, in which one or more medicinal substances are incorporated with the object of affording an agreeable form for their administration, and a convenient method for their preservation. Under the old names of *conserves* and *electuaries*, these preparations have been in use for centuries. In the preparation of confections the basis is finely powdered sugar, and the medicinal ingredients must be brought to the condition of a smooth paste or introduced as a fine powder or liquid. Only *two* confections are official.

Official Confections

Confectio Rosæ	80 Gm. Red Rose, in No. 60 powder; 640 Gm. Powdered Sugar; 120 Gm. Clarified Honey; 160 Cc. Stronger Rose Water
Sennæ	100 Gm. Senna, in No. 60 powder; 5 Gm. Oil of Coriander; 160 Gm. Cassia Fistula, bruised; 100 Gm. Tamarind; 70 Gm. Prune; 120 Gm. Fig, bruised; 555 Gm. Powdered Sugar; Water, sufficient to make 1000 Gm.

Unofficial Confections

Name	Ingredients	Preparation
Confectio Piperis. Br.	40 Gm. Black Pepper; 60 Gm. Caraway Fruit; 300 Gm. Clarified Honey	Mix them and form into a mass
Sulphuris. Br.	100 Gm. Sublimed Sulphur; 25 Gm. Acid Potassium Tartrate; 1 Gm. Tragacanth; 50 Cc. Syrup; 12.5 Cc. Tincture of Orange; 37.5 Cc. Glycerin	Mix them and form into a mass

CONFECTIO ROSÆ. U. S. Confection of Rose

	Metric	Old form
* **Red Rose,** in No. 60 powder	80 Gm.	1 oz. av.
Sugar, in fine powder	640 Gm.	8 oz. av.
Clarified Honey	120 Gm.	1½ oz. av.
Stronger Rose Water	160 Cc.	2 fl. oz.
To make about	1000 Gm.	12½ oz. av.

Rub the Red Rose with the Stronger Rose Water previously heated to 65° C. (149° F.), then gradually add the Sugar and Clarified Honey, and beat the whole together until a uniform mass results.

CONFECTIO SENNÆ. U.S. Confection of Senna

	Metric	Old form
* **Senna,** in No. 60 powder	100 Gm.	1 oz. av. 263 gr.
Cassia Fistula, bruised	160 Gm.	2 oz. av. 245 gr.
Tamarind	100 Gm.	1 oz. av. 263 gr.
Prune, sliced	70 Gm.	1 oz. av. 52 gr.
Fig, bruised	120 Gm.	1 oz. av. 403 gr.
Sugar, in fine powder	555 Gm.	8 oz. av. 385 gr.
Oil of Coriander	5 Gm.	30 minims
Water, a sufficient quantity,		
To make	1000 Gm.	16 oz. av.

Digest the Cassia Fistula, Tamarind, Prune, and Fig with 500 Cc. [old form 8 fl. oz.] of Water in a covered vessel, by means of a water-bath, for three hours. Separate the coarser portions and rub the pulpy mass, first through a coarse hair sieve, and then through a muslin cloth. Mix the residue with 150 Cc. [old form 2½ fl. oz.] of Water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy mass first obtained. Then, by means of a water-bath, dissolve the Sugar in the pulpy liquid, and evaporate the whole in a tared vessel, until it weighs 895 Gm. [old form 14 oz. av. 140 gr.]. Lastly, add the Senna and the Oil of Coriander, and incorporate them thoroughly with the other ingredients while they are yet warm.

Average dose.— 60 grains (4 Gm.).

Massæ *Masses*

Pill masses are official in the U. S. Pharmacopœia under the title of "Massa." As the official preparations are usually kept in bulk by pharmacists, and are permanent preparations, there is a manifest propriety in making a distinct class of them. There are *two* official masses.

Official Masses

Name	Proportions	Preparation
Massa Ferri Carbonatis	100 Gm. Ferrous Sulphate; 46 Gm. Monohydrated Sodium Carbonate; 38 Gm. Clarified Honey; 25 Gm. Sugar, in coarse powder; Syrup and Distilled Water, of each, a sufficient quantity to make 100 Gm.	Dissolve the Ferrous Sulphate and the Monohydrated Sodium Carbonate separately in boiling Distilled Water, add 20 Cc. Syrup to the Solution of Ferrous Sulphate, and mix the solutions. When cold, pour off the supernatant liquid, and wash the precipitate with a mixture of 1 volume of Syrup to 19 volumes of Water. Drain the precipitate, mix it with the Honey and Sugar, and evaporate it to 100 Gm.
Hydrargyri	33 Gm. Mercury; 10 Gm. Glycyrrhiza, powdered; 15 Gm. Althæa, powdered; 9 Gm. Glycerin; 33 Gm. Honey of Rose	Triturate the Mercury with the Honey of Rose until it is extinguished, add gradually the Glycerin, Glycyrrhiza, and Althæa, and continue the trituration until the mass is homogeneous

Unofficial Mass

Name	Ingredients	Preparation
Massa Copaibæ. U. S. P. 1890	94 Gm. Copabia; 6 Gm. Magnesia; Water, a sufficient quantity	Uniformly dampen the Magnesia with a little Water, gradually incorporate the Copaiba with it, and heat on a water-bath, during half an hour, frequently stirring. Lastly, set it aside until it has acquired a pilular consistence

MASSA FERRI CARBONATIS. U.S. Mass of Ferrous Carbonate

[VALLET'S MASS]

	Metric	Old form
* **Ferrous Sulphate,** in clear crystals	100 Gm.	8 oz. av.
Monohydrated Sodium Carbonate	46 Gm.	3 oz. av. 298 gr.
Clarified Honey	38 Gm.	3 oz. av.
Sugar, in coarse powder	25 Gm.	2 oz. av.
Syrup,		
Distilled Water, each, a sufficient quantity,		
To make	100 Gm.	8 oz. av.

Dissolve the Ferrous Sulphate and the Monohydrated Sodium Carbonate, each separately, in 200 Cc. [old form 1 pint] of boiling Distilled Water, and, having added 20 Cc. [old form 1½ fl. oz.] of Syrup to the solution of the Iron salt, filter both solutions, and allow them to become cold. Introduce the solution of Monohydrated Sodium Carbonate into a bottle having a capacity of about 500 Cc. [old form 2½ pints] and gradually add the solution of the Iron salt, rotating the bottle constantly or frequently, until carbonic acid gas no longer escapes. Add a sufficient quantity of Distilled Water to fill the bottle; then cork it and set it aside, so that the Ferrous Carbonate may subside. Pour off the supernatant liquid, and, having mixed

Syrup and Distilled Water in the proportion of 1 volume of Syrup to 19 volumes of Distilled Water, wash the precipitate with the mixture by decantation until the washings no longer have a saline taste. Drain the precipitate on a muslin strainer, and express as much of the Water as possible. Lastly, mix the precipitate at once with the Honey and Sugar, and, by means of a water bath, evaporate the mixture in a tared dish, with constant stirring, until it is reduced to 100 Gm. [old form 8 oz. av.].

Average dose.—4 grains (0.250 Gm.).

MASSA HYDRARGYRI. U.S. Mass of Mercury

[BLUE MASS]

	Metric	Old form
* **Mercury**	33 Gm.	5 oz. av. 122 gr.
Glycyrrhiza, in No. 60 powder	10 Gm.	1 oz. av. 263 gr.
Althæa, in No. 60 powder	15 Gm.	2 oz. av. 175 gr.
Glycerin	9 Gm.	1 oz. av. 193 gr.
Honey of Rose	33 Gm.	5 oz. av. 122 gr.
To make	100 Gm.	16 oz. av.

Triturate the Mercury with the Honey of Rose until it is extinguished[1] and globules of mercury are no longer visible under a lens magnifying at least ten diameters. Add the Glycerin, then the Glycyrrhiza and Althæa gradually, and continue the trituration until the mass is homogeneous. Keep the product in well closed containers.

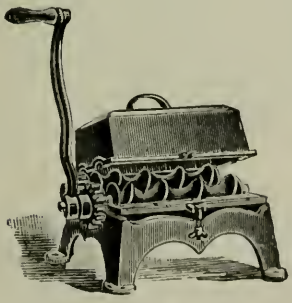
If a portion of the Mass be triturated in a mortar, with warm acetic acid, the filtrate should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid (limit of *mercurous oxide*).

If another portion of the Mass be digested with warm, diluted hydrochloric acid and a little purified animal charcoal, the filtrate should not be affected by hydrogen sulphide T.S., or by stannous chloride T.S. (absence of *mercuric oxide*).

Average dose.—4 grains (0.250 Gm.).

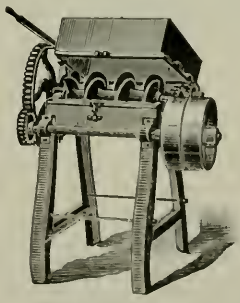
Apparatus for Kneading Masses.—In making masses upon the large scale it is necessary to use mechanical contrivances to secure a thorough admixture of the various ingredients. One of the simplest forms consists of two smooth iron rollers, geared so that they may be

FIG. 696



Day's pill mass mixer

FIG. 697



Day's pill mass mixer

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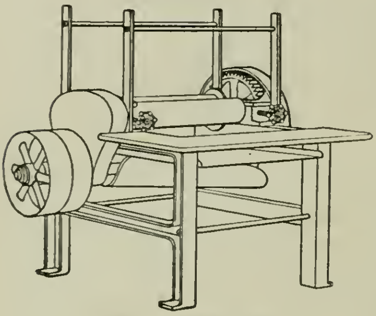
[1] If the mixture should become so thick that the mercury ceases to disappear, a few drops of water shoud be added.

made to approach or recede from each other, revolving in opposite directions and at slightly different rates of speed. The mass roughly mixed is repeatedly passed through the rollers, which may be hollow, so that steam can be introduced inside and thus heated (some masses requiring such treatment), or the rollers can be heated directly on the outside by a row of spirit lamps placed on a table immediately under them. Fig. 696 and 697 illustrate two forms of Day's pill mass mixer. Fig. 696 represents a hand machine having a capacity of three pounds, and Fig. 697 one intended to be run by "power," with a capacity of thirty pounds. They are made of iron and steel, the hoppers are lined with porcelain, and the machine is arranged so that the mass can be discharged when finished, by inclining the machine and revolving the mixers.

Another form of mixer made by the J. H. Day Company is shown in Fig. 698. It is especially designed to incorporate mixtures of extractive matter for pill masses; two steel rollers which can be set, so as to revolve at different distances apart, are secured to a strong iron frame, the operator places the moistened materials that are to be mixed between the rollers, and by continually returning the mass which drops below, it is thoroughly kneaded.

Fig. 698



Day's pill mass rollers

Fig. 699 shows Colton's mass mixer. It is constructed so as to stand heavy work. The double compound gearing will move the double spirals through a very tough mass.

Pilulæ *Pills*

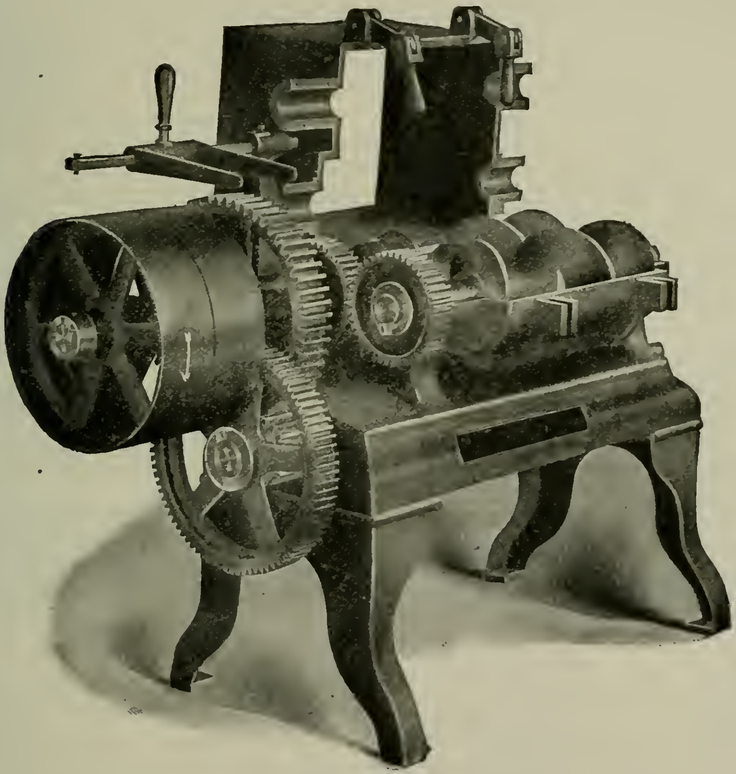
Pills are small, solid bodies, of a globular, ovoid, or lenticular shape, which are intended to be swallowed and thereby produce medicinal action. Pills are more largely used than any other form of solid preparations. Substances which are bitter or unpleasant to the taste, if not corrosive or deliquescent, can be administered in this form if the dose is not too large. The ease and rapidity with which pills can be administered, the length of time during which they retain their original activity, their compact form, and their absence of unpleasant taste when coated, are the principal reasons for their extended use.

In order to give medicinal substances the requisite shape and consistence to form pills, they must be brought into a soft condition and made into a mass, generally through the use of a volatile liquid. The subsequent evaporation of this liquid, or a portion of it, should produce but little change in the form of the pill. As previously stated (page 1210), pill masses are sometimes kept in bulk and made into pills when occasion requires. By far the greatest number, however, are made extemporaneously, and the exercise of the knowledge and perception which are necessary in selecting the proper substance to form the mass constitutes one of the most important duties of the pharmacist. To be able always to select the proper excipient requires a thorough knowledge of the physical properties of all the articles of the materia medica which enter into the composition of pill masses.

Forming the Mass.—The mass consists of two parts: 1. The active ingredients. 2. The excipient, or the substance used to form the mass and give it the proper consistence. The essential requirements of a pill mass are: 1. *Adhesiveness.* 2. *Firmness.* 3. *Plasticity.*

1. **Adhesiveness.**—The mass must be sufficiently adhesive to retain its shape and yet be soft enough to be worked by the fingers or suitable apparatus into the desired form. To enable it to possess adhesiveness, a liquid is usually added to the powdered ingredients, and the selection of this liquid must always depend upon the physical character of the ingredients; in many cases the latter possess sufficient adhesiveness in themselves if they are moistened with water, and hence the quality is *only developed*,—not created, as in the case of powders containing extracts; others, again, are totally devoid of adhesiveness, and sticky substances, like gum, sugar, etc., must be added in sufficient quantity to supply the deficiency. Some substances may be made

Fig. 699



Colton's mass mixer

soft and adhesive by simply heating them, and they regain their original condition when allowed to cool.

2. **Firmness.**—The mass must possess sufficient firmness to permit the pills to retain their shape. The condition of adhesiveness is usually dependent upon the addition of a liquid which dissolves *a small portion* of the solid ingredients, and this solution is adhesive enough to enable the mass to be made; but if too much liquid be added, the quality of firmness will be lost, and the pills either cannot be formed at all, or will subsequently run together in the box. The physical properties of the active ingredients of the pill must be thoroughly understood to judge of the proper quantity and kind of excipient to be used to give adhesiveness without losing firmness. The following general rule may serve to guide the operator: *Never use an excipient alone which is a perfect solvent for the solid substances.* For instance, water should not be used *alone* for making pills of the *soluble* scaled iron salts; for, although the pills may apparently be firm enough when dispensed, they will be very apt in warm weather to run together in the box. If sufficient acacia be used with the water, they can be made to retain their shape.

3. **Plasticity.**—The condition of plasticity is a natural result of the possession of a proper degree of adhesiveness and firmness. Many substances may be formed into a mass which will be either adhesive or firm, but unless these conditions are properly balanced, so that the mass can be quickly and easily formed into pills which will retain their shape without flattening, pills cannot be made successfully. Plasticity can generally be secured by thoroughly working or kneading the mass. In this connection see Fig. 484. The choice of excipient is usually left entirely to the pharmacist, and in making the selection care should be taken that, while the pharmaceutical requirements are fulfilled, the proper solubility or disintegrability of the pill in the stomach is not lost sight of.

Choice of the Excipient.—An examination of the following list of excipients will probably convey a good idea of their uses. They are divided into two classes, liquid and solid. Liquid excipients are generally preferred, because they are more conveniently added to the powders:

List of Excipients

Liquid

Water	Used only when the ingredients of the pill possess sufficient adhesiveness to be developed by the water
Syrup	An excellent excipient when more adhesiveness is needed than can be afforded by the use of water
Syrup of Acacia	Better than syrup, because it is more adhesive, and can be used in smaller quantity. The objection to its use is that the pills made with it are apt to become very hard, and in some cases they may be practically insoluble in the liquids of the stomach
Mucilage of Acacia	More adhesive than any of the preceding, but open to the same objection as syrup of acacia
Glycerin	Somewhat adhesive, but very valuable, because its hygroscopic properties prevent the pills made with it from becoming hard. It is rarely advisable to use it alone, however, as the surfaces of the pills often acquire a dampness which attracts the particles of dusting powder
Glucose	A very valuable excipient. It is colorless, very adhesive, and practically non-volatile at ordinary temperatures
Honey	May be used in place of glucose for dark colored masses, but quinine pills are not white when honey is used as the excipient
Extract of Malt	Has the advantages of glucose, but the disadvantage of honey in not being colorless

List of Excipients—*Continued*

Liquid

Glycerite of Starch	Possesses the merits of glycerin, with the adhesiveness of the starch jelly. Its thick consistence is sometimes an inconvenience
Glycerite of Tragacanth	Similar to glycerite of starch
General Excipient	Suggested by the author as combining the advantages of several of the above (see below)

Solid

Confection of Rose	Useful when a small quantity of an active ingredient is to be made into pills and dilution is necessary, as in pills of strychnine, podophyllin, etc. Its bulkiness is its principal disadvantage for general work
Crumb of Bread (Mica panis)	Valuable for very powerful liquids, like croton oil, volatile oils, etc.
Powdered Althæa	Gives adhesiveness, and is useful as an absorbent, but is bulky
Soap	A very valuable excipient for resinous substances. It increases their solubility, and forms an unexceptionable mass
Rosin Cerate	Valuable for oxidizable substances, resins, etc.
Cacao Butter	Used for pills of potassium permanganate and similar substances
Petrolatum	Used for oxidizable substances like the two preceding excipients

GENERAL EXCIPIENT FOR PILLS

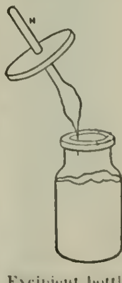
The following excipient is recommended as possessing several advantages. It is a colorless, permanent, very adhesive liquid; the pills made with it are small; and the proportion of glycerin is not large enough to make the surfaces of the pills hygroscopic in an ordinary atmosphere:

Glucose (syrupy)	4 oz. av.
Glycerin	1 oz. av.
Acacia (powdered, best)	90 grains
Benzoic Acid	1 grain

Dissolve the Benzoic Acid in the Glycerin contained in a small tared capsule, add the Acacia with stirring, and then the Glucose, and allow the mixture to stand until the Acacia is dissolved. A *moderate* heat may be applied to hasten solution. The benzoic acid is used as an antiseptic; if the excipient is made in small quantities and frequently, the benzoic acid may be omitted.

In Fig. 700 a simple but effective excipient bottle is shown. It is made from a plain morphine bottle; a piece of sheet rubber cloth, such as is used for making washers, is cut into a disk, slightly larger in diameter than the mouth of the bottle; a hole in the centre permits the introduction of a round, slightly tapering wooden rod, H, or, if preferred, a solid glass rod. It is obvious that as the excipient is used the rod may be slipped down so as always to dip into the excipient a certain distance, and thus the quantity adhering to the end can be easily adjusted. One of the merits of this simple device is that all parts of it can be easily renewed and kept clean.

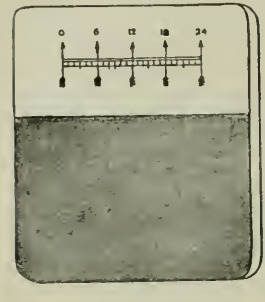
Fig. 700



Excipient bottle

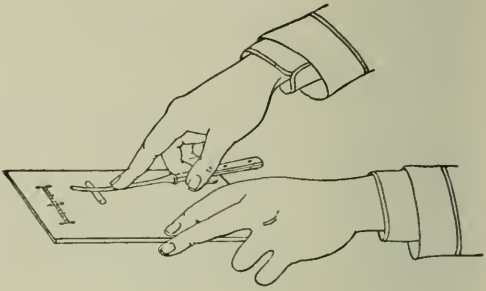
Dividing the Mass.—Upon the small scale the pill tile may be used for this operation (see Fig. 701). This is usually made of queen's ware or porcelain. The objection to this material, however, is that some substances will penetrate through the little fissures in the tile and soil it. These are often very difficult to dislodge, and they usually give the tile a dirty appearance, in spite of the most diligent washing. A few years since, the Whitall Tatum Company made, at the author's suggestion, a pill tile from plate glass, having the scale graduated by an engraver's wheel, and a little over one-half of its surface ground so that the pill cylinder would not slip. This makes an unexceptionable surface. The pill mass is placed upon the tile and rolled into a cylinder, either with a smooth, flat board or a spatula, as shown in Fig. 702. It is then placed upon the graduated scale and cut with the spatula into the desired number of pieces; these are afterwards rolled between the fingers into globular pills.

Fig. 701



Pill tile

Fig. 702



Rolling the pill cylinder

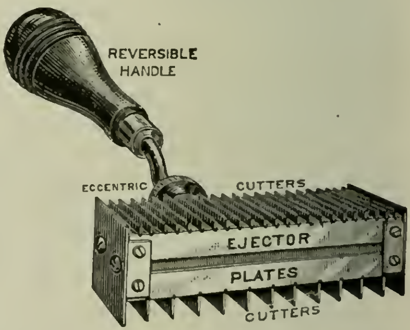
Fig. 703

Pill pestle

Fig. 704

Pill spatula

Fig. 705



Michael's pill cutter

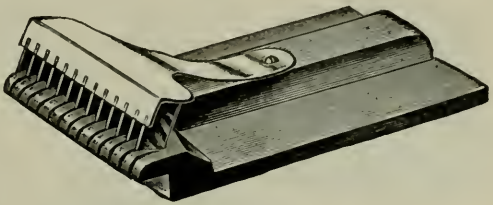
Fig. 703 illustrates a form of pill pestle specially made for kneading a mass in a mortar.

Fig. 704 shows a pill spatula; it has very little "spring," and the end is broad. It is useful in making a mass in a mortar as well as in rolling a pill cylinder. Ordinary steel ointment spatulas, which have the ends broken off or otherwise injured, can often be cut with a three cornered file, and the edge smoothed and made into a serviceable pill spatula.

Fig. 705 shows Michael's pill cutter; it will cut the cylinder into twelve or twenty-four pills at once; by reversing the handle it can be used for making pills of a different size. The Diamond pill cutter is shown in Fig. 706; the pill cylinder is placed under the projecting wooden cross piece, and the metal cutters pressed down upon it; the pieces are then rounded into shape with the fingers.

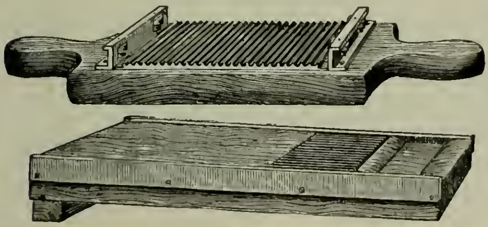
Pill machines are preferred in making larger quantities of pills; indeed, many pharmacists never use a pill tile, but divide and cut all their pills with a machine. This consists of two hard wood boards, one of which is encased in a metal frame (to prevent warping); a brass plate having hemispherical grooves is fastened to one end of the lower board, and a similar plate is adjusted to the upper board, which is furnished with handles at the end; brass guides are attached to the upper board, to cause the cutting surfaces of the grooves on both boards to correspond (see Figs. 707, 708). The pill mass is rolled into a cylinder and laid upon the grooves of the lower board; the upper board is then applied so that the cutting surfaces correspond with those of the lower board, and, by a slight backward and forward motion with downward pressure, the mass is divided.

Fig. 706



Diamond pill cutter

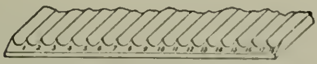
Figs. 707, 708



Pill machine

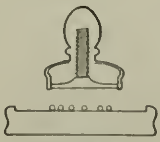
When a smaller number of pills are needed than the full capacity of the cutters indicates, the cylinder is rolled out merely to the length necessary to make the desired quantity. In using the pill machine in this way a common annoyance is experienced, however, in having either to count off the number of grooves each time, or to deface the board with lines. The simple expedient proposed by the author in 1875, and shown in Fig. 709, obviates this. The lower cutter is removed from the board, and its edge is bevelled off so that sufficient space may be gained to stamp a small figure below each cutting edge. Pill machines with this addition may be had from A. H. Wirz, of Philadelphia. The Cooper pill machine is so constructed that but one lower and one upper board

Fig. 709



Pill cutter (numbered edge)

Fig. 710

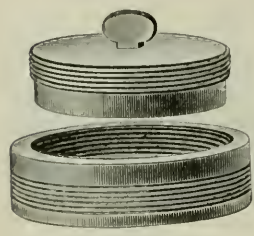


Pill finisher

are necessary for making several sizes of pills. This object is effected by making the cutters for the various sizes removable and adjustable.

Dusting Powder.—To prevent the pill cylinder from sticking to the board or tile, and to lessen the friction, some absorbent powder is dusted upon the surfaces. This may be rice flour, powdered magnesium carbonate, lycopodium, powdered althæa, or powdered licorice root. Rice flour is preferable for white pills, because its presence is not easily recognized, and because the cylinder does not slip, as it usually does when lycopodium is used.

Fig. 711



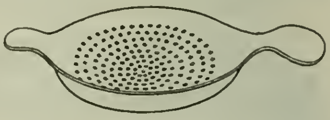
Pill finisher

Finishing the Pills.—Many efforts have been made to supply effective mechanical devices for finishing pills, yet the fact remains that the pharmacist usually prefers to roll and finish them with his fingers. If a finisher is desired, a level surface having a raised rim may be used, and the pills enclosed and rotated by the adjustable pill finisher shown in Fig. 710.

Fig. 711 shows another form of pill finisher; it is made of metal. In Fig. 712 is seen a pill sifter; it is made of horn and perforated with holes. Pills which are moist are placed in a dusting powder, and when the surface moisture has been absorbed, they are thrown upon the sifter and shaken about gently until freed from adhering superfluous powder.

When large quantities of pills are made, they are usually dried by rolling them in some absorbent powder, spreading them out, and exposing them to dry air.

Fig. 712

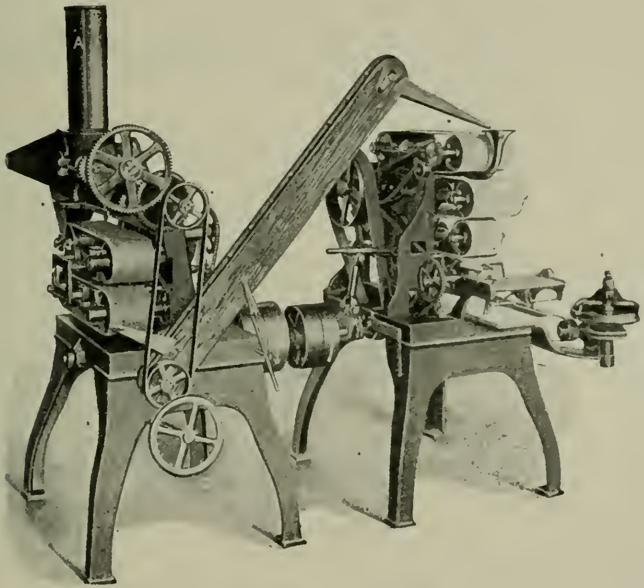


Horn pill sifter

In Fig. 713 is shown a machine for making pills, manufactured by Arthur Colton, of Detroit. It is, of course, complicated; but when the great number of operations that are required in making pills is considered, the results achieved by this apparatus are marvellous. The illustration shows two machines; the one on the left, called the ball making machine, makes the mass homogeneous, and delivers it covered with dusting powder in the shape of balls into the hopper of the machine on the right, which is known as the *Automata*. As each ball is thus delivered to the piping belts of the Automata, a series of operations immediately begins; as it rapidly advances through and toward its destination, it becomes elongated into a strip or pipe; it is rolled many hundred times about its own diameter, and a gentle pressure is given to it as it advances between the belts, sustained from two points of contact; when the pipe is finished, it will have passed through the entire pathway designed for piping, when it now drops on to revolving cutters, where it is divided into pieces of uniform size and weight; these pieces thus cut, drop on to a chute, which conveys them to the entrance of the pill rounding belts; when once drawn in, and between these belts, they are thoroughly rolled, each advancing forward, and by many hundreds side by side, as they go whirling through the automatic finisher; they are now hastened onward until they reach the separator, where a system of sorting is carried on, by which eventually the good pills are retained, and the tailings are rejected. It is possible to make, with the No. 0 automatic pill machine, 864,000 two-grain pills in ten hours' time.

Dispensing Pills.—Pills are usually dispensed in flat circular boxes. These should be made so shallow that the pills cannot lie on top of one another. Square pill boxes are coming into use, and are preferred to round boxes for several reasons, the principal one being that a square label can be used. This can be trimmed more neatly and quickly than a round label, and, in the opinion of many pharmacists of taste, looks better. A small quantity of dusting powder should be placed in the box to prevent the adhesion of freshly made pills.

Fig. 713



Colton's modern pill plant

Official Pills

Pilulæ Aloes	Made by forming a mass, with the aid of water, from 13 Gm. of Purified Aloes and 13 Gm. of Soap, and dividing it into 100 pills
Aloes et Ferri	Made by forming a mass, with the aid of Confection of Rose, from 7 Gm. each of Purified Aloes, Exsiccated Ferrous Sulphate, and Aromatic Powder, and dividing it into 100 pills
Aloes et Mastiches	Made by forming a mass, with the aid of Diluted Alcohol, from 13 Gm. of Purified Aloes, 4 Gm. of Mastic, and 3 Gm. of Red Rose, and dividing it into 100 pills
Aloes et Myrrhæ	Made by forming a mass, with the aid of Syrup, from 13 Gm. of Purified Aloes, 6 Gm. of Myrrh, and 4 Gm. of Aromatic Powder, and dividing it into 100 pills
Asafœtidæ	Made by forming a mass, with the aid of water, from 20 Gm. of Asafetida and 6 Gm. of Soap, and dividing it into 100 pills
Catharticæ Compositæ	Made by forming a mass, with the aid of Diluted Alcohol, from 80 Gm. of Compound Extract of Colocynth, 60 Gm. of Mild Mercurous Chloride, 20 Gm. of Resin of Jalap, and 15 Gm. of Gamboge, and dividing the mass into 1000 pills

Official Pills—*Continued*

Catharticæ Vegetabiles	Made by forming a mass, with the aid of Diluted Alcohol, from 60 Gm. of Compound Extract of Colocynth, 30 Gm. of Extract of Hyoscyamus, 20 Gm. of Resin of Jalap, 15 Gm. of Extract of Leptandra, 15 Gm. of Resin of Podophyllum, and 8 Cc. of Oil of Peppermint, and dividing it into 1000 pills
Ferri Carbonatis	Made by rubbing 8 Gm. of Potassium Carbonate with about 10 drops each of Glycerin and Water, then adding 16 Gm. of Granulated Ferrous Sulphate which has been previously mixed with 4 Gm. of Sugar, and triturating the whole until the reaction has terminated. Finally add 1 Gm. each of powdered Tragacanth and Althæa and enough more water to form a mass, and divide it into 100 pills
Ferri Iodidi	Made by triturating together 4 Gm. of Reduced Iron, 6 Cc. of Water, and 5 Gm. of Iodine, until the liquid ceases to have a reddish tint, then adding 4 Gm. of Glycyrrhiza, 4 Gm. of Sugar, and 1 Gm. each of Extract of Glycyrrhiza and Acacia (all in fine powder and thoroughly mixed), evaporating the mass until it has acquired a pilular consistence, and then dividing it into 100 pills, and finally coating the pills with a solution made by dissolving 10 Gm. of Balsam of Tolu in 15 Cc. of Ether
Laxativæ Compositæ	Made by forming a mass, with the aid of Syrup, from 1.3 Gm. of Aloin, 0.05 Gm. of Strychnine, 0.8 Gm. of Extract of Belladonna Leaves, 0.4 Gm. of Ipecac, and 4.6 Gm. of Glycyrrhiza, and dividing it into 100 pills
Opii	Made by forming a mass, with the aid of Water, from 6.5 Gm. of powdered Opium and 2 Gm. of powdered Soap, and dividing it into 100 pills
Phosphori	Made by dissolving 0.06 Gm. of Phosphorus in 5 Cc. of Chloroform, with the aid of a little heat, adding the solution to 6 Gm. of Althæa and 3 Gm. of Acacia, forming a mass, with the aid of a mixture of Glycerin 2 parts and Water 1 part, and dividing it into 100 pills, and finally coating the pills with a solution prepared by dissolving 10 Gm. of Balsam of Tolu in 15 Cc. of Ether
Podophylli, Belladonnæ et Capsici	Made by forming a mass, with the aid of equal parts of Glycerin and Syrup, from 1.6 Gm. of Resin of Podophyllum, 0.8 Gm. of Extract of Belladonna Leaves, 3.2 Gm. of Capsicum, 6.5 Gm. of Sugar of Milk, and 1.6 Gm. of Acacia, and dividing it into 100 pills
Rhei Compositæ	Made by forming a mass, with the aid of Water, from 13 Gm. of powdered Rhubarb, 10 Gm. of Purified Aloes, 6 Gm. of powdered Myrrh, and 0.5 Cc. of Oil of Peppermint, and dividing it into 100 pills

Unofficial Pills

Name	Ingredients	Preparation
Pilulæ Aloes et Asafœtidæ. U. S. P. 1890	9 Gm. Purified Aloes; 9 Gm. Asafetida; 9 Gm. powdered Soap; Water, a sufficient quantity to make 100 pills	Beat the solids together with Water, to form a mass, and divide it into 100 pills
Pilula Aloes Socotrinæ. Br.	40 Gm. Socotrine Aloes; 20 Gm. Hard Soap; 2.5 Cc. Oil of Nutmeg; 20 Gm. Confection of Rose	Mix and form a mass
Pilulæ Antimonii Compositæ. U. S. P. 1890	4 Gm. Sulphurated Antimony; 4 Gm. Mild Mercurous Chloride; 8 Gm. Guaiac; Castor Oil, sufficient to make 100 pills	Form a mass, from the powders, with the aid of the Castor Oil, and divide it into 100 pills
Pilula Cambogiæ Composita. Br.	25 Gm. Gamboge; 25 Gm. Barbados Aloes; 25 Gm. Compound Powder of Cinnamon; 50 Gm. Hard Soap, all in powder; Syrup of Glucose, a sufficient quantity	Mix and form into a mass. Dose, four to eight grains (0.25 to 0.5 Gm.)
Colocynthidis Composita. Br.	20 Gm. Colocynth Pulp; 40 Gm. Barbados Aloes; 40 Gm. Scammony Resin; 5 Gm. Potassium Sulphate; 5 Cc. Oil of Cloves; Water, a sufficient quantity	Mix the Oil of Cloves with the Potassium Sulphate, add the Colocynth Pulp; mix; add the Barbados Aloes and Scammony Resin, then form into a mass with the aid of Water. Dose, four to eight grains (0.25 to 0.5 Gm.)
Colocynthidis et Hyoscyami. Br.	50 Gm. Compound Pill of Colocynth; 25 Gm. Extract of Hyoscyamus	Mix and form into a mass. Dose, four to eight grains (0.25 to 0.5 Gm.)

Unofficial Pills—*Continued*

Name	Ingredients	Preparation
Galbani Composita. Br.	50 Gm. Asafetida; 50 Gm. Galbanum; 50 Gm. Myrrh; 25 Gm. Syrup of Glucose	Heat all together on a water-bath, stirring until the mass is uniform in consistence
Ipecacuanhæ cum Scillæ. Br.	30 Gm. Compound Powder of Ipecacuanha; 10 Gm. Squill; 10 Gm. Ammoniacum; Syrup of Glucose, a sufficient quantity	Mix and form a mass. Dose, four to eight grains (0.25 to 0.5 Gm.)
Plumbi cum Opio. Br.	6 Gm. Lead Acetate; 1 Gm. Opium, in powder; 0.7 Gm. Syrup of Glucose	Mix and form a mass. Dose, two to four grains (0.125 to 0.25 Gm.)
Quininæ Sulphatis. Br.	3 Gm. Quinine Sulphate; 0.1 Gm. Tartaric Acid; 0.4 Gm. Glycerin; 0.1 Gm. Tragacanth	Triturate the Quinine Sulphate with the Tartaric Acid, and form a mass with the mixed Glycerin and Tragacanth. Dose, two to eight grains (0.125 to 0.5 Gm.)
Pilulæ Rhei. U. S. P. 1890	20 Gm. Rhubarb; 6 Gm. Soap; Water, a sufficient quantity to make 100 pills	Beat the powders together with sufficient Water to form a mass, and divide it into 100 pills
Pilula Saponis Composita. Br.	10 Gm. Opium, in powder; 30 Gm. Hard Soap; 10 Gm. Syrup of Glucose	Mix and form a mass. Dose, two to four grains (0.125 to 0.25 Gm.)
Scammonii Composita. Br.	25 Gm. Scammony Resin; 25 Gm. Jalap Resin; 25 Gm. Curd Soap; 75 Cc. Tincture of Ginger	Add the Tincture of Ginger to the Soap and Resins, form a solution with the aid of a gentle heat, and continue evaporation until it has acquired a pilular consistence
Scillæ Composita. Br.	25 Gm. Squill; 20 Gm. each of Ginger, Ammoniacum, Hard Soap, all in powder, and 20 Gm. Syrup of Glucose	Mix and form a mass. Dose, four to eight grains (0.25 to 0.5 Gm.)

Official Pills.—The following formulas for pills have been adopted by the U. S. P. (8th Rev.) with the view of securing uniformity in their preparation :

PILULÆ ALOES. U.S. Pills of Aloes

	Metric	Old form
* **Purified Aloes,** in fine powder	13 Gm.	200 grains
Soap, in fine powder	13 Gm.	200 grains
Water, a sufficient quantity,		
To make one hundred pills	100	100

Mix the powders intimately, then incorporate sufficient Water to form a mass, and divide it into 100 pills.

Average dose.— 2 pills.

PILULÆ ALOES ET FERRI. U.S. Pills of Aloes and Iron

	Metric	Old form
* **Purified Aloes,** in fine powder	7 Gm.	108 grains
Exsiccated Ferrous Sulphate	7 Gm.	108 grains
Aromatic Powder	7 Gm.	108 grains
Confection of Rose, a sufficient quantity,		
To make one hundred pills	100	100

Mix the powders intimately, then incorporate sufficient Confection of Rose to form a mass, and divide it into 100 pills.

Average dose.— 2 pills.

PILULÆ ALOES ET MASTICHES. U.S. Pills of Aloes and Mastic

[LADY WEBSTER PILLS]

	Metric	Old form
* **Purified Aloes,** in fine powder	13 Gm.	200 grains
Mastic, in fine powder	4 Gm.	62 grains
Red Rose, in fine powder	3 Gm.	46 grains
Diluted Alcohol, a sufficient quantity,		
To make one hundred pills	100	100

Mix the powders intimately, then incorporate sufficient Diluted Alcohol to form a mass, and divide it into 100 pills.

Average dose.— 2 pills.

PILULÆ ALOES ET MYRRHÆ. U.S. Pills of Aloes and Myrrh

	Metric	Old form
* **Purified Aloes,** in fine powder	13 Gm.	200 grains
Myrrh, in fine powder	6 Gm.	93 grains
Aromatic Powder	4 Gm.	62 grains
Syrup, a sufficient quantity,		
To make one hundred pills	100	100

Mix the powders intimately, then incorporate sufficient Syrup to form a mass, and divide it into 100 pills.

Average dose.— 2 pills.

PILULÆ ASAFŒTIDÆ. U.S. Pills of Asafetida

	Metric	Old form
* **Asafetida**	20 Gm.	309 grains
Soap, in fine powder	6 Gm.	93 grains
Water, a sufficient quantity,		
To make one hundred pills	100	100

Beat the solids together with Water, so as to form a mass, and divide it into 100 pills.

Average dose.— 2 pills.

PILULÆ CATHARTICÆ COMPOSITÆ. U.S. Compound Cathartic Pills

	Metric	Old form
* **Compound Extract of Colocynth**	80 Gm.	2 oz. av. 360 gr.
Mild Mercurous Chloride	60 Gm.	2 oz. av. 50 gr.
Resin of Jalap, in fine powder	20 Gm.	309 grains
Gamboge, in fine powder	15 Gm.	231 grains
Diluted Alcohol, a sufficient quantity,		
To make one thousand pills	1000	1000

Mix the powders intimately, then incorporate a sufficient quantity of Diluted Alcohol to form a mass, and divide it into 1000 pills.

Average dose.— 2 pills.

PILULÆ CATHARTICÆ VEGETABILES. U.S. Vegetable Cathartic Pills

	Metric	Old form
* **Compound Extract of Colocynth**	60 Gm.	2 oz. av. 50 gr.
Extract of Hyoscyamus	30 Gm.	1 oz. av. 25 gr.
Resin of Jalap, in fine powder	20 Gm.	309 grains
Extract of Leptandra	15 Gm.	231 grains
Resin of Podophyllum	15 Gm.	231 grains
Oil of Peppermint	8 Cc.	130 minims
Diluted Alcohol, a sufficient quantity,		
To make one thousand pills	1000	1000

Mix the Compound Extract of Colocynth intimately with the Resin of Podophyllum, Resin of Jalap, and Extract of Leptandra, and then add the Oil of Peppermint. Rub the Extract of Hyoscyamus with enough Diluted Alcohol to render it plastic, then incorporate it with the mixture first prepared, using a sufficient quantity of Diluted Alcohol to form a mass, and divide it into 1000 pills.

Average dose.— 2 pills.

PILULÆ FERRI CARBONATIS. U. S. Pills of Ferrous Carbonate

[Blaud's Pills Chalybeate Pills Ferruginous Pills]

	Metric	Old form
* **Granulated Ferrous Sulphate**	16 Gm	247 grains
Potassium Carbonate	8 Gm.	124 grains
Sugar	4 Gm.	62 grains
Tragacanth, in fine powder	1 Gm.	15 grains
Althæa, in No. 60 powder	1 Gm.	15 grains
Glycerin,		
Water, each, a sufficient quantity,		
To make one hundred pills	100	100

Rub the Potassium Carbonate, in a mortar, with a sufficient quantity (about 10 drops each) of Glycerin and Water, then add the Ferrous Sulphate and Sugar, previously triturated together to a uniform powder, and rub the mass thoroughly, until it assumes a greenish color. When the reaction has terminated, incorporate the Tragacanth and Althæa, and, if necessary, add a little more Water, so as to obtain a mass of pilular consistence. Divide this into 100 pills.

These pills should be freshly prepared when wanted.

Average dose.— 2 pills.

PILULÆ FERRI IODIDI. U.S. Pills of Ferrous Iodide

	Metric	Old form
* **Reduced Iron**	4 Gm.	62 grains
Iodine	5 Gm.	77 grains
Glycyrrhiza, in No. 60 powder	4 Gm.	62 grains
Sugar, in fine powder	4 Gm.	62 grains
Extract of Glycyrrhiza, in fine powder	1 Gm.	15 grains
Acacia, in fine powder	1 Gm.	15 grains
Water,		
Balsam of Tolu,		
Ether, each, a sufficient quantity,		
To make one hundred pills	100	100

To the Reduced Iron, contained in a small mortar, add 6 Cc. [old form 100 minims] of Water, and then, gradually, the Iodine with constant stirring, until the liquid ceases to have a reddish tint. Then add the remaining powders, previously well triturated together, and mix the whole thoroughly. Transfer the mass to a porcelain dish, and evaporate the excess of moisture, on a water-bath, with constant stirring, until the mass has acquired a pilular consistence. Then divide it into 100 pills.

Dissolve 10 Gm. [old form 154 grains] of Balsam of Tolu in 15 Cc. [old form 243 minims] of Ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally rolling them about until the drying is completed. Keep the pills in a well-stoppered bottle.

Pills of Ferrous Iodide should be devoid of the smell of iodine.

If a few of the pills be triturated with water, and the liquid filtered, the filtrate should not assume more than a light blue tint upon the addition of starch T.S. (absence of more than traces of *free iodine*).

Average dose.— 2 pills.

PILULÆ LAXATIVÆ COMPOSITÆ. U.S. Compound Laxative Pills

	Metric	Old form
* **Aloin**	1.30 Gm.	20 grains
Strychnine	0.05 Gm.	¾ grain
Extract of Belladonna Leaves	0.80 Gm.	12¼ grains
Ipecac, in fine powder	0.40 Gm.	6 grains
Glycyrrhiza, in fine powder	4.60 Gm.	71 grains
Syrup, a sufficient quantity,		
To make one hundred pills	100	100

Triturate the Aloin, Strychnine, Ipecac, and Glycyrrhiza together thoroughly, so as to produce a uniform powder. Incorporate with this the Extract of Belladonna Leaves and sufficient Syrup to form a mass, and divide it into 100 pills.

Average dose.— 2 pills.

PILULÆ OPII. U.S. Pills of Opium

	Metric	Old form
* **Powdered Opium**	6.5 Gm.	100 grains
Soap, in fine powder	2.0 Gm.	31 grains
Water, a sufficient quantity,		
To make one hundred pills	100	100

Mix the powders intimately, then incorporate sufficient Water to form a mass, and divide it into 100 pills.

Average dose.— 1 pill.

PILULÆ PHOSPHORI. U.S. Pills of Phosphorus

	Metric	Old form
* **Phosphorus**	0.06 Gm.	1 grain
Althæa, in No. 60 powder	6.00 Gm.	93 grains
Acacia, in fine powder	3.00 Gm.	46 grains
Chloroform,		
Glycerin,		
Water,		
Balsam of Tolu,		
Ether, each, a sufficient quantity,		
To make one hundred pills	100	100

Dissolve the Phosphorus, in a test-tube, in 5 Cc. [old form 81 minims] of Chloroform, with the aid of a very gentle heat, replacing from time to time any of the Chloroform which may be lost by evaporation. Mix the Althæa and Acacia in a mortar, next add the solution of Phosphorus, then immediately afterwards a sufficient quantity, about 4 Cc. [old form 65 minims], of a mixture of 2 volumes of Glycerin and 1 volume of Water, and quickly form a mass; divide it into 100 pills.

Dissolve 10 Gm. [old form 154 grains] of Balsam of Tolu in 15 Cc. [old form 243 minims] of Ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally rolling them about until the drying is completed. Keep the pills in a well-stoppered bottle.

Average dose.— 1 pill.

PILULÆ PODOPHYLLI, BELLADONNÆ ET CAPSICI. U.S. Pills of Podophyllum, Belladonna, and Capsicum

	Metric	Old form
* **Resin of Podophyllum**	1.6 Gm.	24½ grains
Extract of Belladonna Leaves	0.8 Gm.	12¼ grains
Capsicum, in moderately fine powder	3.2 Gm.	49 grains
Sugar of Milk, in fine powder	6.5 Gm.	100 grains
Acacia, in fine powder	1.6 Gm.	24½ grains
Glycerin,		
Syrup, each, a sufficient quantity,		
To make one hundred pills	100	100

Triturate the Resin of Podophyllum, Capsicum, Sugar of Milk, and Acacia together to produce a uniform powder. Incorporate with this the Extract of Belladonna Leaves and sufficient of a mixture of equal parts of Glycerin and Syrup to form a mass; divide it into 100 pills.

Average dose.— 1 pill.

PILULÆ RHEI COMPOSITÆ. U. S. Compound Pills of Rhubarb.

	Metric	Old form
* **Rhubarb,** in No. 60 powder	13.0 Gm.	200 grains
Purified Aloes, in fine powder	10.0 Gm.	154 grains
Myrrh, in fine powder	6.0 Gm.	93 grains
Oil of Peppermint	0.5 Cc.	8 minims
Water, a sufficient quantity,		
To make one hundred pills	100	100

Mix the Oil of Peppermint intimately with the powders, then incorporate sufficient Water to form a mass; divide it into 100 pills.

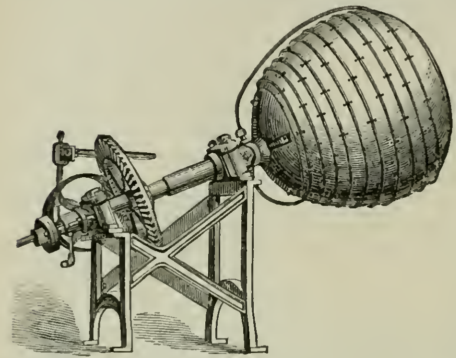
Average dose.— 2 pills.

COATING PILLS

Pills are coated with sugar, chocolate, gelatin, silver leaf, gold leaf, salol, keratin, and talcum or French chalk, with the view of masking their taste.

Sugar Coating.—The sugar coating of pills is carried on upon a very large scale in this country. The pills are carefully dried, placed in a round bottomed copper pan, a mixture of syrup and starch added, the whole heated, and the pan kept moving constantly, so that a rotary motion is imparted. While evaporation takes place, additions of syrup are made from time to time, so that a crust of sugar gradually forms upon the surface of each pill. Fig. 714 shows the usual form of pill coater. The rotary motion and heating of the copper pan are effected by the use of steam. In Fig. 715 is shown a small "table coating pan," made by the F. J. Stokes Machine Company, to be employed without the use of steam coils. It is intended to be bolted on a table or bench, and is not adapted to the coating of a large number of pills. A polish is given to the pills by agitating them in a bag or rolling them in a shaker in contact with a piece of wax or paraffin, or by using a machine like that shown in Fig. 716. It is made by the F. J. Stokes Machine Company, of Philadelphia. The inside of the circular holder is lined with canvas which holds the paraffin, and it is rotated by steam power.

Fig. 714



Machine for sugar coating pills

Chocolate coated pills are made like sugar coated pills, chocolate being added to the pan to flavor and color the coating. It is suspected, however, that some manufacturers replace the real substance with sufficient "burnt umber" or similar coloring to match the color of the chocolate.

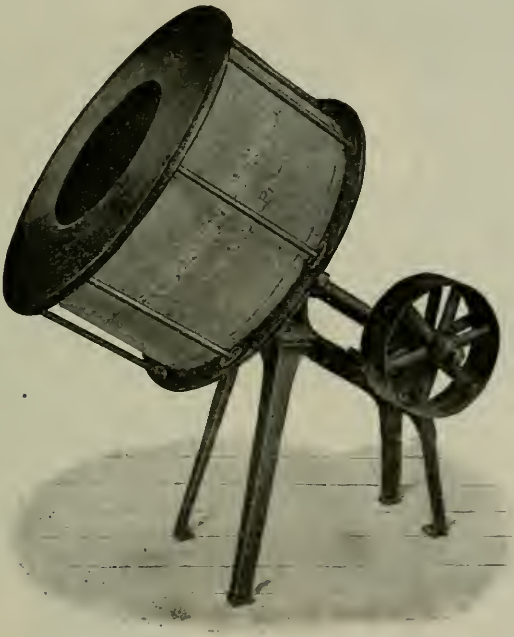
Pills cannot be satisfactorily coated with sugar in the small way without much labor. This is not the case with gelatin coating. It is quite possible for the pharmacist to coat pills with gelatin and be able to dispense them in fifteen minutes.

Fig. 715

Small table coating pan

Gelatin Coating.—The coating of pills with gelatin is an old process. Formerly each pill was impaled upon a long needle, dipped into a solution of gelatin, and the end of the needle stuck into a cork to permit the coating to dry. This slow process was improved by Charles B. Allaire, who devised a machine for dipping a number of pills at once, and also one for stripping the needle bar. Since then many machines have been introduced for coating pills with gelatin, and since the introduction of sugar, gum, or saccharin in small quantities to the gelatin mass their use is likely to increase. Prof. Patch's coater is shown in Fig. 717. The dried pills, which must not be made with glycerin, roll down the inclined grooves, shown in the tray in the drawing, until each of the hemispherical depressions at the end of the groove contains a pill. A wooden strip armed with sixteen needles is inverted over the sixteen pills in the depressions, and the points of the needles are pressed into them until every one is impaled. The adjustable handle is now attached, and the pills are dipped into a hot aqueous solution of gelatin (page 1231), and then gently twirled until the coating has set, when the strip is transferred to the catch in the wheel. This wheel is made to rotate, first in one direction and then in the opposite, by alternately pulling and relaxing the string attached to the axle. This rapidly dries the coating. The needles are stripped of the pills by engaging them in the comb, which is shown in the cut. In the Franciscus pill coater the needles are set in a brass bar, and the rotation is in a different direction (see Fig. 718). Other machines are favorably known. In the larger sized Porcupine pill coater the revolution of the cylinder to which the needle bars are attached is effected by clock work.

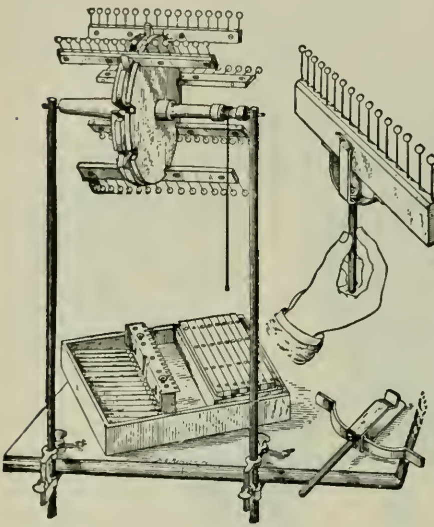
Fig. 716



Machine for polishing pills

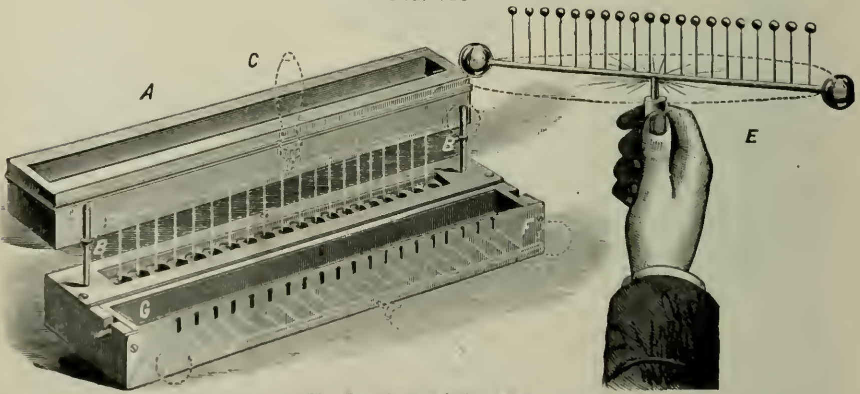
Maynard's pill coater is illustrated by Figs. 719, 720, 721, 722, 723, and 724. It is operated by first placing the flat metallic ring, F, around the feeding plate, E, and pouring the pills into the cup which is thus formed. The conical indentations in E are filled, and the excess of pills remaining on the top of the plate is permitted to roll off into a box. The dipper or needle holder, D, is then placed in position immediately over the pills on the feeding plate, the guide pins on the sides securing accuracy in centring the pills with the needle points. The handle of the needle holder is then pressed downward until the points of the needles enter the pills nearly to their centres. The pills, after they are impaled, as seen at C, are dipped into the melted gelatin solution. The needle holder is then slowly revolved in the air in order to facilitate the even distribution of the gelatin film on the surface of the pills. When the film becomes thoroughly cold, it should be solid enough to permit the pills to be stripped from the needles. It is well to have two needle holders, so that while the gelatin on the pills on one is solidifying the other may be started on the coating. In this way the process is rendered continuous. When the coating on the pills is sufficiently hard, the pills are stripped from the needles by grasping the circular plate on the needle holder with one hand and pulling the handle of the needle holder upward. The pills drop off, and should be deposited on the tray of wire gauze, B, to dry. The circular plate through which the needles pass should be slightly greased with cosmoline to prevent the pills from adhering to it. The gelatin solution is heated in an agate ironware dish, set in a copper water bath having a cover. This arrangement prevents a film from forming on the surface and aids in retaining the uniformity of the gelatin solution. When the pills are not being dipped, the cover should be kept on the dish.

Fig. 717



Prof. Patch's gelatin coater

Fig. 718

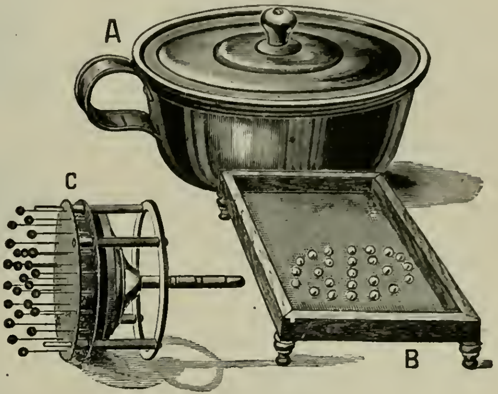


The Franciscus gelatin coater

A pill coater is shown in Fig. 725 which was devised by A. J.

Palethorpe, of Bingham, Notts, England. It is similar to Maynard's pill coater, but it has some advantages over it. It is made very substantially; the shape of the needle plate is hexagonal instead of round, and this prevents it from rolling off the counter. It is used, according to the directions of Mr. Palethorpe, as follows:

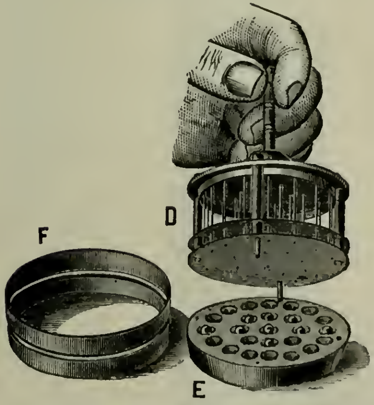
Figs. 719, 720, 721



Maynard's pill coater

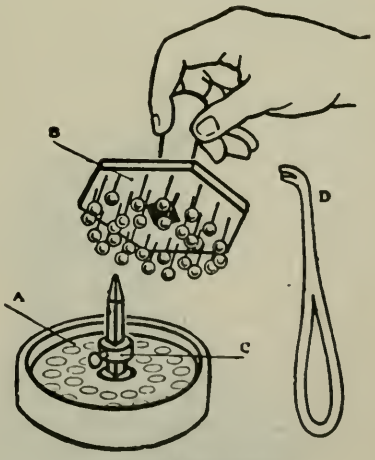
"Place the pills, free from powder, in the tray, A, and give this a turn. The pills having 'found' the holes, take the needle plate, B, by the handle, and having regulated the sliding bar, C, so that the needles may be depressed the proper depth, pass the plate on to the guide through the square hole, and with a firm and even pressure, press the needles into the pills and remove the plate. Now dip the pills completely into the solution, and just before removal allow them to rest on the surface of the solution for a second to remove the excess. Reverse the plate, with the pills upward, turn in the hand until the solution ceases to run, and set aside for a short time to harden. This is best effected by raising the sliding bar and resting the plate thereon, the pills being all clear of the woodwork. When sufficiently dry, remove the plate and pluck off the pills with the hook D. The pills are thus not touched by the fingers at all. If it is important to get rid of the needle holes, carefully apply a 'spot' of gelatin solution, diluted to half strength with water, with a camel's

Figs. 722, 723, 724



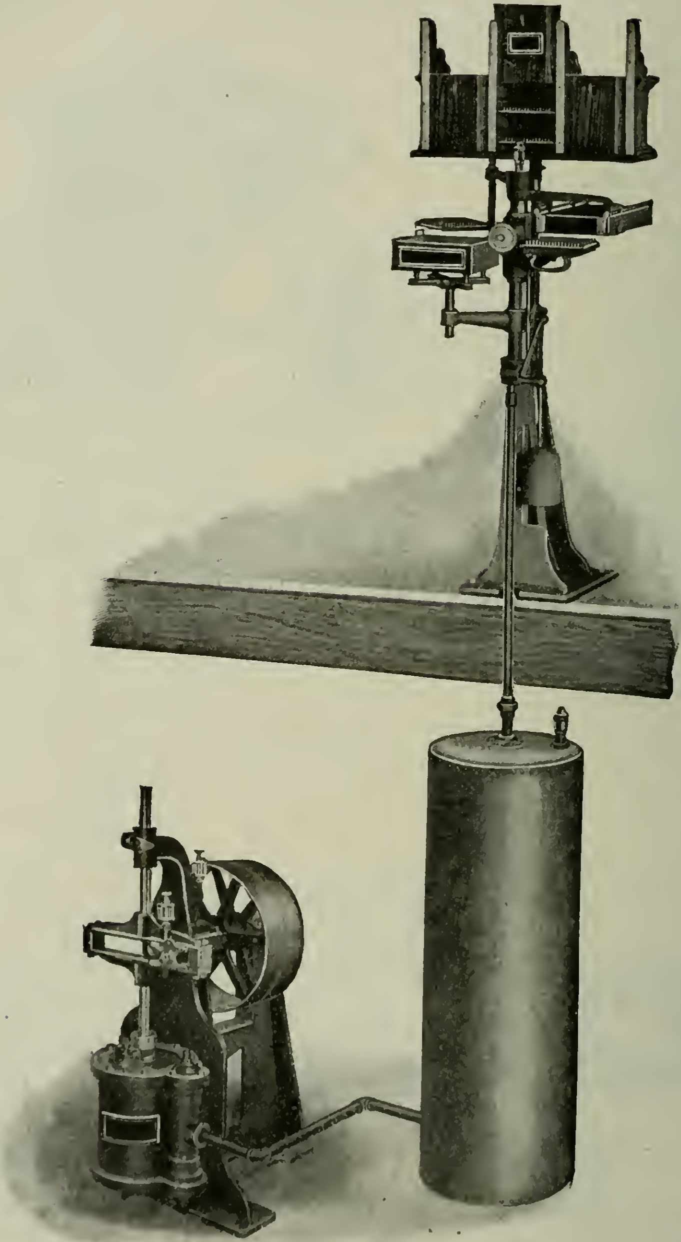
Maynard's pill coater

Fig. 725



Palethorpe's gelatin coater

FIG. 726



Colton's gelatin coater

hair pencil, taking care not to leave an excess of gelatin over the holes, and allow to dry."

A valuable invention in coating pills with gelatin was made by J. B. Russell. Needles for impaling the pills before dipping have been discarded, and the pills are held firmly upon the ends of tubes by suction, the tubes being connected with a box from which the air has been exhausted by a vacuum pump. A little over one-half of each pill is dipped in the gelatin solution. This is rapidly dried. Subsequently the pill is reversed, and the uncoated portion is then dipped, thus completing the coating. The process is used in the laboratory of Parke, Davis & Co.

The great demand for gelatin coated pills has stimulated the manufacturers to perfect machines for making them on a large scale. Fig. 726 shows one of these made by Arthur Colton, of Detroit. It is not the largest made by this firm, although this one has the capacity to coat 50,000 pills in ten hours. The vacuum pump and tank is seen in position on the floor below, but it may be located in any convenient place. After the pills are made and seasoned they are ready for coating. The pill drawer is first stored with pills, the front of which contains a feeding plate, registering with the dipping plate. The latter is now placed upon the vacuum jacket and clamped to place; the pill drawer is then pulled forward, which brings the feeder exactly in proximity with the dipping plate. The vacuum being on, the pills are carefully brushed upon the feeding plate, when every receptacle will be filled. The pills are held in place by the force of the suction supplied from the exhaust tank. The pill drawer is returned to its place, and the vacuum jacket (containing the dipping plate and pills) is now reversed for immersion. This done, the jacket is inverted to the first position and the vacuum shut off. The plate is released from its seat and then placed in the kiln to dry the pills, after which the operation is repeated, leaving but one plate (for the beginning of reverse operations). This is placed upon the vacuum jacket, precisely in the same manner as previously described. The plate is now taken from the drying kiln and placed securely upon the transferring apparatus; then, with the lever, the two are brought into close contact, one above the other. The force of the vacuum acting through the perforations will immediately release the pills, transferring them instantly to the dipping plate on the jacket. The operator then proceeds to immerse the uncoated half of pills in the manner first described.

The vacuum can be regulated by a valve on the tank and by one on the machine itself, for this is necessary to accommodate the retention of heavy or light pills on the perforated plate.

Pills may be coated with gelatin by cutting the pill cylinder to its centre, placing in the cleft a piece of sewing silk, rolling it, dividing it into pills, dipping in gelatin solution, drying, and cutting apart.

GELATIN COATING SOLUTION

(Prof. Patch)

Gelatin (French, gold label)	2½ oz. av.
Powdered Boric Acid	120 gr.
Mucilage of Acacia	2 fl. oz.
Distilled Water	7 fl. oz.

Macerate the Gelatin with the Water until it softens, dissolve it by heating in a water-bath, and add the Boric Acid; then slowly add the Mucilage of Acacia, and strain the mixture. If sweetening is desired a very small quantity of soluble saccharin may be used.

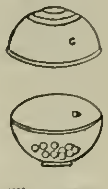
Salol Coating.—Pills may be coated with salol by melting the salol in a dish, and having dried and rounded the pills, they are placed in a mortar, and the melted salol dropped upon them, a little at a time; after each application the pills are immediately rotated so as to distribute the melted salol uniformly over their surfaces. The object of coating pills with salol, as in keratin coating, is to produce what are known as "enteric" pills,—*i.e.*, pills so coated that they will not dissolve in the stomach, but be carried into the intestines before disintegrating.

Keratin Coating.—Keratin is made from corneous animal substances, like horn, quills, hoofs, etc., by steeping these in a digestive liquid,—an acid solution of pepsin,—or by treatment with acetic acid, and dissolving the residue in ammonia water by prolonged maceration; the solution is then evaporated. Keratin has been employed for the purpose of coating pills, so as to enable them to pass through the acid juices of the stomach and be dissolved in the alkaline intestinal fluids. It is proposed to use these coatings for four classes of medicine. 1. Medicines that can by prolonged contact cause irritation to the mucous membrane of the stomach,—arsenic, salicylic acid, creosote, chrysarobin, quinine compounds, copaiba, cubebs, ferruginous preparations, and especially ferric chlorides, opium, mercurial preparations, mercuric iodide and chloride, phosphorus, and all the tænifuge preparations. 2. Medicines that can injure the digestion by forming insoluble precipitates with pepsin and peptones,—tannin, alum, lead acetate, preparations of bismuth, silver nitrate, corrosive sublimate, etc. 3. Medicines that are rendered inactive or decomposed by the gastric juice,—alkali, bile, soap, calcium sulphide, iron sulphide, pancreatin, etc. 4. Medicines which should arrive in the intestines as concentrated as possible,—kousso, santonin, extract of male fern, alkali. For the preparation of a solution of keratin suitable for the coating of pills several formulæ have been proposed, in all of which either acetic acid or ammonia is used as a solvent. The acetic solution might be used for coating pills containing salts of mercury, gold, or iron, arsenic, creosote, salicylic acid, tannin, alum, etc. On the other hand, recourse might be had to an ammoniacal solution for pills containing pancreatin, trypsin, bile, alkalies, iron sulphide, etc. If the pill mass should contain water, the pills would shrink and fissures would be produced in the keratin coating. It is, therefore, recommended to use in the making of these pills a mixture of yellow wax, 1 part, and suet or cacao butter, 10 parts. It is also necessary to avoid the use of vegetable powders and to employ in their place kaolin or charcoal powder.

When the pills are finished they should be dipped into cacao butter, rolled in the charcoal powder, and then keratinized. For this purpose the pills, placed in a porcelain capsule, are sprinkled with a suitable quantity of keratin solution and then shaken together until the evaporation of the solvent takes place. This moistening and drying require to be repeated several times (as many as ten) before the layer of keratin is sufficiently thick.

Pearl Coating.—This term is applied to the method of coating pills with finely powdered talcum or French chalk ; the process is similar to that used in silver coating (see below), by placing in a globular box (see Fig. 727) a mixture of very finely powdered talcum and sugar, and, having covered the pills with the adhesive mixture, they are rotated until coated. A polish may be given to the surfaces by rotating the pills in a box coated on the inside with paraffin.

Fig. 727



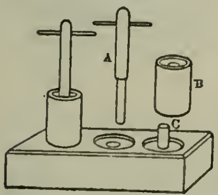
Silver coater

Gold or Silver Coating.—Pills may be coated with gold or silver leaf by first placing a drop of syrup of acacia in a mortar, and, after carefully spreading it over the surface with the end of the finger, dropping in the pills, rotating them so that they shall be uniformly coated with a very thin layer of mucilage, and then dropping them into the gold or silver leaf contained in the coater. This is merely a smooth, globular box, made of horn or turned wood, opening in the middle (see Fig. 727). When the pills are rotated, they soon become coated with the leaf, and are then ready to dispense. In the absence of a globular box a large sized pill box may be used.

COMPRESSED PILLS, TROCHES, AND TABLETS

Compressed pills, troches, and tablets are made by subjecting dry powders to a sufficient degree of pressure in suitable machines to cause them to cohere ; the pressure may be effected by a blow from a mallet, or by means of a lever or combination of levers. To enable the pharmacist to prepare his own compressed pills the author devised, in 1875, the machine shown in Fig. 728 for making them. It is made of cast steel. The base has two countersunk depressions, with a short post in the centre of each ; a lenticular depression is made in the upper surface of each post. A steel cylinder having a central aperture of the diameter of the post is placed in the depression, the proper quantity of powder is introduced, and the plunger, which has a corresponding lenticular depression on its lower surface, is placed on the powder and is struck a quick blow with a mallet ; the powder is compressed, and the pill adheres to the cylinder ; by removing the cylinder and holding it over a box and tapping the plunger again lightly, the pill is forced out, and falls into a box. Brockedon, of England, was the first manufacturer who introduced this form of pill. In this country, Jacob Dunton, of Philadelphia, was the first to extend the process to a long line of pills, but subsequently John Wyeth & Bro. prepared compressed pills upon an enormous scale, and they are made now by many manufacturers, both here and abroad.

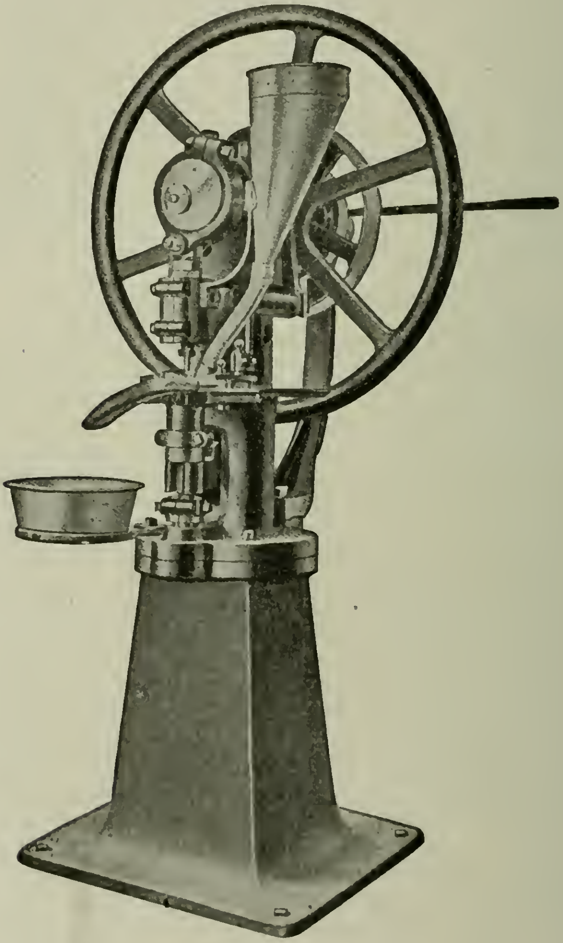
Fig. 728



Compressed pill machine

In one of the compressed pill machines in use by this firm a circular steel disk, which is perforated with a number of holes, is made to revolve slowly ; at regular intervals its motion is stopped long enough to deposit the proper weight of powder and to permit a plunger having a moulded end, as in Fig. 728, moving from above, almost to meet a similar one rising from below the plate ; the powder is caught between the two moulds, is compressed, and the pill finds its way out through the spout into the box below. The advantages of compressed pills are that no excipient is used in their preparation, they are easily disintegrated or dissolved in the liquids of the stomach, and their lenticular shape is favorable to their being easily swallowed. Machines for making compressed pills and troches which are adapted for either hand or steam power are now made so extensively that it is difficult to make a selection. Machines that are to be operated by hand are, of course, not so heavy in their construction. Fig. 729 shows the tablet machine made by the H. K. Mulford Company, of Philadelphia. The material which is to be compressed is fed into

Fig. 729

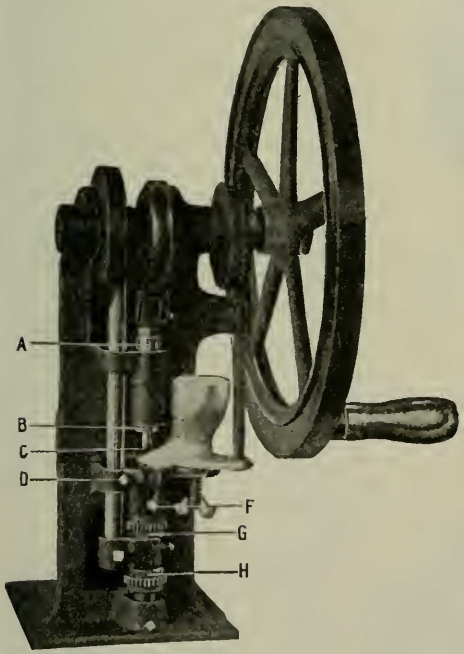


Mulford's tablet machine

the funnel. In the lower part of this funnel there is a sieve, to prevent large lumps from passing through and clogging the feeder. By means of simple yet ingenious mechanism the powder finds its way to the die plate, the feeder being shaken constantly in order to keep the powder in motion, so that uniformity in feeding is secured while it is being delivered. When the chamber in the die plate has received its charge, the feeder moves out of the way to make room for the compressor, which then forms the tablet in the die. The ejector follows the compressor after it has moved out of the die plate, and the tablet is knocked off and into the pan underneath by the feeder. The same motions are repeated continuously. When everything is in order and the machine is properly operated, compressed tablets may be made very rapidly, 60,000 tablets in ten hours. The weight of the tablet may be adjusted with simplicity and accuracy.

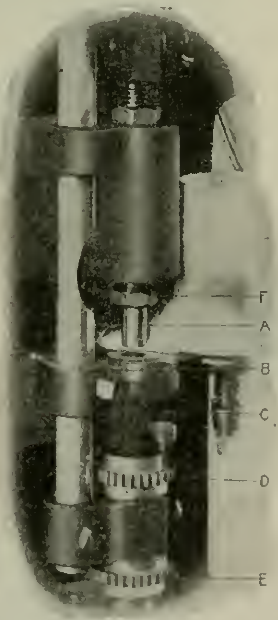
Fig. 730 shows the Eureka tablet machine, made by the F. J. Stokes Machine Company, of Philadelphia. This machine is well adapted for the use of the pharmacist. It is entirely automatic, and will compress 100 tablets per minute. In Fig. 731 an enlarged view showing the method of compressing the tablet with this machine is seen. A is the upper punch or compressor just leaving the die, B. The tablet is shown in the die after it has been compressed. This will be raised by the lower punch, C, to the surface, where the feed cup will eject it and fill the die with another charge of material, upon which the operation will be repeated. D is the adjustment for regu-

Fig. 730



Eureka tablet machine

Fig. 731

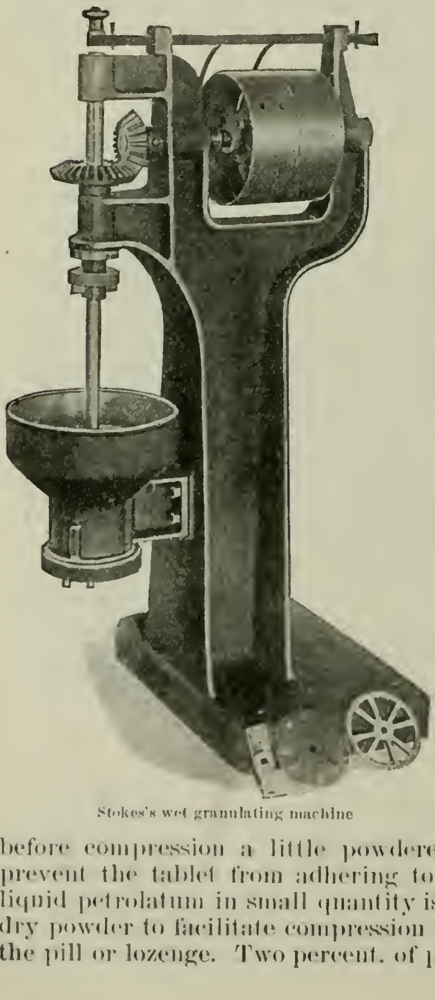


Eureka tablet machine (enlarged view of punches, etc.)

lating the lower punch, so that it ejects the tablet properly. E is the adjustment for regulating the weight of the tablet, and F is the adjustment for controlling the pressure or density of the tablet.

In making compressed pills and lozenges it must not be supposed that the various powders which are to be compressed need no previous treatment. Both experience and knowledge are necessary to always achieve success. Some powders are too dry, and need moisture before they can be compressed; others are too damp, and need drying; others have so little cohesive property that even the application of a powerful press is insufficient to keep them from splitting or breaking; others again possess too great a tendency to adhere to anything with which they come in contact. The manufacture of compressed pills and powders has developed a special knowledge of the properties of medicinal substances which is very valuable to those who operate these machines largely. A few illustrations of the methods used for overcoming the difficulties alluded to will be appended. Tablets of potassium chlorate are made without trouble, the slightly moist, finely granulated salt being preferred, because it will feed more regularly than that which is in fine powder. Sodium bicarbonate is compressed very frequently, and it is used in making the so called soda mint tablets. Its powers of cohesion are not good, but if five percent. of powdered acacia be added, and the whole moistened with water, sifted through a coarse sieve, and dried, there will be no difficulty. The oil of peppermint should be added after it is dried, from 1 to 1½ percent. being the usual quantity. Powders which consist mainly of sugar of milk need dampening with a mixture of one part of simple syrup and two parts of water. The damp powder should be sifted through a coarse sieve and dried. Just before compression a little powdered talcum is often sifted in to prevent the tablet from adhering to the die. White petrolatum or liquid petrolatum in small quantity is sometimes incorporated with a dry powder to facilitate compression and improve the appearance of the pill or lozenge. Two percent. of petrolatum dissolved in sufficient

Fig. 734



Stokes's wet granulating machine

ether to permit of its thorough diffusion through the powder is sufficient. Of course, the powder should be sifted and dried. When troches or pills are to be made of such dry and apparently incompressible powders as quinine sulphate, charcoal, salicylic acid, or sodium salicylate, compression can be accomplished by moistening the powder with a solution of gelatin, sifting, drying, and using a little talcum. If a trace of the ethereal solution of petrolatum or finely powdered arrowroot is added to the quinine sulphate, instead of the talcum, the pills will disintegrate more readily, but pills of quinine bisulphate are more easily made and are more soluble. Very frequently the dampening of the powder with a little ether or alcohol is all that is necessary to secure compression. On the large scale it may be found more advantageous to replace acacia with white dextrin. Hypodermic tablets may be made with a base of purified sugar of milk, although perfectly neutral dried sodium sulphate and purified sodium chloride are probably better.

Many powders require "granulating" before they can be made to feed regularly, and several granulating machines are upon the market. Upon the small scale this operation is performed by moistening the mixed powders, and rubbing the mass through a sieve with the hand. Fig. 734 shows a machine for "wet granulating," made by the F. J. Stokes Company.

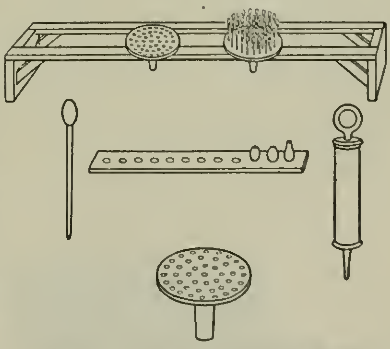
GELATIN CAPSULES AND PEARLS

The gelatin coated pill is not the only form in which nauseous or bitter medicines may be administered with their taste concealed, gelatin capsules having been in use for many years.

Gelatin capsules are of three kinds, designated as hard, soft, and empty. The first two are used in administering liquids. Empty capsules may be used for liquids, but they are generally employed in concealing the taste of bitter solids.

Hard and Soft Gelatin Capsules.—The principle upon which they are made is that of dipping a smooth mould, usually of bone, ivory, brass, or white metal, into a thick, hot solution of gelatin, allowing the film to become cold, removing it at the proper time, filling it with the liquid, and then sealing it.

Figs. 735, 736, 737, 738, 739



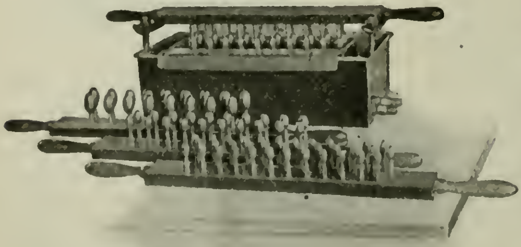
Apparatus for making and filling capsules

Figs. 735, 736, 737, 738, and 739 illustrate the method of making and filling capsules. The process is not new, and the theory is simple, but success in making capsules is not apt to crown the first efforts, considerable experience being necessary.

The material employed for the shells or envelopes of soft, elastic capsules is a composition of gelatin and glycerin, the proportions being varied according as a softer or a harder capsule is desired. A sufficient quantity of water is employed in making the composition to produce a fluid which shall be of the proper consistence. No exact formula can be strictly adhered to, because the proportion will vary with different samples of gelatin; but after a little experience the operator learns to adjust it to a nicety. The solution must be kept at a uniform temperature—about 40° C. (104° F.) by means of a water bath. A wooden mould, or one made of brass or white metal, having a stem about four inches in length (see Fig. 735), is employed for forming the shell. A number of these moulds are fixed in the perforated wooden disks, and when in use these disks are supported on a simple frame or rack, consisting of two parallel strips of wood about four inches apart. The moulds must be slightly oiled to prevent the composition from adhering to them; but excess of oil must be avoided, or they will refuse to take the gelatin. All being now in readiness, the operator takes one of the disks from the rack by its handle, inverts it, and dips the mould carefully into the gelatin composition, then withdraws it slowly with a steady motion, so as not to take up more of the fluid than is required. The moulds are now held in a current of cold air, produced by a fan or other suitable device, being kept in constant motion by the operator to secure an even distribution of the gelatin until it is sufficiently congealed, when the disk is returned to its place, and the operation is repeated with a second disk. The disks are allowed to remain a few minutes on the rack until the gelatin is hard enough to be handled without sticking to the fingers. They are then taken to a table, and by a smart rap with the hand (the disk being held in a vertical position) the moulds are shaken out of their sockets. An operator provided with an ivory knife next separates the capsule from the superfluous gelatin which has adhered to the stem of the mould, and the soft, elastic shell is then pulled from the mould and placed in an upright position for filling upon the shell supporter. This operation of stripping off the capsules can best be performed by the delicate fingers of a girl, since any roughness in the cuticle of the operator will leave its impression indelibly upon the soft gelatin.

The capsules are filled by the skilful use of the syringe, great care being taken that none of the oil be allowed to touch the edge of the capsule, since such an accident would render it impossible to seal the capsule. The final operation of sealing is accomplished by passing over the opening a small stick charged with the gelatin composition of which the capsule is made. When the capsules are thus finished, they are allowed to stand a few hours on the supporters to dry, and are then spread out on a sheet of white paper in order to detect any that may be imperfectly sealed. These having

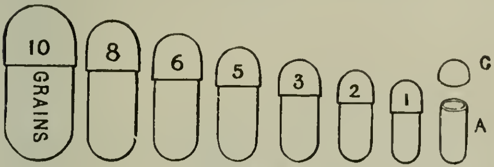
Fig. 740



Stokes's gelatin capsule apparatus

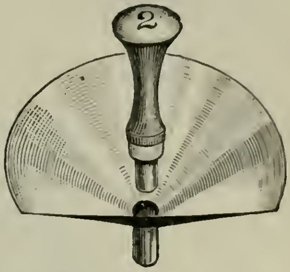
been removed, the capsules are ready to be packed in boxes for the market. The hard capsules differ from the elastic ones only in the omission of glycerin from the composition of the envelopes, the manipulation being the same, except that it is necessary to allow the finished capsules to remain several days on the supporters to become completely dry and hard before they are packed.

FIG. 741



Empty capsules

FIG. 742



Davenport's capsule filler

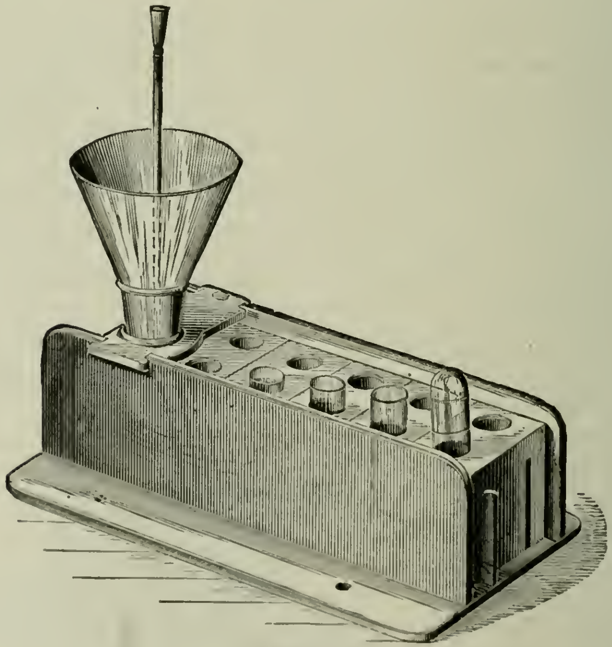
In the apparatus made by the F. J. Stokes Machine Company (see Fig. 740), the dipping bulbs are made of "white metal," and mounted on hardwood blocks.

Empty Capsules.—These are not ovoid in shape, but cylindrical (see Fig. 741). They are made of several sizes, and are usually designated by numbers. The smallest size in the illustration is represented with the cap, C, off. These are used by pharmacists for enclosing nauseous or bitter powders or masses. They are filled in several ways. One plan is to make a mass of the powders, divide it into little rolls, as in making pills, insert them in the larger end of the capsule, A, and place the cap, C, tightly upon it. To fill the capsules with powders several devices are employed. Whitfield's capsule filler is the most elaborate apparatus. Davenport's method is very simple. The filler is shown in Fig. 742. It consists of a funnel, tube, and plunger. The funnel is flattened at one side, to assist in taking up the material, the tube attached to the funnel is of the proper size to be placed in the capsule, and its end is cut off at an angle to permit its ready insertion in the capsule. The funnel and tube are made from one piece of metal, without seam or joints. The plunger is of hard wood, and of the proper size for entering the tube. It is supplied with a rubber collar, which admits of the piston being pressed entirely through the tube to eject the material. Each filler and plunger is numbered to correspond with the number of the capsule. In use, the material is first divided into powders; the capsule is placed on the tube, the flat edge of the funnel held nearest to the operator, and the powder scraped into the funnel; the filler is held in an upright position, and the plunger raised; after the powder has passed into the tube, the plunger is inserted, the capsule held firmly on the tube, and pressure applied to the plunger, forcing the powder into the capsule, which is then removed and capped in the usual manner.

Reymond's capsule filler consists of two blocks of hard wood. In one twelve sockets are bored of sufficient depth to enable the capsules to be inserted one-half of their length. These sockets are so shaped at the bottom as to correspond with the lower end of the capsule. A small hole is bored through the bottom of each socket. The upper side of the upper block is provided with twelve funnel shaped receptacles of sufficient capacity to hold all the powder intended to fill the capsule, the lower end of these receptacles being so shaped that when the two sections are in proper position for use they will project just over the upper edge of the capsule. The under side of this section is provided with twelve holes a trifle larger than those in the lower block, and of sufficient length to cover that portion of the capsule projecting above the lower block. Pegs are inserted in either section to fit into corresponding holes in the other, so as to hold the two together in proper position when the filler is in use. A tampon is provided with which to pack the capsule.

A capsule filler made by the Parke, Davis Company is shown in Fig. 743. It consists of a metal frame holding a hopper and a block of wood having two slots cut lengthwise in it and perforated to hold the capsule; two triangular strips of metal (the higher ends of the strips being at the point farthest from the hopper) are fastened edgewise in the metal base so that they fit into the slots in the wooden block. The empty capsules having been placed in the perforations are filled from the hopper, and the block having been pushed to the right, the next capsule is filled, and so on, when the whole row is filled. The capsules after being capped are raised by the inclined metal strips so that they can be easily picked off.

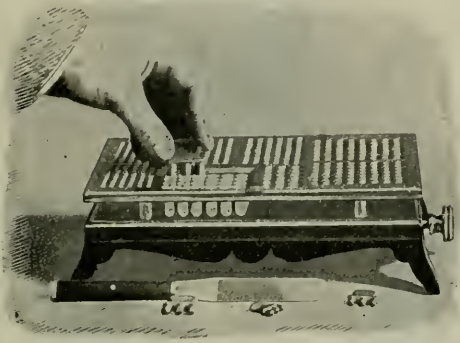
FIG. 743



Capsule filler

Ihrig's capsule filler is shown in Fig. 744, and consists of a stationary base with a square, polished, movable table containing perforations for holding the empty capsules; the table is raised and lowered by a thumb screw. The perforations are arranged in fields of sixty each for five sizes of capsules, and of fifty-six each for two sizes of capsules. The lower portion of the capsule should rest on the base at the beginning of the filling process, and the upper plate raised so that the top of the capsule is slightly below the surface of the upper plate. A metal bevelled square is next placed in proper position, as shown in **Fig. 744**, so as to exclude the perforations not in use from the capsules which are to be filled; the powder is then distributed over the capsules and pressed down by means of a metallic triple punch. When these are filled, the upper plate is lowered by turning the thumb screw, the cap adjusted, and the capsules are finished.

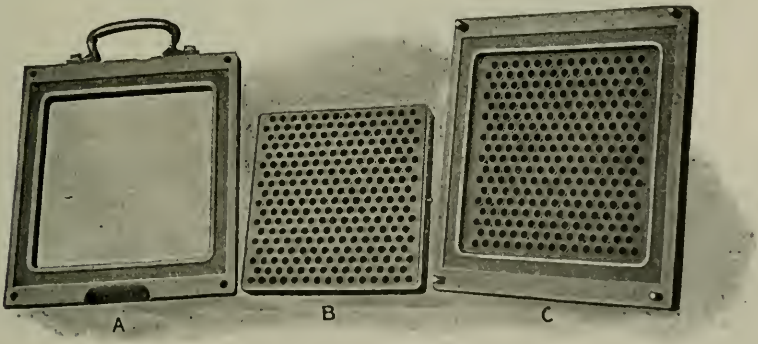
Fig. 744



Ihrig's capsule filler

Pearls or globules differ from gelatin capsules in shape, being globular, and in being usually smaller in size. In addition, they show no air space, the gelatin shell being completely filled with the medicinal substance. Their preparation requires the use of special apparatus, and they cannot be profitably made on the small scale. The

Fig. 747 Fig. 748 Fig. 749

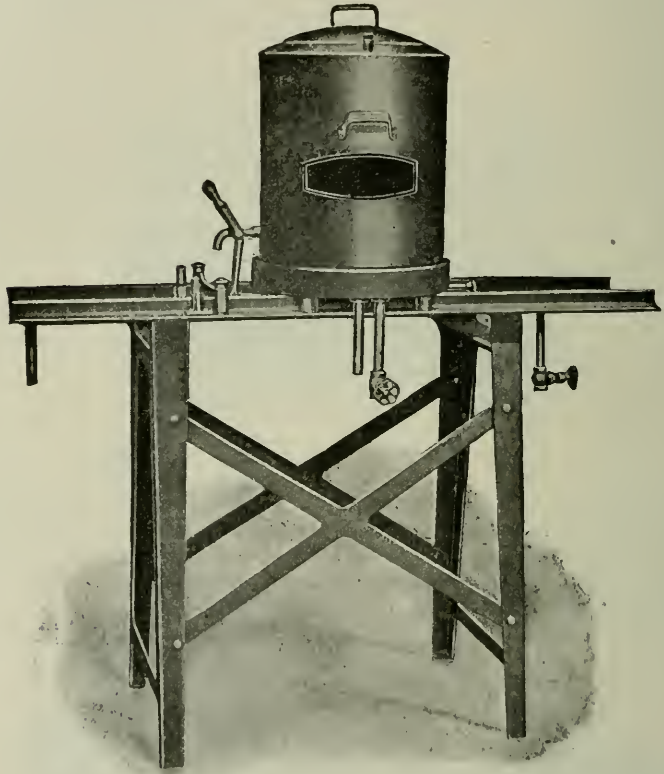


Colton's pearl or globule mould

mixture of which the shell of the globule is composed consists largely of gelatin, but must be mixed with other ingredients to make a capsule of such quality as will secure sufficient toughness.

A pair of moulds which are termed upper and lower moulds are needed (see Figs. 747, 748, and 749). When the lower mould is placed upon a level surface, a leaf of gelatin (see Fig. 750) should be laid over the entire face of the matrix, extending out and over the edges of the frame which has previously been slightly heated on the warming table; the gelatin leaf thus placed will soon conform itself to the various corners and ledges found in the frame; this is now ready to receive the liquid, of which a measured quantity has been previously placed in a graduate. This should be poured into the receptacle prepared for it; when this is done, the upper gelatin leaf is placed upon the liquid surface by slightly rolling it over and across the liquid; this is done to exclude every particle of air. The upper mould is now placed over the lower, through the guidance of dowel pins, and the "flask" is now ready for compression. It is placed upon the table of a press, where it is slid into position by the me-

Fig. 750



Colton's pearl or globule leaf making machine dium of guiding grooves, pressure is applied, and the table rises until the sealing point is reached; the table then returns to its place of starting. The moulds are now separated and the net containing the globules removed; the globules may be quickly extracted from the net, by catching it at opposite corners, and giving it a sudden stretching, repeating this at the remaining corners.

In order to make pearls or globules it is necessary to prepare the gelatin leaf or film very carefully, and of the required thickness. Fig. 750 shows Colton's leaf making machine, which consists of a jacketed copper tank in which the gelatin mixture is placed. This is supported on a grooved "warming" table, so constructed that receiving plates may slide smoothly upon it. The gelatin mixture is heated by turning on the steam to the copper tank, and the flow of the liquefied mixture upon the receiving plate is controlled by the faucet. Any excess is skimmed from the plate by an adjustable gauge, so that the thickness of the film or leaf can be fixed exactly. The film sets after cooling, and is placed in a seasoning kiln to secure the desired consistence for use in the pearl or globule mould.

Suppositoria *Suppositories*

Suppositories are solid bodies intended to be introduced into the rectum, urethra, or vagina to produce medicinal action. Their form is usually conical, with a rounded apex, and their consistence should be such that, while they will retain their shape at ordinary temperatures, they will readily melt or soften at the temperature of the body. Oil of Theobroma, or cacao butter, is the best base for suppositories, because it accurately fulfils both of the above requirements. It was first suggested in this connection in 1852 by Mr. Alfred B. Taylor, of Philadelphia. It is rarely necessary to raise the melting point of cacao butter by the addition of wax, spermaceti, etc., except in the warmest summer weather, or when phenol, camphor, chloral, the volatile oils, or similar substances form the medicating ingredients. Gelatin suppositories are made from a mass containing gelatin and glycerin, by soaking gelatin in water, draining off the excess, adding five parts by weight of glycerin to every twelve parts of soft gelatin, and heating in a water bath. The medicating substance is rubbed into a smooth paste with a small quantity of water or glycerin and added to the mass. Since the extended use of suppositories the size has been gradually reduced until fifteen grain suppositories are now most largely employed. The U. S. P. (8th Rev.) has, however, increased the size of rectal suppositories to 2 Gm., or thirty grains, and has given the following directions for the preparation of suppositories:

"Suppositories are solid bodies of various weights and shapes, adapted for introduction into the different orifices of the human body, and melting readily at blood heat. The vehicles usually employed are Oil of Theobroma, Glycerinated Gelatin, or Sodium Stearate.

"For suppositories made with Oil of Theobroma the following general processes may be employed:

Take of
***The Medicinal Substance,** the prescribed quantity
Oil of Theobroma, grated, a sufficient quantity

"Reduce the Medicinal Substance, if dry, to a very fine powder, or, if an extract, soften it with an appropriate liquid, then mix it thoroughly in a mortar with about an equal weight of grated Oil of Theobroma, and incorporate the remainder of the Oil of Theobroma until a homogeneous, plastic mass is obtained, adding, if necessary, a small quantity of Expressed Oil of Almond. Roll the mass on a graduated tile until a cylinder of the proper length is formed, divide this into the required number of equal parts, and with a spatula, or other convenient mechanical aid, form them into the desired shape.

"If the process of fusion is preferred, mix the medicinal Substance with about an equal weight of grated Oil of Theobroma, as above directed, then thoroughly incorporate it with the remainder of the Oil of Theobroma, previously melted by a gentle heat, in a suitable vessel provided with a lip; then allow it to cool to about 38° C. (100.4° F.), and, when the mixture begins to congeal, pour it immediately into suitable well-cooled moulds. Keep the moulds at a freezing temperature until the suppositories have hardened and are ready to be removed.

"For suppositories containing chloral, phenol, their derivatives, or substances which soften the vehicle, raise the melting point of the Oil of Theobroma by the addition of from 10 to 15 percent. of spermaceti, but the melting point must not be raised above 37° C. (98.6 F.).

"For suppositories made with Glycerinated Gelatin the following process may be used:

Take of
* **The Medicinal Substance,** the prescribed quantity
Glycerinated Gelatin,
Glycerin,
Water, each, a sufficient quantity

"Mix the Medicinal Substance, if solid and soluble in Water or Glycerin, or if a miscible liquid, with a little Water, and add sufficient Glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted Glycerinated Gelatin, and pour it at once into suitable moulds which have been greased with a small quantity of petrolatum. Cool the moulds thoroughly before removing the suppositories."

GELATINUM GLYCERINATUM. U.S. Glycerinated Gelatin

	Metric	Old form
* **Gelatin**	100 Gm.	4 oz. av.
Glycerin	100 Gm.	4 oz. av.
Water, a sufficient quantity,		
To make	200 Gm.	8 oz. av.

Pour upon the Gelatin sufficient Water, which has been previously boiled and cooled, to cover it; allow it to stand one hour; pour off the Water and allow the Gelatin to drain for a few minutes; then transfer it to a tared dish, add the Glycerin, and heat it on a water-bath until the Gelatin is dissolved. Strain the solution while hot, and continue to heat on the water-bath until the product weighs 200 Gm. [old form 8 oz. av.]. When cold, cut the mass into pieces, and preserve these in suitable containers.

SUPPOSITORIA GLYCERINI. U.S. Suppositories of Glycerin

	Metric	Old form
***Glycerin**	**30.0 Gm.**	1 oz. av. 25 gr.
Monohydrated Sodium Carbonate	**0.5 Gm.**	7½ grains
Stearic Acid	**2.0 Gm.**	31 grains
Water	**5.0 Cc.**	81 minims
To make 10 rectal suppositories		10 suppositories

Dissolve the Monohydrated Sodium Carbonate in the Water and add it to the Glycerin, contained in a dish, on a water-bath; add the Stearic Acid, and heat the mixture carefully until carbon dioxide ceases to be evolved, and the liquid is clear. Then pour the melted mass into suitable moulds, remove the suppositories when they are completely cold, and preserve them in tightly stoppered glass vessels.

Unofficial Suppositories

Name	Ingredients	Preparation
Suppositoria Acidi Carbolici. Br.	0.8 Gm. Phenol; 1.6 Gm. White Beeswax; sufficient Oil of Theobroma to make 12 suppositories, each weighing about 1 Gm.	Dissolve the Phenol in the previously melted Oil of Theobroma and Beeswax, and pour into suitable moulds to form 12 suppositories
Acidi Tannici. Br.	2.4 Gm. Tannic Acid; sufficient Oil of Theobroma to make 12 suppositories, each weighing about 1 Gm.	Mix the Tannic Acid with the melted Oil of Theobroma, with trituration, and pour into suitable moulds to form 12 suppositories
Belladonnæ. Br.	1.2 Gm. Alcoholic Extract of Belladonna; sufficient Oil of Theobroma to make 12 suppositories, each weighing about 1 Gm.	Proceed as in Tannic Acid suppositories
Iodoformi. Br.	2.4 Gm. Iodoform; sufficient Oil of Theobroma to make 12 suppositories, each weighing about 1 Gm.	Proceed as in Tannic Acid Suppositories
Morphinæ. Br.	0.2 Gm. Morphine Hydrochloride; sufficient Oil of Theobroma to make 12 suppositories, each weighing about 1 Gm.	Proceed as in Tannic Acid suppositories
Plumbi Composita. Br.	2.4 Gm. Lead Acetate; 0.8 Gm. Opium; sufficient Oil of Theobroma to make 12 suppositories, each weighing about 1 Gm.	Proceed as in Tannic Acid suppositories

Suppositories are usually of three kinds: 1. Rolled. 2. Moulded. 3. Pressed.

1. **Rolled suppositories** are made by a very simple method. The cacao butter is scraped or grated and placed in a mortar; the medicating ingredients are reduced to powder, or, if composed of extracts, are softened with water and rubbed until a smooth paste is formed; a mass resembling a pill mass is now made by thoroughly incorporating the ingredients with a pestle, and, having thoroughly dusted a pill tile with lycopodium, a suppository cylinder is formed by rolling the mass upon the tile with a spatula, after having softened it by partly shaping it with the fingers. If the mass is brittle, it may be softened by thoroughly incorporating a few drops of olive oil with it; the cylinder is rolled out and then cut into the proper number of pieces with a spatula; the conical shape is given by rolling *one end* upon the tile with a spatula, so as to produce a rounded point. In

warm weather it is necessary to use lycopodium, powdered elm bark, or a similar absorbent powder freely. With practice, excellent rolled suppositories can be made. This method has the substantial merit of requiring very little apparatus, but considerable skill is needed to produce suppositories equalling in finish those which are moulded.

2. **Moulded suppositories** are more largely used than any other kind; preference is given to them because of their more finished appearance. The directions of the U. S. P. 1890, which differ in some respects from those of the U. S. P. (8th Rev.), are appended.

"Mix the medicinal portion (previously brought to a proper consistence, if necessary) with a small quantity of Oil of Theobroma, by rubbing them together, and add the mixture to the remainder of the Oil of Theobroma, previously melted and cooled to the temperature of 35° C. (95° F.). Then mix thoroughly, without applying more heat, and immediately pour the mixture into suitable moulds. The moulds must be kept cold by being placed on ice, or by immersion in ice-cold water; and the inner surface of the moulds should be carefully freed from adhering moisture, before the melted mass is poured in. In the absence of suitable moulds, suppositories may be formed by allowing the mixture, prepared as above, to cool, care being taken to keep the ingredients well mixed, and dividing into parts of a definite weight each, which may be made into a conical or other convenient form for a suppository.

"*Rectal Suppositories* should be cone shaped or spindle shaped, and when made from Oil of Theobroma should weigh about 2 Gm. [old form 31 grains].

"*Urethral Suppositories* (*Bougies*) should be pencil shaped, pointed at one extremity, and either 7 Cm. [2.7 in.] in length, weighing about 2 Gm. [old form 31 grains], or 14 Cm. [5.5 in.] in length, weighing about 4 Gm. [old form 62 grains], when made with Glycerinated Gelatin. If prepared with Oil of Theobroma they should weigh about one-half the above quantities.

"*Vaginal Suppositories* should be globular or oviform in shape, and weigh about 10 Gm. [old form 154 grains] if made with Glycerinated Gelatin, and about 4 Gm. [old form 62 grains] if made with Oil of Theobroma.

"Moulds for urethral suppositories should be warmed sufficiently before pouring the mass to facilitate the proper filling of the mould. Suppositories having a firmer consistence may be prepared by substituting Mucilage of Acacia for a portion of the Water or Glycerin.

"If the Medicinal Substance be insoluble in Water or Glycerin, thoroughly levigate it in a warm mortar with a sufficient quantity of Glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted Glycerinated Gelatin, and pour it into suitable moulds as above directed. With bulky powders about one-half of the Glycerin may be replaced with Water before levigation. Glycerinated Gelatin suppositories should be protected against the effects of heat and moisture and dry air by keeping them in tightly closed containers in a cool place."

The principle upon which suppositories are moulded depends upon the fact that the mass after being introduced into the moulds contracts upon cooling; when the limit of contraction is reached, the suppository is a trifle smaller than the mould in which it has been made, and it can be easily extracted; hence the importance of allowing the moulds to become thoroughly cold after the introduction of the melted mass. The novice almost invariably makes the mistake of opening the divided moulds too soon (before the limit of contraction is reached); the suppository sticks to the mould, and splitting ensues. The difficulties encountered in making moulded suppositories generally arise from the use of too much heat in melting the mass. A suppository mass containing an extract bears some analogy to an emulsion, with the proportions of the ingredients reversed; the fatty substance here is in great excess; the extractive matter is the substance to be uniformly suspended, while the water is relied upon to effect this object; this can be done by making the extract into a soft paste with the water, and gradually incorporating it with the partly melted cacao butter by stirring.

Other difficulties in moulding suppositories are easily overcome by the exercise of judgment and knowledge of physical laws. A defect frequently seen in the finished cacao butter suppository is that the surface is not always perfectly smooth. This may arise from several causes. Sometimes ridges are seen traversing the suppository; these are usually produced by overcautiousness, the operator pausing in pouring the melted mass into the mould, then pouring in a little more, then pausing again, and so on. On taking out the suppository, a ridge will be found at each spot where a pause was made. The remedy for this is to keep on pouring steadily when this part of the process is reached. Other defects are pitting and an imperfection in the formation of the summits of the suppositories. The pitting is caused by drops of water which have been allowed to remain upon the sides of the mould; the imperfect summits are due to water which has not been shaken out of the mould before pouring in the melted mass. Still another defect is a conical hole in the centre of the base of each suppository. This is due to not overflowing the moulds so as to leave an excess of mass upon the top. In all cases there should be a little more mass than will fill the moulds, and after cooling the excess can be cut off.

If *strong heat is used*, the water is evaporated, the extract separates in small masses, and, like a bad emulsion, the mass is "cracked." The remedy is to pour it at once upon an ointment slab or tile, add a little water, and rub it until the original condition is regained.

Henry S. Wellcome, of London, has devised an improvement in the shape of the moulded suppository which prevents the expulsion of the suppository after insertion; this consists in tapering the suppository at the base, and from there gradually expanding its width until near the top, which terminates in a blunt point (see Fig. 752).

FIG. 752

Wellcome's suppository

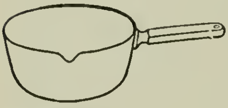
Pouring the Mass.—The mass should be poured into the mould from a dipper held in the right hand, a vigorous stirring being maintained with a spatula held in the left hand immediately before the pouring begins; indeed, when heavy powders are directed, the stirring must not cease during the pouring, or the last suppositories will contain a larger proportion of the heavy powder than those which were first made. A porcelain casserole (see Fig. 753) is the best vessel to melt the mass in, and it is much better to dip it into a dish containing hot water than to use direct heat.

Fig. 754 shows a very convenient little tinned dipper (which may be made by any tinsmith) for pouring melted suppository mass; the shape of the lip and the handle are the parts which especially fit it for this purpose. The use of lycopodium to dust the inside of the moulds is unnecessary. If proper attention be given to cooling the moulds thoroughly, there will be no difficulty from the adhesion of the suppositories.

Suppository Moulds.—Many forms are in use. They may be arranged in three classes: 1. Individual moulds. 2. Divided moulds. 3. Hinged moulds.

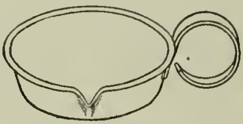
1. *Individual Moulds* are those which were first employed. In this form an oval metallic dish is furnished with a lid which contains twelve circular perforations (see Fig. 756) for supporting twelve individual moulds made of white metal. To prevent the moulds from slipping through when they are placed in the perforations, they each have a shoulder, which rests upon the lid (see Figs. 755 and 757). The dish is nearly filled with chopped ice or snow, the lid supporting the moulds is placed in position, and the melted mass is poured in. After the suppositories have become thoroughly cold, they are removed by inverting the mould and tapping it lightly on a hard surface, when they usually drop out. They sometimes fail, however, to answer the summons promptly. This is generally due to the mould not being perfectly clean. The difficulty of quickly and easily cleaning these small moulds, and the liability of losing or misplacing them, constitute the most serious drawbacks to the use of this form.

Fig. 753



Casserole

Fig. 754



Suppository mass dipper

Fig. 755

Fig. 756

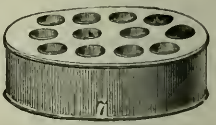
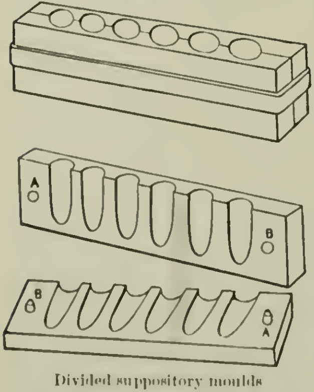


Fig. 757

Individual suppository moulds

Figs. 758, 759

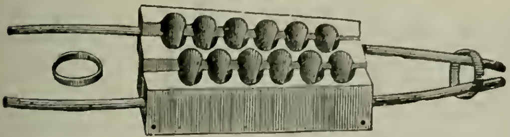


Divided suppository moulds

2. *Divided Moulds.*—This, at present, is a favorite kind of suppository mould, one of the advantages being the facility with which it can be cleaned. They are preferably cooled by placing them upon a piece of ice. The simplest form is shown in Fig. 758. The upper mould is represented as closed and ready for use, being held together by an ordinary rubber band. The open mould is shown below. It is made of brass, and consists of two parts,

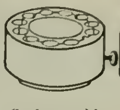
which are kept in position by placing the pins A and B in their respective sockets, see Fig. 759. This form is seen enlarged in the Wirz mould (see Fig. 760). This mould will make twelve suppositories at one time, and it is held together by two brass rings which are slipped over the handles. The circular forms have the very great advantages of requiring but a small piece of ice, and of being almost indestructible. Figs. 761 and 762 show See's mould. The central core, A, is held in position by a set screw. Fig. 761 represents the closed mould, and Fig. 762 shows the core when elevated. This mould is made by J. M. Maris & Co., of Philadelphia. The best divided mould is unquestionably that shown in Fig. 763. It was manufactured by L. R. Blackman, of Newport, R. I. The division of this mould is horizontal instead of perpendicular. It is made of gun metal, is nickel plated, contains no small working parts, and is compact and simple in its construction. The relative position of the upper and lower parts is shown in the illustration. When the suppositories have contracted sufficiently to leave the mould easily, it may be known by pressing one of them slightly upon the top. If it can be moved downward slightly, it indicates that they are loose, when the upper part, carrying the suppositories, may be separated by lifting it from the lower part; it is then inverted over a piece of paper, when a light tap will cause the suppositories to drop out.

FIG. 760



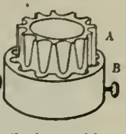
The Wirz suppository mould

FIG. 761



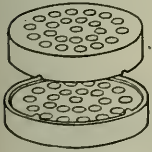
See's mould (closed)

FIG. 762



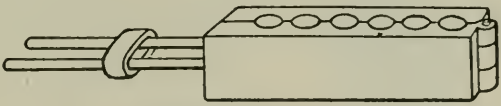
See's mould (open)

FIG. 763



Blackman's suppository mould

FIG. 764

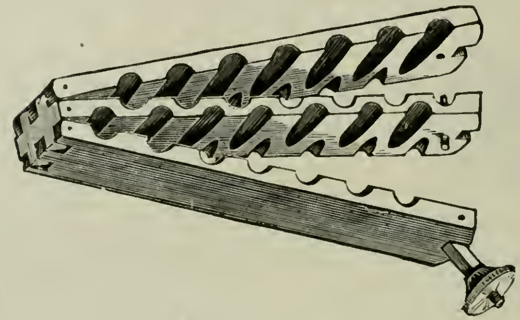


Hinged suppository mould

3. *Hinged Moulds.*—This form differs from the divided moulds in being connected with a hinge. They are used in the same way as the divided moulds. One of the simplest forms is seen in Fig. 764. This opens perpendicularly, and is closed in the same way as the mould shown in Fig. 760. Benton, Myers & Co.'s mould (Fig. 765) is constructed so that two different sizes of suppositories may be made in it. It is in addition a double mould, is hinged at one end, and closed by a screw catch at the other. Figs. 766 and 767 are illustrations of a very serviceable English mould, recommended by Mr. Henry B. Brady, of Newcastle-on-Tyne. It differs from all others in being hinged at the bottom. It is held together by two screw catches, one at each end. Fig. 767 shows this mould closed, and in position upon a cake of ice. Fig. 768 shows Colton's mould for making glycerin suppositories. The manner of using it is similar to that of the pre-

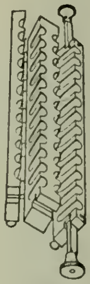
ceding moulds. It makes a double pointed suppository, as shown in the illustration. Moulds for making gelatin suppositories with a rounded end, as shown in Fig. 768, are also made by Arthur Colton, of Detroit. In Fig. 769 is shown the Stokes suppository mould for making forty-eight suppositories at one filling.

Fig. 765



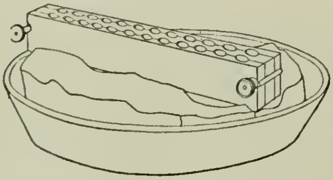
Benton Myers & Co.'s suppository mould

Fig. 766



Brady's suppository mould

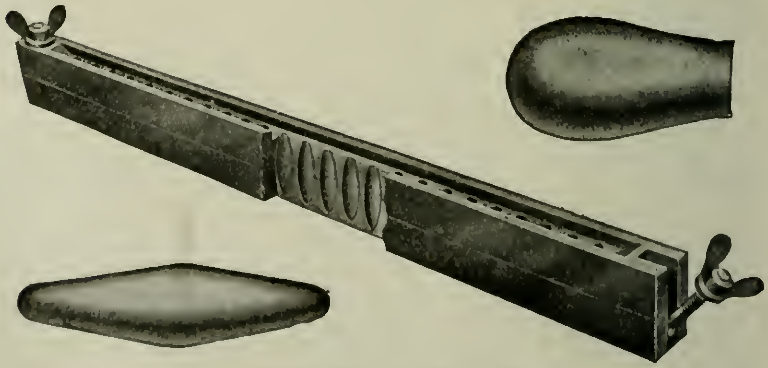
Fig. 767



Brady's suppository mould on ice

Compressed Suppositories.—The method of making suppositories by compression has been used to some extent, but the expense of the apparatus required in their production at one time constituted a serious drawback. A. M. Knowlson, of Troy, N. Y., made an effective suppository machine, which pressed the mass through a cylinder into a mould, and finally discharged the well finished suppository, without the use of any heat whatever. In Archibald's suppository machine the compression is effected by a lever working perpendicularly in a cylinder containing a suppository mass. This apparatus is shown in Fig. 770. The

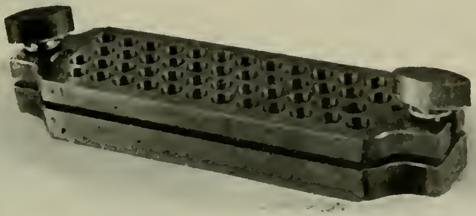
Fig. 768



Colton's glycerin suppository mould

suppository mass may be made in the usual way, or the medicating ingredient, if in powder, may be mixed with the grated cacao butter and thoroughly distributed through it. The proper mould (7) having been introduced in the swing bed (4), the latter is moved accurately into position under the hopper (3), and the plunger (1) having been elevated by moving the hand lever (2), the mass is introduced into the hopper (3). By pressing the hand lever (2) down the mass is forced into the mould. Without raising the lever the swing bed is then pushed around to the right, as shown in Fig. 770, and the mould lifted out by the handle (7). The suppository may be removed from the mould by gently sliding one of the halves over the other, for this gradually forces it out of the mould without the necessity of touching the suppository with the fingers. If the suppository adheres to the mould, it may often be forced out by a slight pressure of the thumb upon the apex. In warm weather the moulds should be cooled before using them by laying them upon ice or by immersion in ice water. Soap liniment, glycerin, or powdered talc have been used as applications to the inside of the moulds when the mass has a tendency to adhere. Moulds accompany the apparatus for making rectal, vaginal, nasal, and urethral suppositories, and any special size can be furnished by the manufacturer.

Fig. 769



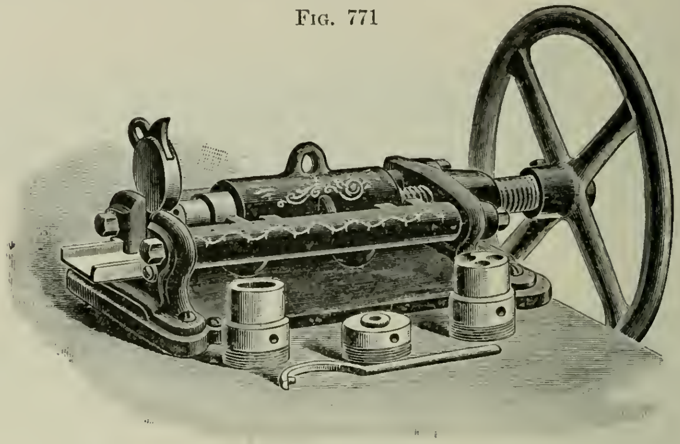
The Stokes suppository machine

Fig. 770

Archibald's suppository machine

For making larger quantities of suppositories the Whitall Tatum Company furnish the machine shown in Fig. 771. It consists of a cylinder, which can be turned back to receive the charge of suppository mass, the proper mould having been previously screwed into its place. The cylinder is then returned to its position, and, the gate having been closed, pressure is made by turning the wheel. The gate being then lifted, a slight pressure suffices to force out the suppositories. Repeating the operation, it is obvious that the machine will turn out suppositories as long as any mass remains in the cylinder. Brass dies and a tube are furnished to make 15 grain, 30 grain, vaginal, urethral, or nasal suppositories. Urethral or nasal suppositories are made by screwing on the proper die and then pressing the mass through it. A long rod like suppository is thus forced out, which may be cut into suitable lengths.

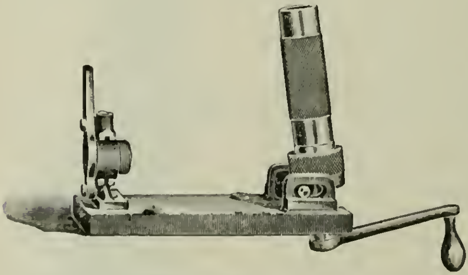
Fig. 771



Suppository machine

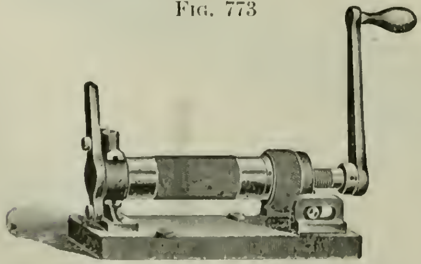
Gautier's suppository mould consists of a truncated metallic cone divided longitudinally into two parts, which fit accurately together by grooved surfaces. This cone is bored cylindrically for some distance, the diameter of the hole corresponding at this part with that of the wider end of a suppository, while at the upper end of it there is a female screw. Lower down it gradually tapers to a point, assuming the exact shape of a conical suppository. In use, the two parts of the cone are kept in position by an outer jacket of metal, which slips over them. The medicament having been well mixed with the previously grated cacao butter, the exact weight of the mass required in a suppository is introduced into the cylindro-conical opening through a small funnel. By means of a piston, which exactly fits the cylindrical part, and is constructed with a milled head and screw at the upper end, pressure is then applied, and the finished suppository may be released.

Fig. 772



Rapid fire suppository machine "open for charging"

Fig. 773

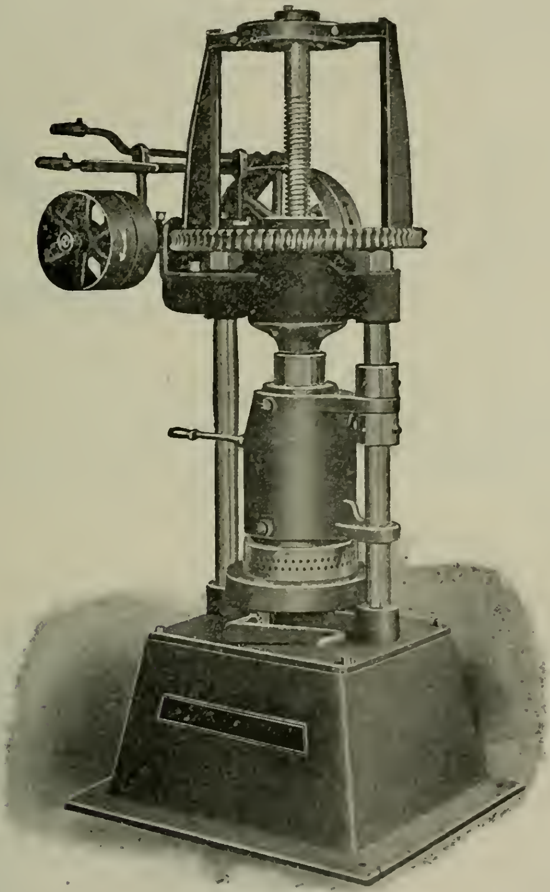


Rapid fire suppository machine "ready for action"

Figs. 772 and 773 show the rapid fire suppository machine. Its operation is similar to that used for the Whitall Tatum Company machine, over which it has some advantages. Fig. 772 shows the machine "open for charging," and Fig. 773 illustrates it when "ready for action."

Fig. 774 shows Colton's power suppository machine. It is adapted for making suppositories upon a large scale. It is different from the other machines on account of the device for cooling the mass in hot weather, the cylinder in which the mass is placed being surrounded with a jacket for holding iced water.

Fig. 774



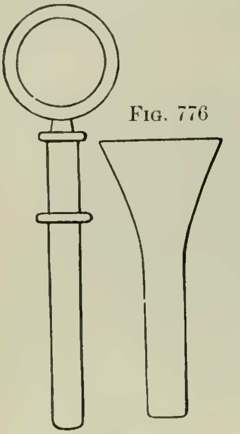
Colton's power suppository machine

Suppositories are sometimes introduced into the rectum with difficulty. Figs. 775 and 776 show a suppositer to aid in their insertion. The tube is made of hard metal, and has a funnel shaped top (Fig.

776). The suppository is dropped into the tube (which should be slightly oiled), point downward, and the tube is carefully inserted into the rectum. The piston (Fig. 775) is now applied to the end of the suppository, which is gently pushed into the rectum, the tube being then withdrawn.

Fig. 775

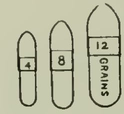
Fig. 776



Suppositer

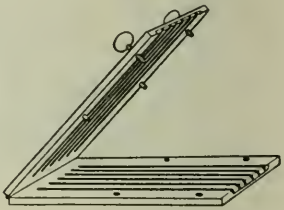
Suppository Capsules.—Dr. F. E. Stewart has suggested the employment of gelatin shells with conical caps, to be used as suppositories. The medicating ingredients are inserted in the lower portion. The upper margin is then moistened with water, and the cap inserted. Before introducing them into the rectum they should be wet with sufficient water to enable them to slip in easily (see Fig. 777).

Fig. 777



Suppository capsules

Fig. 778



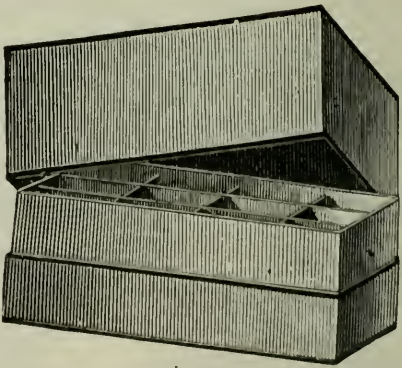
Mitchell's gelatin bougie mould

Urethral suppositories, or bougies, are preferably made of gelatin, owing to the difficulty of introducing into the urethra those made from cacao butter, on account of their brittleness. They may be made by melting together three parts of white gelatin, one part of

Fig. 779

Wellcome's urethral suppository

Fig. 780



Suppository box

glycerin, and one part of distilled water, by weight, then adding the desired medicament and drawing the mass into a glass tube of suitable size, which has been previously oiled by sucking a small quantity of oil into it and allowing it to run out. After cooling, the mass is pushed out by means of an oiled rod, and cut into pieces of suitable length. These should be rolled in lycopodium to prevent adhesion. Fig. 778 shows Mitchell's bougie mould for making them in quantity.

Henry S. Wellcome, of London, has devised an improved form of urethral suppository upon the same plan as the rectal suppository (see Fig. 779). This, from its peculiar shape, and particularly on account of the elongated bulb near the top, is less likely to be involuntarily expelled after insertion.

Dispensing Suppositories.—In order to prevent injury to the surface of suppositories in handling them with warm fingers, it is advisable to place the finger tips for a few moments upon the ice until they are chilled, before placing the suppositories in the box. The latter is preferably furnished with partitions (see Fig. 780). In the absence of this special box, the suppositories should be protected by a layer of cotton.

CHAPTER LXVIII

SOLID EXTEMPORANEOUS PREPARATIONS USED EXTERNALLY

Cerates, Ointments, Plasters, and Papers

Cerata *Cerates*

Cerates are unctuous substances of such consistence that they may be easily spread, at ordinary temperatures, upon muslin or similar material with a spatula, and yet not so soft as to liquefy and run when applied to the skin. They are mostly used as dressings for inflamed surfaces, and are generally made with oil, lard, or petrolatum for a basis, with sufficient wax to give the desired consistence. Owing to the presence of wax (*Cera*) they are called *Cerates.* Paraffin, spermaceti, and resin are also used to raise the melting points of oils and fats.

Cerates are made either by *fusion* or by *incorporation.* In the first method, the ingredients are melted together, and the mixture strained, to separate mechanical impurities, and stirred until cold, to render it homogeneous. By incorporation is meant the process which consists in placing the fatty ingredients upon an ointment slab or pill tile, or in a mortar, and gradually mixing in the other ingredients, with a spatula or pestle, until a uniform preparation results.

Six cerates are official.

Official Cerates made by Fusion

Ceratum	Made by fusing together 300 Gm. of White Wax, 200 Gm. of White Petrolatum, and 500 Gm. of Benzoinated Lard, and stirring until cold
Camphoræ	Made by mixing 100 Gm. of Camphor Liniment with 350 Gm. of White Wax, 150 Gm. of White Petrolatum, and 400 Gm. of Benzoinated Lard, melted together
Cantharidis	Made by fusing together 180 Gm. of Yellow Wax, 180 Gm. of Rosin, and 170 Gm. of Lard, straining, adding 320 Gm. of Cantharides, previously macerated with 150 Gm. of Liquid Petrolatum in a warm place for forty-eight hours, and stirring until cold
Resinæ	Made by fusing together 350 Gm. of Rosin, 150 Gm. of Yellow Wax, and 500 Gm. of Lard, straining and cooling
Resinæ Compositum	Made by fusing together 225 Gm. of Rosin, 225 Gm. of Yellow Wax, 300 Gm. of Prepared Suet, and 115 Gm. of Turpentine, adding 135 Gm. of Linseed Oil to the melted mixture; straining and then stirring until cold

Official Cerate made by Incorporation

Ceratum Plumbi Subacetatis	Made by incorporating 20 Gm. of Solution of Lead Subacetate with 20 Gm. of Wool-Fat and adding 38 Gm. of White Petrolatum and 20 Gm. of Paraffin, melted together, and in which 2 Gm. of Camphor has been dissolved. Mix the whole thoroughly

Unofficial Cerate

Name	Ingredients	Preparation
Ceratum Cetacei. U. S. P. 1890.	100 Gm. Spermaceti; 350 Gm. White Wax; 550 Gm. Olive Oil	Melt together the Spermaceti and White Wax; add the warmed Olive Oil, and stir until the mixture is cold

CERATUM. U.S. Cerate

[SIMPLE CERATE]

	Metric	Old form
* **White Wax**	300 Gm.	4 oz. av. 350 gr.
White Petrolatum	200 Gm.	3 oz. av. 88 gr.
Benzoinated Lard	500 Gm.	8 oz. av.
To make	1000 Gm.	16 oz. av.

Melt the White Wax, add the White Petrolatum, then the Benzoinated Lard, continuing the heat until the mixture is liquefied, and stir it constantly until it congeals.

For use in southern latitudes, and during the heated season in other localities, 50 Gm. [old form 350 grains] of Benzoinated Lard may be replaced by an equal quantity of White Wax.

CERATUM CAMPHORÆ. U.S. Camphor Cerate

	Metric	Old form
* **Camphor Liniment**	100 Gm.	1 oz. av. 262 gr.
White Wax	350 Gm.	5 oz. av. 262 gr.
White Petrolatum	150 Gm.	2 oz. av. 175 gr.
Benzoinated Lard	400 Gm.	6 oz. av. 176 gr.
To make	1000 Gm.	16 oz. av.

Melt the White Wax, add the White Petrolatum, then the Benzoinated Lard, and continue the heat until the mixture is liquefied. While the mixture is cooling, add the Camphor Liniment, and incorporate thoroughly by stirring until it congeals.

CERATUM CANTHARIDIS. U.S. Cantharides Cerate

	Metric	Old form
* **Cantharides,** in No. 60 powder	320 Gm.	5 oz. av. 52 gr.
Liquid Petrolatum	150 Gm.	2 oz. av. 175 gr.
Yellow Wax	180 Gm.	2 oz. av. 385 gr.
Rosin	180 Gm.	2 oz. av. 385 gr.
Lard	170 Gm.	2 oz. av. 315 gr.
To make	1000 Gm.	16 oz. av.

Mix the Cantharides with the Liquid Petrolatum, and set the mixture aside, well covered, in a warm place, for forty-eight hours. Then add it to the Rosin, Yellow Wax, and Lard, previously melted and strained through muslin, and keep the mixture in a liquid condition by means of a water-bath, stirring occasionally, for one hour. Finally, remove it from the bath, and stir the mixture until it begins to congeal.

CERATUM PLUMBI SUBACETATIS. U.S. Cerate of Lead Subacetate

[GOULARD'S CERATE]

	Metric	Old form
* **Solution of Lead Subacetate**	20 Gm.	75 minims
Wool-Fat	20 Gm.	87½ grains
Paraffin	20 Gm.	87½ grains
White Petrolatum	38 Gm.	166 grains
Camphor	2 Gm.	9 grains
To make	100 Gm.	1 oz. av.

To the melted Wool-Fat in a warm mortar gradually add the Solution of Lead Subacetate, and incorporate it by slow trituration.

To the mixture add the White Petrolatum and Paraffin, previously melted, and in which the Camphor has been dissolved; mix thoroughly until homogeneous.

CERATUM RESINÆ. U.S. Rosin Cerate

[Basilicon Ointment]

	Metric	Old form
* Rosin	350 Gm.	3½ oz. av.
Yellow Wax	150 Gm.	1½ oz. av.
Lard	500 Gm.	5 oz. av.
To make	1000 Gm.	10 oz. av.

Melt the Rosin, add the Yellow Wax and the Lard, and continue the heat until liquefied, then strain the liquid through muslin, and allow it to congeal with occasional stirring.

In cold weather 530 Gm. [old form 5 oz. av. 132 gr.] of Lard, and 120 Gm. [old form 1 oz. av. 87 gr.] of Yellow Wax may be used.

CERATUM RESINÆ COMPOSITUM. U.S. Compound Rosin Cerate

[Deshler's Salve]

	Metric	Old form
* Rosin	225 Gm.	3 oz. av. 262 gr.
Yellow Wax	225 Gm.	3 oz. av. 262 gr.
Prepared Suet	300 Gm.	4 oz. av. 350 gr.
Turpentine	115 Gm.	1 oz. av. 368 gr.
Linseed Oil	135 Gm.	2 oz. av. 70 gr.
To make	1000 Gm.	16 oz. av.

Melt the Rosin, Yellow Wax, Turpentine, and Prepared Suet; to this add the Linseed Oil, and continue the heat until the mixture is liquefied; then strain it through coarse muslin, and stir it until it begins to congeal.

Unguenta *Ointments*

Ointments are fatty preparations, of a softer consistence than cerates, intended to be applied to the skin by inunction. The medicating ingredients are combined with a vehicle of lard, petrolatum, wool-fat, or similar substance. Ointments are made in several ways: 1. By fusion. 2. By incorporation. 3. By chemical reaction.

1. **By Fusion.**—In making ointments in this way, care must be observed not to apply sufficient heat to burn the constituents. Cerates and ointments may be strained through flannel or muslin to separate mechanical impurities, and if desired, some of them can be filtered through paper. (See Hot Filtration, page 214.)

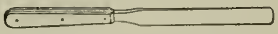
2. **By Incorporation.**—The method of making ointments by incorporation is more frequently used than any other. The medicating ingredients used are nearly always insoluble in the basis, and it is necessary, therefore, to reduce them to a fine state of division in order to facilitate their absorption or medicinal action. The usual mode of procedure is to place the fatty basis upon an ointment slab, and the medicating substance close by. The latter, if in fine powder, is first mixed with a *small portion* of the basis by rubbing both backward

and forward with the blade of a spatula until the mixture is perfectly smooth. It is then a very simple operation to dilute this small quantity of concentrated ointment by incorporating it with the rest of the basis, by using the spatula in the same way. If extracts are to be incorporated, they are softened by adding a little water or diluted alcohol, until a smooth paste is made, which is then mixed with the basis with a spatula. An excellent ointment slab is made by setting a plate of ground glass in a wooden frame or slide (see page 1071). Ointments are sometimes made in a mortar with the pestle; but this mode is less convenient. Lard should be benzoinated or otherwise protected from rancidity.

Fig. 781

Paper ointment block

Fig. 782



Spatula (all horn)

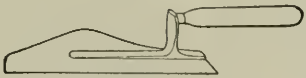
Fig. 781 shows the ointment block furnished by Fox, Fultz & Co. It resembles the well known "paper pads." Its advantages are that the operator can tear off the piece of prepared paper upon which he has made an ointment and throw it away. This obviates the necessity of wasting time in cleaning an ointment slab every time that it is used.

In incorporating ointments containing substances which act on steel, horn spatulas may be used. These may either be a single blade of horn cut into a suitable shape, or provided with a handle, as shown in Fig. 782 (see also Figs. 135 and 137). When large quantities of ointments are required to be made by incorporation, as is sometimes the case in hospitals, dispensaries, etc., an ointment trowel may be made by cutting a mason's trowel into the shape shown in Figs. 783 and 784,—the former giving the bottom view, the latter the side view. This affords a large working surface, and the incorporation can be performed quickly.

Fig. 783

Ointment trowel
(bottom view)

Fig. 784



Ointment trowel (side view)

3. **By Chemical Reaction.**—The only official ointment that is made by chemical reaction is the ointment of mercuric nitrate. In this, the olein of the lard is converted into elaidin through the action of heat and nitric acid; solution of mercuric nitrate is then incorporated with the elaidin vehicle.

Maxims to be observed in making or dispensing Ointments.—1. They should never be dispensed if they have the slightest taint of rancidity. 2. They should always be smooth and free from grittiness or irritating particles. 3. Ointments containing free acid, iodine, or tannin should not be rubbed with an iron or steel spatula, on account of the chemical action on the metal.

Official Ointments made by Fusion

Unguentum	Made by fusing together 200 Gm. of White Wax and 800 Gm. of Benzoinated Lard, and stirring until cold
Acidi Borici	Made by fusing together 100 Gm. of Paraffin and 800 Gm. of White Petrolatum, incorporating 100 Gm. of powdered Boric Acid, and stirring until cold
Aquæ Rosæ	Made by fusing together at a moderate heat 560 Gm. of Expressed Oil of Almond, 125 Gm. of Spermaceti, and 120 Gm. of White Wax, gradually adding 190 Gm. of Stronger Rose Water, in which 5 Gm. of Sodium Borate has been dissolved, and stirring until a uniformly soft and creamy mixture is obtained
Chrysarobini	Made by incorporating 6 Gm. of Chrysarobin in 94 Gm. of melted Benzoinated Lard, heating gently during twenty minutes, and then stirring until cold
Diachylon	Made by fusing 50 Gm. of Lead Plaster with 49 Gm. of Olive Oil, allowing the mass to partly cool, and then adding 1 Gm. of Oil of Lavender Flowers, and stirring until cold
Hydrargyri	Made by mixing 500 Gm. of Mercury with 20 Gm. of Oleate of Mercury, then adding 250 Gm. of Benzoinated Lard, and 230 Gm. of Prepared Suet, previously melted together and partially cooled, and continuing the trituration until globules of mercury cease to be visible under a magnifying power of 10 diameters
Hydrargyri Ammoniati	Made by incorporating 10 Gm. of powdered Ammoniated Mercury with 50 Gm. of melted White Petrolatum, adding 40 Gm. of melted Hydrous Wool-Fat, and stirring until cold
Phenolis	Made by adding 3 Gm. of Phenol to 97 Gm. of melted White Petrolatum, and stirring the mixture until cold
Picis Liquidæ	Made by fusing at a moderate heat 350 Gm. of Lard and 150 Gm. of Yellow Wax, then adding 500 Gm. of Tar, straining, and stirring constantly until cold
Zinci Oxidi	Made by incorporating 200 Gm. of powdered Zinc Oxide with 800 Gm. of melted Benzoinated Lard, and stirring the mixture until cold
Zinci Stearatis	Made by incorporating 50 Gm. of powdered Zinc Stearate with 50 Gm. of melted White Petrolatum, continuing a gentle heat until smooth, and then stirring until cold

Official Ointments made by Incorporation without Heat

Unguentum Acidi Tannici	Made by dissolving 20 Gm. of Tannic Acid in 20 Gm. of Glycerin, and incorporating the solution with 60 Gm. of Ointment
Belladonnæ	Made by rubbing 10 Gm. of Extract of Belladonna Leaves with 5 Cc. of Diluted Alcohol until soft, then incorporating the mixture thoroughly with 20 Gm. of Hydrous Wool-Fat and 65 Gm. of Benzoinated Lard
Gallæ	Made by incorporating 20 Gm. of powdered Nutgall with 80 Gm. of Ointment
Hydrargyri Dilutum	Made by uniformly mixing 670 Gm. of Mercurial Ointment with 330 Gm. of Petrolatum
Hydrargyri Oxidi Flavi	Made by triturating 10 Gm. of Yellow Mercuric Oxide with 10 Gm. of Water, and thoroughly incorporating the mixture with 40 Gm. of Hydrous Wool-Fat and 40 Gm. of Petrolatum
Hydrargyri Oxidi Rubri	Made by triturating 10 Gm. of Red Mercuric Oxide with 10 Gm. of Water, and thoroughly incorporating the mixture with 40 Gm. of Hydrous Wool-Fat and 40 Gm. of Petrolatum
Iodi	Made by triturating 4 Gm. of Iodine and 4 Gm. of Potassium Iodide with 12 Gm. of Glycerin until dissolved, and thoroughly mixing the solution with 80 Gm. of Benzoinated Lard, avoiding the use of metallic utensils
Iodoformi	Made by thoroughly incorporating 10 Gm. of Iodoform with 90 Gm. of Lard
Potassii Iodidi	Made by dissolving 10 Gm. of Potassium Iodide and 0.6 Gm. of Potassium Carbonate in 10 Gm. of Water, and thoroughly incorporating the solution with 80 Gm. of Benzoinated Lard
Stramonii	Made by rubbing 10 Gm. of Extract of Stramonium with 5 Cc. of Diluted Alcohol until soft, then incorporating the mixture thoroughly with 20 Gm. of Hydrous Wool-Fat and 65 Gm. of Benzoinated Lard
Sulphuris	Made by thoroughly incorporating 150 Gm. of Washed Sulphur with 850 Gm. of Benzoinated Lard
Veratrinæ	Made by rubbing 4 Gm. of Veratrine with 6 Gm. of Expressed Oil of Almond, and incorporating the mixture thoroughly with 90 Gm. of Benzoinated Lard

Official Ointment made by Chemical Reaction

Unguentum Hydrargyri Nitratis	See page 1264

Unofficial Ointments

Name	Ingredients	Preparation
Unguentum Acidi Salicylici. Br.	0.5 Gm. Salicylic Acid; 24.5 Gm. Paraffin Ointment	Mix them
Aconitinæ. Br.	0.5 Gm. Aconitine; 4 Gm. Oleic Acid; 20.5 Gm. Lard	Dissolve the Aconitine in the Oleic Acid, with the aid of a gentle heat, and mix the solution with the Lard
Atropinæ. Br.	0.5 Gm. Atropine; 2 Gm. Oleic Acid; 22.5 Gm. Lard	Dissolve the Atropine in the Oleic Acid, with the aid of a gentle heat, and mix the solution with the Lard
Cantharidis. Br.	30 Gm. Cantharides, bruised; 300 Gm. Benzoinated Lard	Add the Cantharides to the melted Benzoinated Lard and digest for twelve hours at about 48.9° C. (120° F.), then strain and stir until cold
Capsici. Br.	12 Gm. Capsicum Fruit, bruised; 6 Gm. Spermaceti; 44 Gm. Olive Oil	Digest on a water bath, occasionally stirring, strain, and cool without stirring
Cetacei. Br.	200 Gm. Spermaceti; 80 Gm. White Beeswax; 720 Gm. Almond Oil; 20 Gm. Benzoin	Add the Benzoin to the melted Spermaceti, and White Beeswax and Almond Oil, digest, with frequent stirring during two hours, strain, and stir while cooling
Cocainæ. Br.	1 Gm. Cocaine; 4 Gm. Oleic Acid; 20 Gm. Lard	Dissolve the Cocaine in the Oleic Acid, with the aid of a gentle heat, and mix the solution with the Lard
Conii. Br.	88 Cc. Juice of Conium; 33 Gm. Hydrous Wool-Fat	Evaporate the Juice of Conium to one-eighth its volume, at a temperature not exceeding 60° C. (140° F.), and incorporate it with the Hydrous Wool-Fat
Creosoti. Br.	30 Gm. Creosote; 120 Gm. Hard Paraffin; 150 Gm. Soft Paraffin	Melt the Hard and Soft Paraffins together, add the Creosote, and stir until cold
Eucalypti. Br.	30 Gm. Oil of Eucalyptus; 120 Gm. Hard Paraffin; 150 Gm. Soft Paraffin	Melt the Hard and Soft Paraffins together, add the Oil of Eucalyptus, and stir until cold
Gallæ cum Opio. Br.	92.5 Gm. Gall Ointment; 7.5 Gm. Opium, in powder	Thoroughly mix
Glycerini Plumbi Subacetatis. Br.	30 Gm. Glycerin of Lead Subacetate; 150 Gm. Paraffin Ointment	Mix them
Hamamelidis. Br.	10 Cc. Liquid Extract of Hamamelis; 90 Gm. Hydrous Wool-Fat	Mix them
Hydrargyri Compositum. Br.	150 Gm. Mercury Ointment; 90 Gm. Yellow Beeswax; 90 Gm. Olive Oil; 45 Gm. Camphor, powdered	Mix the Beeswax, Olive Oil, and Mercury Ointment with the aid of heat, add the Camphor, and triturate until cold
Hydrargyri Iodidi Rubri. Br.	2 Gm. Mercuric Iodide; 48 Gm. Benzoinated Lard	Mix them
Hydrargyri Nitratis Dilutum. Br.	25 Gm. Mercuric Nitrate Ointment; 100 Gm. Soft Paraffin	Mix them
Hydrargyri Oleatis. Br.	20 Gm. Mercuric Oleate; 60 Gm. Benzoinated Lard	Mix them
Hydrargyri Subchloridi. Br.	10 Gm. Mercurous Chloride; 90 Gm. Benzoinated Lard	Mix them
Paraffini. Br.	90 Gm. Hard Paraffin; 210 Gm. Soft Paraffin	Melt them together and stir constantly during the cooling. (White Soft Paraffin may replace the Yellow if desired)
Plumbi Acetatis. Br.	2 Gm. Lead Acetate; 48 Gm. Paraffin Ointment (white)	Mix them
Plumbi Carbonatis. U. S. P. 1890	10 Gm. Lead Carbonate; 90 Gm. Benzoinated Lard	Incorporate the finely powdered Lead Carbonate with the Benzoinated Lard
Plumbi Iodidi. U. S. P. 1890	10 Gm. Lead Iodide; 90 Gm. Benzoinated Lard	Incorporate the finely powdered Lead Iodide with the Benzoinated Lard

Unofficial Ointments—*Continued*

Name	Ingredients	Preparation
Unguentum Staphisagriæ. Br.	40 Gm. Stavesacre Seeds; 20 Gm. Yellow Beeswax; 170 Gm. Benzoinated Lard	Digest the crushed Seeds in the melted Lard, on a water bath, during two hours, strain, add the beeswax, heat until uniform, and stir during cooling
Sulphuris Iodidi. Br.	2 Gm. Sulphur Iodide; 2 Gm. Glycerin; 46 Gm. Benzoinated Lard	Triturate the Sulphur Iodide and Glycerin to a smooth paste, and incorporate it with the Benzoinated Lard

UNGUENTUM. U. S. Ointment

	Metric	Old form
* **White Wax**	200 Gm.	1 oz. av.
Benzoinated Lard	800 Gm.	4 oz. av.
To make	1000 Gm.	5 oz. av.

Melt the White Wax, add the Benzoinated Lard, and heat gently until liquefied; then stir the mixture until it congeals.

UNGUENTUM ACIDI BORICI. U.S. Ointment of Boric Acid

	Metric	Old form
* **Boric Acid,** in fine powder	100 Gm.	44 grains
Paraffin	100 Gm.	44 grains
White Petrolatum	800 Gm.	350 grains
To make	1000 Gm.	1 oz. av.

Melt the Paraffin, add the White Petrolatum, and heat gently for ten minutes. Then gradually add the hot liquid to the Boric Acid, contained in a warm mortar, triturating thoroughly, and stir the mixture until it congeals.

UNGUENTUM ACIDI TANNICI. U.S. Ointment of Tannic Acid

	Metric	Old form
* **Tannic Acid**	20 Gm.	88 grains
Glycerin	20 Gm.	88 grains
Ointment	60 Gm.	262 grains
To make	100 Gm.	1 oz. av.

Dissolve the Tannic Acid in the Glycerin, with the aid of a gentle heat, and mix the solution thoroughly with the Ointment in a mortar, avoiding the use of iron utensils.

UNGUENTUM AQUÆ ROSÆ. U.S. Ointment of Rose Water

	Metric	Old form
* **Spermaceti**	125 Gm.	2 oz. av.
White Wax	120 Gm.	1 oz. av. 403 gr.
Expressed Oil of Almond	560 Gm.	8 oz. av. 420 gr.
Sodium Borate, in fine powder	5 Gm.	35 grains
Stronger Rose Water	190 Gm.	3 oz. av. 17 gr.
To make about	1000 Gm.	about 16 oz. av.

Reduce the Spermaceti and the White Wax to fine shavings, and melt them at a moderate heat, add the Expressed Oil of Almond and stir, continuing the heat until the mixture is uniform; then gradually add the Stronger Rose Water, previously warmed, and in which the Sodium Borate has been dissolved, stirring the mixture rapidly and continuously until it congeals and becomes of uniform consistence.

When this Ointment is to be used as a vehicle for metallic salts, the Sodium Borate should be omitted.

UNGUENTUM BELLADONNÆ. U.S. Belladonna Ointment

	Metric	Old form
* **Extract of Belladonna Leaves**	10 Gm.	44 grains
Diluted Alcohol	5 Cc.	½ fl. dr.
Hydrous Wool-Fat	20 Gm.	88 grains
Benzoinated Lard	65 Gm.	285 grains
To make about	100 Gm.	about 1 oz. av.

Triturate the Extract with the Diluted Alcohol until a smooth mixture is obtained; with this incorporate the Hydrous Wool-Fat; then add the Benzoinated Lard and mix thoroughly.

UNGUENTUM CHRYSAROBINI. U.S. Chrysarobin Ointment

	Metric	Old form
* **Chrysarobin**	6 Gm.	26 grains
Benzoinated Lard	94 Gm.	412 grains
To make about	100 Gm.	1 oz. av.

Triturate the Chrysarobin with the Benzoinated Lard, previously melted, and heat the mixture on a water-bath with occasional stirring for twenty minutes; then strain and stir until it congeals.

UNGUENTUM DIACHYLON. U.S. Diachylon Ointment

	Metric	Old form
* **Lead Plaster**	50 Gm.	219 grains
Oil of Lavender Flowers	1 Gm.	4 minims
Olive Oil	49 Gm.	214 grains
To make	100 Gm.	about 1 oz. av.

Melt the Lead Plaster by applying a gentle heat, add the Olive Oil, and mix thoroughly; then allow the mixture to cool, add the Oil of Lavender Flowers, and stir the ointment until it congeals. It should be prepared extemporaneously.

UNGUENTUM GALLÆ. U.S. Nutgall Ointment

	Metric	Old form
* **Nutgall,** in very fine powder	20 Gm.	88 grains
Ointment	80 Gm.	350 grains
To make	100 Gm.	1 oz. av.

Rub the Nutgall with the Ointment, gradually added, until they are thoroughly mixed. Avoid the use of metallic utensils.

UNGUENTUM HYDRARGYRI. U.S. Mercurial Ointment

	Metric	Old form
* **Mercury**	500 Gm.	1 oz. av.
Oleate of Mercury	20 Gm.	18 grains
Prepared Suet	230 Gm.	201 grains
Benzoinated Lard	250 Gm.	219 grains
To make	1000 Gm.	2 oz. av.

Triturate the Oleate of Mercury in a warm mortar, add the Mercury gradually by means of a pipette, and when the globules are completely divided and distributed, set it aside for about fifteen minutes. Melt the Lard and Suet, allow the mixture to partially cool, and add about 25 Gm. [old form 22 grains] of it to the mercurial mixture, and continue the trituration until globules are no longer visible under a lens magnifying ten diameters. Then add the remainder of the Lard and Suet and mix thoroughly.

Assay

Weigh 10 Gm. of Mercurial Ointment in a tared dish, melt it, then remove it from the fire and add 50 Cc. of warm petroleum benzin. Stir the mixture well, allow the Mercury to settle completely, and decant the petroleum benzin. Wash the residue with successive portions of 10 Cc. each of warm petroleum benzin until it is entirely free from fatty matter, carefully retain all of the separated Mercury in the dish, and allow all traces of the benzin to evaporate. Add to the residue 10 Cc. of diluted hydrochloric acid, heat it gently and stir with a glass rod until the Mercury collects in a globule. Pour off the acid, warm the Mercury with a little distilled water, dry the globule on bibulous paper, and weigh. The Mercury should weigh not less than 4.9 Gm.

UNGUENTUM HYDRARGYRI AMMONIATI. U.S. Ointment of Ammoniated Mercury

	Metric	Old form
* **Ammoniated Mercury**, in very fine powder	10 Gm.	44 grains
White Petrolatum	50 Gm.	219 grains
Hydrous Wool-Fat	40 Gm.	175 grains
To make about	100 Gm.	1 oz. av.

Rub the Ammoniated Mercury with an equal weight of the melted White Petrolatum, then add the remainder of the melted White Petrolatum, mix thoroughly with the Hydrous Wool-Fat, and stir the mixture until it congeals.

UNGUENTUM HYDRARGYRI DILUTUM. U.S. Blue Ointment

	Metric	Old form
* **Mercurial Ointment**	670 Gm.	294 grains
Petrolatum	330 Gm.	144 grains
To make	1000 Gm.	1 oz. av.

Mix them thoroughly.

UNGUENTUM HYDRARGYRI NITRATIS. U.S. Ointment of Mercuric Nitrate

[Citrine Ointment]

	Metric	Old form
* **Mercury**	70 Gm.	30 grains
Nitric Acid	175 Gm.	55 minims
Lard, free from water	760 Gm.	333 grains
To make about	1000 Gm.	1 oz. av.

Heat the Lard in a capacious glass or porcelain vessel to a temperature of 105° C. (221° F.), then withdraw the heat and gradually add 70 Gm. [old form 22 minims] of the Nitric Acid. When the reaction moderates, reapply the heat until effervescence ceases, and allow the mixture to cool to about 40° C. (104° F.). Having dissolved the

Mercury in the remainder of the Nitric Acid, using sufficient heat to prevent the solution from crystallizing, add this solution to the Lard mixture. When the mass begins to congeal, stir it thoroughly with a wooden spatula, until it is of a bright citrine color. Contact with metallic utensils should be avoided.

UNGUENTUM HYDRARGYRI OXIDI FLAVI. U.S. **Ointment of Yellow Mercuric Oxide**

	Metric	Old form
* **Yellow Mercuric Oxide,** in very fine powder	10 Gm.	44 grains
Water	10 Gm.	46 minims
Hydrous Wool-Fat	40 Gm.	175 grains
Petrolatum	40 Gm.	175 grains
To make	100 Gm.	1 oz. av.

Triturate the Yellow Mercuric Oxide with the Water until the mixture is perfectly smooth, then add the Hydrous Wool-Fat in divided portions, and incorporate thoroughly with the Petrolatum, avoiding contact with metallic utensils.

UNGUENTUM HYDRARGYRI OXIDI RUBRI. U.S. **Ointment of Red Mercuric Oxide**

[Red Precipitate Ointment]

	Metric	Old form
* **Red Mercuric Oxide,** in very fine powder	10 Gm.	44 grains
Water	10 Gm.	46 minims
Hydrous Wool-Fat	40 Gm.	175 grains
Petrolatum	40 Gm.	175 grains
To make	100 Gm.	1 oz. av.

Triturate the Red Mercuric Oxide with the Water until the mixture is perfectly smooth and absolutely free from gritty particles, then add the Hydrous Wool-Fat in divided portions, and incorporate thoroughly with the Petrolatum. Contact with metallic utensils should be avoided.

UNGUENTUM IODI. U.S. **Iodine Ointment**

	Metric	Old form
* **Iodine**	4 Gm.	17½ grains
Potassium Iodide	4 Gm.	17½ grains
Glycerin	12 Gm.	53 grains
Benzoinated Lard	80 Gm.	350 grains
To make	100 Gm.	1 oz. av.

Triturate the Iodine and Potassium Iodide in a glass mortar with the Glycerin until dissolved, then gradually incorporate the Benzoinated Lard and mix thoroughly, avoiding the use of a metallic spatula. This Ointment should be freshly made when required.

UNGUENTUM IODOFORMI. U.S. **Iodoform Ointment**

	Metric	Old form
* **Iodoform,** in very fine powder	10 Gm.	44 grains
Lard	90 Gm.	394 grains
To make	100 Gm.	1 oz. av.

Triturate the Iodoform thoroughly with about twice its weight of the Lard, then incorporate the remainder of the Lard.

UNGUENTUM PHENOLIS. U.S. Ointment of Phenol

[UNGUENTUM ACIDI CARBOLICI, PHARM. 1890]

	Metric	Old form
* **Phenol**	3 Gm.	13 grains
White Petrolatum	97 Gm.	425 grains
To make	100 Gm.	1 oz. av.

To the melted White Petrolatum add the Phenol, and stir the mixture until it begins to congeal.

UNGUENTUM PICIS LIQUIDÆ. U.S. Tar Ointment

	Metric	Old form
* **Tar**	500 Gm.	218 grains
Yellow Wax	150 Gm.	67 grains
Lard	350 Gm.	153 grains
To make	1000 Gm.	1 oz. av.

Melt the Yellow Wax, add the Lard, and to the melted mixture add the Tar, previously warmed, and incorporate thoroughly; strain through muslin, and stir the mixture until it congeals.

UNGUENTUM POTASSII IODIDI. U.S. Ointment of Potassium Iodide

	Metric	Old form
* **Potassium Iodide**	10.0 Gm.	44 grains
Potassium Carbonate	0.6 Gm.	2½ grains
Water	10.0 Gm.	46 minims
Benzoinated Lard	80.0 Gm.	350 grains
To make about	100 Gm.	1 oz. av.

Dissolve the Potassium Iodide and Potassium Carbonate in the Water by trituration, then gradually add the Benzoinated Lard and incorporate thoroughly. This Ointment should be prepared extemporaneously.

UNGUENTUM STRAMONII. U.S. Stramonium Ointment

	Metric	Old form
* **Extract of Stramonium**	10 Gm.	44 grains
Diluted Alcohol	5 Cc.	½ fl. dr.
Hydrous Wool-Fat	20 Gm.	88 grains
Benzoinated Lard	65 Gm.	285 grains
To make about	100 Gm.	about 1 oz. av.

Triturate the Extract with the Diluted Alcohol until a smooth mixture is obtained; with this incorporate the Hydrous Wool-Fat, then add the Benzoinated Lard, and mix thoroughly.

UNGUENTUM SULPHURIS. U.S. Sulphur Ointment

	Metric	Old form
* **Washed Sulphur**	150 Gm.	67 grains
Benzoinated Lard	850 Gm.	371 grains
To make	1000 Gm.	1 oz. av.

Rub the Washed Sulphur with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM VERATRINÆ. U.S. Veratrine Ointment

	Metric	Old form
* **Veratrine**	4 Gm.	17½ grains
Expressed Oil of Almond	6 Gm.	26 grains
Benzoinated Lard	90 Gm.	394 grains
To make	100 Gm.	1 oz. av.

Rub the Veratrine with the Expressed Oil of Almond, then gradually add the Benzoinated Lard, and mix thoroughly.

UNGUENTUM ZINCI OXIDI. U.S. Ointment of Zinc Oxide

[ZINC OINTMENT]

	Metric	Old form
* **Zinc Oxide,** in very fine powder	200 Gm.	90 grains
Benzoinated Lard	800 Gm.	360 grains
To make	1000 Gm.	about 1 oz. av.

Rub the Zinc Oxide, which must be free from gritty particles, with an equal weight of the melted Benzoinated Lard, and with this incorporate the remainder of the Benzoinated Lard, previously melted; if necessary, strain the ointment while warm, and stir thoroughly until it congeals.

UNGUENTUM ZINCI STEARATIS. U.S. Ointment of Zinc Stearate

	Metric	Old form
* **Zinc Stearate,** in fine powder	50 Gm.	219 grains
White Petrolatum	50 Gm.	219 grains
To make	100 Gm.	1 oz. av.

To the White Petrolatum, melted on a water-bath, add the Zinc Stearate. Continue the heat until the mixture becomes smooth, then stir while cooling, until it congeals.

Preserving and Dispensing Cerates and Ointments.—As has been already stated, fatty substances may be preserved from rancidity by digesting them with balsamic resins, poplar buds, styrax, etc. To preserve them during hot weather, they require in addition a cool temperature and freedom from exposure to the air (see page 1001). When a fresh lot of ointment is made to replenish a stock jar, the jar should be thoroughly cleaned, and the old ointment remaining thrown away, unless it is certain that the latter is entirely free from rancidity, as otherwise it would soon cause the new ointment to become rancid. Amber glass, stoneware, or porcelain jars are the best receptacles for ointments. Queen's-ware or china jars soon permit the fatty substance to penetrate through the minute fissures which are always present. Fig. 785 shows a German porcelain jar, which is just as useful for preserving ointments as it is for holding a penetrating

FIG. 785

Porcelain jar

FIG. 786

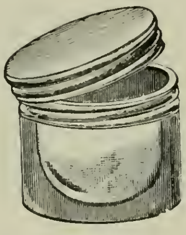
Ointment jar (amber glass)

substance like green soap. Fig. 786 illustrates an amber glass stock ointment jar made by the Whitall Tatum Company. The letters for the label are blown in the glass, and then ground off, so that the label is indestructible. The only difficulty is that the label requires a strong light to enable it to be seen clearly. For dispensing ointments the opal glass pot is very useful. The best shapes are shown in Figs. 787 and 787*a*. The bottom is rounded, so that the patient can easily reach all the ointment with the finger, and the top is metallic, with a screw cap. There is room for the label on the glass. The pot shown in Fig. 788 is not recommended. The bottom forms an angle with the sides which collects the ointment, the shoulder also catches a portion, while the wooden top is very apt to shrink, so that there is difficulty in getting it off without breaking it. Fig. 789 shows Fox Fultz & Co.'s Sterling ointment pot. It is fitted with a metallic screw cap; the round label has a transparent celluloid disk above it and a heavy waxed disk below it, the whole making a grease-proof top to the pot. The glass box shown in Fig. 790 has a wooden top with a lithographed label. These are certainly the handsomest ointment boxes and the most expensive. The lids will often contract, however, and give trouble in getting them on and off. Of the very cheap boxes, those turned from wood are totally *unfit* for dispensing ointments. The ointment quickly penetrates through the grain of the wooden bottom, and the greasy abomination is exceedingly unwelcome to most housekeepers. A chip wood box covered with pasteboard is preferable, because it offers more resistance to the passage of the fatty substance. The impervious walnut boxes, made by gluing several veneers of hard wood together, are still better.

Fig. 787

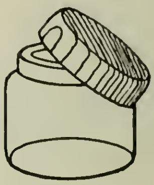
Ointment pot

Fig. 787*a*



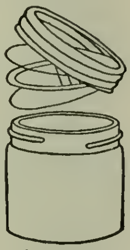
Ointment pot

Fig. 788



Ointment pot (wooden top)

Fig. 789



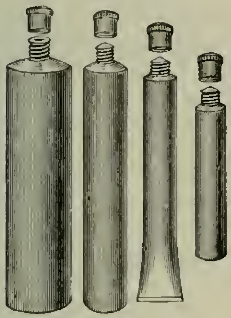
Sterling ointment pot

Fig. 790

German ointment pot

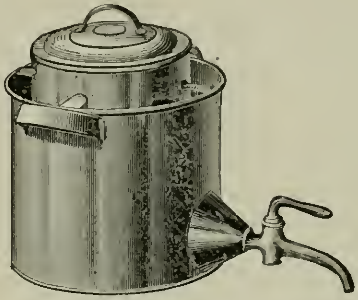
Collapsible tubes, made by A. H. Wirz, of Philadelphia, are used in dispensing soft ointments. If these contain no acid or corrosive constituents the tubes answer an admirable purpose as containers for them (see Fig. 791). These soft metal tubes are filled from the bottom with the ointment melted with just sufficient heat to permit it to be poured, and then closed by folding the ends together, as shown in one of them, and rolling the fold over twice with a pair of pliers. A screw cap is placed upon the top, and the ointment is perfectly protected from exposure. To obtain a little, the screw cap is taken off, and the bottom of the tube slightly pressed between the thumb and finger, when a portion of the ointment quickly exudes. Fig. 792 shows Alper's ointment filler. It consists of a tin kettle surrounded by a water bath, in such a way that the liquid ointment can easily be drawn through the stopcock. Small boxes, bottles, or collapsible tubes can quickly and easily be filled with petrolatum, ointment, or similar preparations, without the inconvenience of handling them in spoons or ladles.

Fig. 791



Collapsible tubes

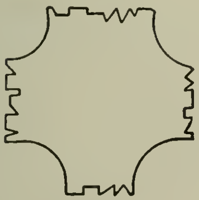
Fig. 792



Alper's ointment filler

Finishing Ointments.—Some skill is required to fill a box with ointment neatly and deftly by using a spatula without soiling the exterior of the box. The surface is generally scraped with the edge of the spatula to give it a smooth finish, and then is sometimes held near a hot surface, like a stove plate, to give it a gloss. Occasionally it will be found that some nervous patients desire to be assured that an ointment or cerate has not been tampered with by a servant, and it may be desirable for other reasons to finish the surface of an ointment with a distinctive design. This may be done by

Fig. 793



Ointment finisher

Fig. 794

Finishing ointment

cutting a piece of tin into a shape similar to that shown in Fig. 793. By placing one of the teeth on the edge of the pot (see Fig. 794), and slowly rotating it, with alternate pauses, a very neat finish may be given to the surface. The finisher (see Fig. 793) shows four sides, and is of course capable of making four patterns.

Emplastra *Plasters*

Plasters are substances intended for external application of such consistence that they adhere to the skin, and require the aid of heat in spreading them. The word plaster is applied not only to the solid substance which is spread upon the muslin, leather, paper, or other material which serves to hold it, but to the spread plaster itself. The basis of most plasters is either made from rubber, lead plaster, gum resin, or Burgundy pitch.

In the preparation of plasters, care is requisite that the heat employed be not sufficiently elevated to produce decomposition, nor so long continued as to drive off any volatile ingredient upon which the virtues of the preparation may in any degree depend. After having been prepared, they are usually shaped into cylindrical rolls, and wrapped in paper to exclude the air. Plasters should be firm at ordinary temperatures, should spread easily when heated, and, after being spread, should remain soft, pliable, and adhesive, without melting, at the heat of the human body. When long kept, they are apt to change color and to become hard and brittle, and, as this alteration is most observable upon their surface, it must depend chiefly upon the action of the air, which should therefore be excluded as much as possible. The defect may usually be remedied by melting the plaster with a moderate heat and adding a sufficient quantity of oil to give it the due consistence. To soften the surface of a spread plaster, it should be brushed with a little tincture of camphor. *Seven* plasters are official.

Official Plasters containing Lead or Adhesive Plaster as their Basis

Emplastrum Adhæsivum	Made by melting 20 Gm. of Rubber, adding 20 Gm. of Petrolatum, heating until dissolved, incorporating 960 Gm. of melted Lead Plaster with the solution, and stirring until the mass stiffens
Belladonnæ	Made by melting 700 Gm. of Adhesive Plaster on a water bath, and incorporating 300 Gm. of Extract of Belladonna Leaves
Hydrargyri	Made by triturating 30 Gm. of Mercury with 1 Gm. of Oleate of Mercury and 10 Gm. of Hydrous Wool-Fat, until globules of Mercury are no longer visible, and then adding 59 Gm. of melted Lead Plaster
Opii	Made by rubbing 6 Gm. of Extract of Opium with 8 Cc. of Water until soft, then adding to it 90 Gm. of melted Adhesive Plaster, and continuing the heat until the mixture weighs 100 Gm.
Plumbi	Made by adding a solution of 60 Gm. of Lead Acetate, dissolved in 250 Cc. of hot Water to a solution of 100 Gm. of Soap, dissolved in 350 Cc. of hot Water, collecting and washing the precipitate, and forming it into rolls
Saponis	Made by rubbing 10 Gm. of Soap with sufficient Water to form a soft mass; then mixing thoroughly with 90 Gm. of Lead Plaster, previously melted

Official Spread Plaster

Emplastrum Capsici	Made by spreading a thin and even layer of melted Adhesive Plaster upon muslin, and allowing to cool; then applying a thin coating of Oleoresin of Capsicum (0.25 Gm. of Oleoresin over a surface 15 centimeters square)

Unofficial Plasters

Name	Ingredients	Preparation
Emplastrum Ammoniaci cum Hydrargyro. U. S. P. 1890	720 Gm. Ammoniac; 180 Gm. Mercury; 8 Gm. Oleate of Mercury; 1000 Cc. Diluted Acetic Acid; Lead Plaster to make 1000 Gm.	Digest the Ammoniac with the Acid until perfectly emulsified, strain and evaporate, on a water bath, until it hardens on cooling. Extinguish the Mercury in the Oleate of Mercury by trituration, add the Ammoniac while yet hot and finally enough melted Lead Plaster to make 1000 Gm. Mix the whole thoroughly
Arnicæ. U. S. P. 1890	330 Gm. Extract of Arnica Root; 670 Gm. Resin Plaster;	Add the Extract to the melted Resin Plaster and mix thoroughly
Cantharidis. Br.	35 Gm. powdered Cantharides; 20 Gm. Yellow Beeswax; 20 Gm. Lard; 20 Gm. Resin; 5 Gm. Soap Plaster	Melt the Resin, add the Soap Plaster and the Beeswax and Lard, sprinkle the Cantharides into the mixture, and stir until cool
Ferri. U. S. P. 1890 (Strengthening-Plaster.)	90 Gm. Ferric Hydrate; 50 Gm. Olive Oil; 140 Gm. Burgundy Pitch; 720 Gm. Lead Plaster	Melt the Lead Plaster and Burgundy Pitch on a water bath, add the Olive Oil, then the Ferric Hydrate, and stir until cool
Ichthyocollæ. U. S. P. 1890	10 Gm. Isinglass; 40 Gm. Alcohol; 1 Gm. Glycerin; Water and Tincture of Benzoin, a sufficient quantity	Dissolve the Isinglass in sufficient hot water to make 120 Gm. Spread one-half of this, in successive layers, on a piece of taffeta, 38 Cm. square, held in a frame, allowing each layer to dry. Add the Alcohol and Glycerin to the remainder of the Isinglass solution and apply it in the same manner, then coat the reverse side of the taffeta with Tincture of Benzoin and, when dry, cut it into suitable pieces
Menthol. Br.	30 Gm. Menthol; 20 Gm. Yellow Beeswax; 150 Gm. Resin	Melt the Beeswax and Resin together and at about 75° C. (167° F.) dissolve the Menthol in the melted mixture
Picis. Br.	520 Gm. Burgundy Pitch; 260 Gm. Frankincense; 90 Gm. Resin; 90 Gm. Yellow Beeswax; 40 Gm. Olive Oil; 40 Cc. Water	Add the Olive Oil and water to the other ingredients, previously melted, and evaporate to a proper consistence
Picis Burgundicæ. U. S. P. 1890	800 Gm. Burgundy Pitch; 50 Gm. Olive Oil; 150 Gm. Yellow Wax	Add the Olive Oil to the melted Burgundy Pitch and Wax, strain, and stir constantly until cool
Picis Cantharidatum. U. S. P. 1890	80 Gm. Cantharides Cerate; Burgundy Pitch to make 1000 Gm.	Melt the Cerate, strain out and discard the Cantharides, add sufficient melted Burgundy Pitch to the Cerate to weigh 1000 Gm., and stir during the cooling
Plumbi Iodidi. Br.	50 Gm. Lead Iodide; 400 Gm. Lead Plaster; 50 Gm. Resin	Mix the finely powdered Lead Iodide with the melted Lead Plaster and Resin at a low temperature
Resinæ. U. S. P. 1890	140 Gm. Resin; 800 Gm. Lead Plaster; 60 Gm. Yellow Wax	Melt first the Lead Plaster and Yellow Wax at a gentle heat, add the Resin, and, when uniformly melted, mix thoroughly

EMPLASTRUM ADHÆSIVUM. U.S. Adhesive Plaster

	Metric	Old form
* **Rubber,** cut in small pieces	20 Gm.	140 grains
Petrolatum	20 Gm.	140 grains
Lead Plaster	960 Gm.	15 oz. av. 158 gr.
To make	1000 Gm.	16 oz. av.

Melt the Rubber at a temperature not exceeding 150° C. (302° F.); add the Petrolatum, and continue the heat until the Rubber is dissolved. Add the Lead Plaster to the hot mixture; continue the heat until it becomes liquid, then strain, allow it to cool, and stir until it stiffens.

EMPLASTRUM BELLADONNÆ. U.S. Belladonna Plaster

Belladonna Plaster should contain not less than 0.38 percent. nor more than 0.42 percent. of mydriatic alkaloids.

	Metric	Old form
* **Extract of Belladonna Leaves**	300 Gm.	4 oz. av. 350 gr.
Adhesive Plaster	700 Gm.	11 oz. av. 88 gr.
To make about	1000 Gm.	16 oz. av.

Melt the Adhesive Plaster on a water-bath, add to it the Extract of Belladonna Leaves, softened by the heat of a water-bath, and continue the heat, stirring constantly until the mixture is perfectly homogeneous; then allow it to cool.

Spread Belladonna Plasters made with a rubber base should yield, when assayed by the process given below, not less than 0.38 percent. nor more than 0.42 percent. of mydriatic alkaloids.

Assay of Belladonna Plaster (Rubber Base)

Belladonna Plaster, spread upon cloth	10 Gm.
Chloroform,	
Ammonia Water,	
Alcohol,	
Distilled Water,	
Normal Sulphuric Acid V.S.,	
Tenth-normal Sulphuric Acid V.S.,	
Fiftieth-normal Potassium Hydroxide V.S.,	
Cochineal T.S., each, a sufficient quantity	

Into a suitable beaker containing 50 Cc. of chloroform and 3 Cc. of ammonia water, introduce the Belladonna Plaster cut into strips. Stir until the Plaster is entirely removed from the cloth; then pour off the chloroform into another beaker, wash the cloth with 25 Cc. of chloroform and 1 Cc. of ammonia water carefully, and add the washings to the chloroformic solution first obtained. If necessary, repeat the washing with 25 Cc. of chloroform, and add this also to the chloroformic solution. Then dry the cloth at a low temperature; cool and weigh it, and subtract its weight from the original weight of the Plaster. To the chloroformic solution, add four-fifths of its volume of alcohol, stir gently, and allow the liquid to stand until all of the rubber has separated in a compact mass. Then pour off the supernatant liquid into a separator of 250 Cc. capacity, and, having prepared a solution of sulphuric acid by diluting 40 Cc. of normal sulphuric acid V.S. with 60 Cc. of distilled water, add 20 Cc. of the solution to the separator, and agitate for two minutes, rotating gently. Draw off the chloroformic solution into another separator, shake this with 10 Cc. of the sulphuric acid solution, and add the acid solution to that in the first separator. Repeat until the acid washings cease to give a reaction with mercuric potassium iodide T.S.; combine the acid liquids, and, having rendered this solution alkaline with ammonia water, shake out the alkaloids with three successive portions of 25, 15, and 10 Cc. of chloroform. Collect these in a flask, distil off all of the chloroform with the aid of a water-bath. To the alkaloidal residue add a slight excess of tenth-normal sulphuric acid V.S., noting the quantity used, and then add 10 drops of chloroform and, after rotating, evaporate the latter by means of a water-bath. Then add 5 drops of cochineal T.S., and rotating, titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from the number of cubic centimeters of tenth-normal sulphuric acid V.S. first added, and divide the difference by the number of grammes of Belladonna Plaster separated from the cloth; multiply the quotient by 0.0287, and this product by 100, which will give the percentage of mydriatic alkaloids in the Belladonna Plaster.

EMPLASTRUM CAPSICI. U.S. Capsicum Plaster

	Metric	Old form
* **Oleresin of Capsicum**	0.25 Gm.	4 grains
Adhesive Plaster, spread on fabric, a sufficient quantity		

Apply the Oleoresin of Capsicum to the surface of the Adhesive Plaster by means of a brush, so as to form a thin coating over an area fifteen centimeters [old form 6 inches] square, leaving a margin around the sides.

EMPLASTRUM HYDRARGYRI. U.S. Mercurial Plaster

	Metric	Old form
* **Mercury**	30 Gm.	4 oz. av. 350 gr.
Oleate of Mercury	1 Gm.	70 grains
Hydrous Wool-Fat	10 Gm.	1 oz. av. 263 gr.
Lead Plaster	59 Gm.	9 oz. av. 193 gr.
To make	100 Gm.	16 oz. av.

Triturate the Mercury with the Oleate of Mercury until the former is thoroughly divided, then add the Hydrous Wool-Fat, and continue the trituration until globules of Mercury are no longer visible. Add the mixture to the Lead Plaster, which has previously been melted in a tared dish, and incorporate thoroughly, adding, if necessary, sufficient Lead Plaster to make the product weigh 100 Gm. [old form 16 oz. av.].

EMPLASTRUM OPII. U.S. Opium Plaster

	Metric	Old form
* **Extract of Opium**	6 Gm.	420 grains
Water	8 Cc.	8 fl. dr.
Adhesive Plaster	90 Gm.	14 oz. av. 175 gr.
To make	100 Gm.	16 oz. av.

Rub the Extract of Opium with the Water until it is uniformly soft; add it to the Adhesive Plaster, which has been previously melted in a tared dish on a water-bath, and continue the heat with constant stirring until the product weighs 100 Gm. [old form 16 oz. av.].

EMPLASTRUM PLUMBI. U.S. Lead Plaster

[Diachylon Plaster]

	Metric	Old form
* **Soap,** dried, and in coarse powder	100 Gm.	3 oz. av. 231 gr.
Lead Acetate	60 Gm.	2 oz. av. 51 gr.
Water, a sufficient quantity		

Dissolve the Soap in 350 Cc. [old form 15 fl. oz.] of hot Water and strain the solution. Dissolve the Lead Acetate in 250 Cc. [old form 8½ fl. oz.] of hot Water, and at once filter the solution into the warm Soap solution, stirring constantly.

When the precipitate has subsided, decant the liquid, and wash the precipitate thoroughly with hot Water. Transfer the mass to a warm slab, kneading it thoroughly to free it from water. Finally, roll the plaster into cylindrical forms and wrap them in paraffined paper.

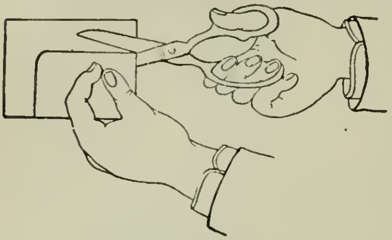
EMPLASTRUM SAPONIS. U.S. Soap Plaster

	Metric	Old form
* **Soap**, dried, and in coarse powder	10 Gm.	1 oz. av.
Lead Plaster	90 Gm.	9 oz. av.
Water, a sufficient quantity,		
To make about	100 Gm.	10 oz. av.

Rub the Soap with enough Water to reduce it to a semi-liquid state; then mix it with the Lead Plaster previously melted, incorporate thoroughly by stirring, and evaporate to the proper consistence.

Spreading Plasters.—Since the introduction of machine spread plasters the preparation of a plaster by a pharmacist upon the prescription of a physician has become almost a "lost art."

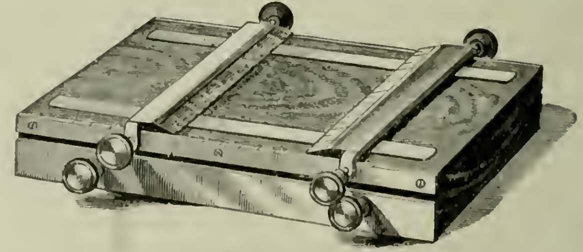
Fig. 795



Cutting plaster paper

Plasters are prepared for use by spreading them upon leather, muslin, or paper, according to the particular purpose for which they are intended. Leather is most convenient when the application is made to the sound skin, muslin when the plaster is used as a dressing to ulcerated or abraded surfaces or with the view of bringing and retaining together the sides of wounds. The leather usually preferred is white sheepskin, or the kind known commercially as "hemlock splits." A margin about a quarter or half an inch broad should usually be left uncovered, in order to facilitate the removal of the plaster and to prevent the clothing in contact with its edges from being soiled. An accurate outline may be obtained by pasting, or fastening with thumb tacks, upon the leather a piece of paper so cut as to leave in the centre a vacant space of the required dimensions, and removing the paper after the plaster is spread. The paper is folded four times. Fig. 795 shows one-fourth of the whole in the act of being cut. The rounded corners give a neater finish than square ones. The same object may often be accomplished by employing two narrow rulers of sheet tin, graduated in inches, and so shaped that each of them will form two sides of a rectangle. These may be applied in such a manner as to enclose within them any given rectangular space, and may be fixed by weights upon the leather, or pref-

Fig. 796



The Franciscus plaster board

erably adjusted by set screws, while the plaster is being spread. The Franciscus machine is constructed on this principle (see Fig. 796).[1] For any other shape, as in the case of plasters for the breast, pieces of tin may be employed having a space within, corresponding to the required outline. Figs. 797, 798, 799, 800, 801, 802, 803, and 804 show patterns for plasters with margins for various parts of the body. Figs. 797 and 798 are for use behind the ears, the pointed portion of the plasters being used for the top. Care must be observed to have the physician designate whether the plaster is intended for the right ear (Fig. 798) or the left ear (Fig. 797). Chest plasters are sometimes cut in the shape of Fig. 799; those intended for use between the shoulders may have the form of Fig. 800. In Fig. 801 a plaster is shown which is intended for the "small of the back," and in Fig. 802 is one for either the right or the left side. Fig. 803 shows a pattern for fastening to kid, to spread a breast plaster on, and Fig. 804 represents the plaster with the margin as spread from such a pattern. The spreading of the plaster is most conveniently accomplished by the use of a spatula or plaster iron (see Fig. 806). This may be heated by means of a spirit lamp. Care must be taken that the instrument be not so hot as to discolor or decompose the plaster, and special care is requisite in the case of those plasters which contain a volatile ingredient. A sufficient portion of the plaster should first be melted by the heated instrument, and, having been received on a piece of coarse, stiff paper, or in a shallow tin tray open on one side, should, when nearly cool, be transferred to the leather and applied quickly and evenly over its surface. By this plan the melted plaster is prevented from penetrating the leather, as it would be apt to do if applied too hot. Before removing the paper from the edge of the plaster, if this has become so hard as to crack, the iron should be drawn over the line of junction. Fig. 805 shows one method of spreading a small plaster with a spatula. Strips of paper are fastened upon the kid with thumb tacks (such as are used by draughtsmen, as shown in the

Fig. 797

Left ear plaster

Fig. 798

Right ear plaster

Fig. 799

Chest plaster

Fig. 800

Shoulder plaster

Fig. 801

Back plaster

Fig. 802

Side plaster

Fig. 803

Breast plaster pattern

Fig. 804

Breast plaster

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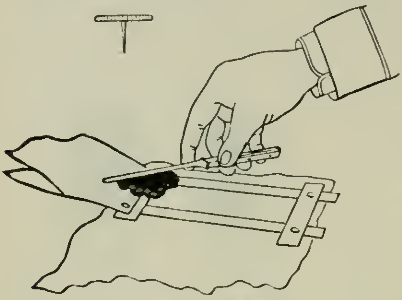
[1] The other side of this valuable apparatus can be used as a lozenge board or pill machine.

upper part of Fig. 805), a piece of waste paper is fastened at the top to prevent soiling the margin, the melted plaster is poured upon it, and the spatula, having been previously warmed by passing it through an alcohol flame or that of a Bunsen burner, is used by quickly passing the edge of the blade over the surface; a portion of the melted plaster precedes the blade in its passage, and thus a thin layer is spread upon the leather. Especial care must be observed not to allow very hot plaster to remain upon the leather, or it may pass through and discolor the back. For large plasters the plaster iron (see Fig. 806) may be employed. This is heated, and, owing to the greater weight of metal, it holds the heat much better than the blade of a spatula. It is, however, not so easily nor so quickly used as the latter instrument by those unaccustomed to it. After the plaster has been spread, the strips of paper are carefully removed, and if the plaster is brittle it should be held near the source of heat, so that the strips may be removed without tearing off pieces of the plaster from the leather.

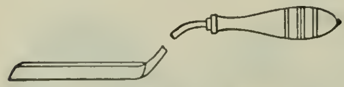
Fig. 805



Spreading a plaster

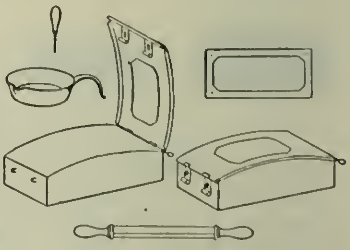
Large quantities of stock plasters may be spread by the apparatus shown below. To an oblong rectangular block of hard wood, slightly convex on its upper surface, is attached by a movable joint a sheet iron frame, with an opening of the dimensions of the plaster to be spread, and clasps at the other end, by which this may be fixed to the block (see Fig. 807). Another portion of the apparatus is a sheet iron or tin frame, by which the leather is cut out and the margin marked. The leather thus prepared is laid on the convex surface of the block; the iron frame is brought down on it evenly; the plaster, previously melted, but not too hot, is poured on the leather in the centre, and, by means of a square iron bar having a wooden handle at each end (see lower part of Fig. 807), which has been heated by a spirit lamp, it is spread uniformly over the surface, the thickness being regulated by the frame against which the iron is pressed. Any excess of plaster is thus pressed over upon the frame. The heated point of an awl (see Fig. 807, upper left corner) is then drawn along the interior edge of the frame so as to separate the plaster from it, after which the clasps are unfastened and the plaster removed.

Fig. 806



Plaster iron

Fig. 807

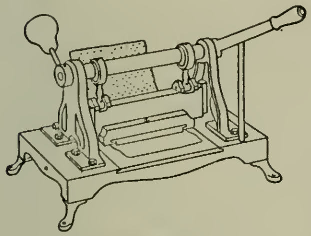


Plaster spreading apparatus

The dipper shown in Fig. 807 is well adapted for holding suitable quantities for spreading plasters extemporaneously. If a portion of the various roll plasters be melted and run into a number of these, and the dippers labelled, they will be found very convenient as containers. Fig. 808 shows a machine for perforating or "porousing" plasters.

Blisters do not usually require the application of heat to spread them. They may be spread on adhesive plaster in the same way as plasters are prepared. The spatula shown in Fig. 809 is well fitted for spreading blisters, as it gives room for the fingers and permits a solid grasp of the handle. The practice of using the thumb in spreading blisters, although tolerated by many good pharmacists, should be regarded as more honored in the breach than in the observance. It is an unnecessary and inelegant procedure, the spatula giving a much smoother finish.

Fig. 808



Plaster perforating machine

Fig. 809

Blister spatula

Chartæ *Papers*

Papers are preparations intended principally for external application, made either by saturating paper with medicinal substances, or by applying the latter to the surface of the paper by the addition of some adhesive liquid. Only one paper is official (see Charta Sinapis, below).

Unofficial Paper

Name	Ingredients	Preparation
Charta Potassii Nitratis. U. S. P. 1890	200 Gm. Potassium Nitrate; 800 Gm. Distilled Water	Immerse strips of white, unsized paper, in a solution of the Potassium Nitrate, in the Water, and dry them

CHARTA SINAPIS. U. S. Mustard Paper

	Metric	Old form
* **Black Mustard,** in No. 60 powder	100 Gm.	10 oz. av.
Rubber	10 Gm.	1 oz. av.
Petroleum Benzin,		
Carbon Disulphide, each, a sufficient quantity		

Pack the Black Mustard in a conical percolator, and gradually pour Petroleum Benzin upon it until the percolate ceases to produce a permanent, greasy stain upon blotting paper. Remove the powder from the percolator, and dry it by exposure to the air. Having meanwhile dissolved the Rubber in a mixture of 100 Cc. [old form 10 fl. oz.], each, of Petroleum Benzin and Carbon Disulphide, mix the purified Mustard with a sufficient quantity of the solution to produce a semi-liquid magma, and apply this, by means of a suitable brush, to one side of a piece of rather thick, well-sized paper, so as to cover it completely, and then allow the surface to dry.

A surface of sixty square centimeters [old form 9½ square inches] should contain about 4 Gm. [old form 62 grains] of Black Mustard deprived of oil.

Before it is applied to the skin, Mustard Paper should be dipped in warm water for about fifteen seconds.

PART VI

FORMULARY OF UNOFFICIAL PREPARATIONS

THE following formulas have been collected principally with the view of saving the labor and time of the pharmacist, who is often suddenly called upon to prepare some remedy for which he may not have a formula in his recipe book. The author's name is appended to the formula when it is known, and the selection has been carefully made so as to embrace many which are not easy of access. The subjects are arranged alphabetically, using the English title, and appending the Latin title whenever one has been adopted; it is believed that this will facilitate ready reference to any formula. As it is very desirable to secure uniformity in practice throughout the United States in the use of unofficial preparations, the National Formulary has been added, and the formulas for many of the preparations which were inserted in the first edition of this work which conflict with these have been dropped. The National Formulary preparations are distinguished by the letters N. F., and the original number of the preparation in the Formulary will be found before the title.

Acetic Acid, Camphorated

Camphor,	1 oz. av.
Acetic Acid,	16 fl. oz.

Powder the Camphor with the aid of alcohol, and dissolve it in the Acetic Acid.

Aromatic and Antacid Corrective of Indigestion

(Dr. J. J. Levick)

Sodium Bicarbonate,	80 grains
Compound Tincture of Cardamom,	4 fl. dr.
Compound Infusion of Gentian,	2½ fl. oz.
Peppermint Water,	3 fl. oz.

Mix. A tablespoonful as required.

Brassicon

Camphor,	20 grains
Oil of Peppermint,	1 fl. dr.
Volatile Oil of Mustard,	12 minims
Ether,	2 fl. dr.
Alcohol,	6 fl. dr.
Spirit of Peppermint, sufficient to color	

Mix. Used externally in headache.

Bromo-Chloralum

Aluminum Chloride,	1 oz. troy
Aluminum Bromide,	240 grains
Boiling Water,	8 fl. oz.

Dissolve by heat in a water bath; when cool, filter through paper.

Camphor, Carbolated

Camphor,	60 grains
Phenol,	20 grains
Alcohol,	2 minims

Mix.

Camphor Julep

(Thomsonian name)

Camphor,	30 grains
Myrrh,	105 grains
Sugar,	60 grains
Water,	2 fl. oz.

Caustic, Iodine

(Rieseberg's)

Iodine,	1 oz. troy
Glycerin,	2 fl. oz.

Applied every second day with a brush. As the preparation is very powerful, its effect must be watched.

Caustic, Painless

(Esmarch's)

Arsenic Trioxide,	2 grains
Morphine Sulphate,	2 grains
Mild Chloride of Mercury,	16 grains
Powdered Acacia,	96 grains

Mix.

Cerate of Extract of Cantharides

CERATUM EXTRACTI CANTHARIDIS. U. S. 1880

	By measure
Cantharides, in No. 60 powder, 30 parts, or	6 oz. av.
Resin, 15 parts, or	3 oz. av.
Yellow Wax, 35 parts, or	7 oz. av.
Lard, 35 parts, or	7 oz. av.
Alcohol, a sufficient quantity.	

Moisten the Cantharides with 18 parts [or 4 fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then gradually pour on Alcohol, until 180 parts [or 2½ pints] of percolate are obtained, or until the Cantharides are exhausted. Distil off the Alcohol by means of a water bath, transfer the residue to a tared capsule and evaporate it, on a water bath, until it weighs 15 parts [or 3 oz. av.]. Add to this the Resin, Wax, and Lard, previously melted together, and keep the whole at a temperature of 100° C. (212° F.) for 15 minutes. Lastly, strain the mixture through muslin, and stir it constantly until cool.

Cerate of Lead, Compound

(J. Parrish, Sr.)

Cerate of Lead Subacetate,	240 grains
Cerate,	240 grains
Powdered Opium,	60 grains
Mild Chloride of Mercury,	60 grains

Mix. Used in eruptions of a local character.

Cerate, Savine

CERATUM SABINÆ. U. S. 1880

	By measure
Fluidextract of Savine, 25 parts, or	5 oz. av.
Resin Cerate, 90 parts, or	18 oz. av.

Melt the Resin Cerate by means of a water bath, add the Fluidextract of Savine, and continue the heat until the alcohol has evaporated; then remove the heat, and stir constantly until cool.

Cerate, Soap

CERATUM SAPONIS. U. S. 1870

Soap Plaster,	2 oz. troy
Yellow Wax,	2½ oz. troy
Olive Oil,	4 oz. troy

Melt together the Plaster and Wax, add the Oil, and, after continuing the heat a few minutes, stir the mixture until cool.

Cerate of Zinc Carbonate

Precipitated Zinc Carbonate,	2 oz. troy
Ointment,	10 oz. troy

Mix them thoroughly.

Chloroform, Gelatinized

Purified Chloroform,	6 fl. dr.
White of Egg,	6 fl. dr.

Put into a wide mouth two-ounce vial, shake it, and allow it to stand for three hours.

Collodion for Corns

(Gezow's)

Salicylic Acid,	45 grains
Extract of Indian Hemp,	8 grains
Collodion,	6 fl. dr.

Dissolve.

Collodion, Corn, Liebig's

Salicylic Acid,	5 grains
Extract of Indian Hemp,	30 grains
Collodion,	5 fl. dr.

Mix and dissolve.

Collodion, Hæmostatic

(Pavesi's)

Tannic Acid,	80 grains
Benzoic Acid,	45 grains
Phenol,	158 minims
Collodion,	3½ fl. oz.

Mix and dissolve.

Collodion, Iodinal

(J. T. Shinn's)

Iodine,	120 gr.
Canada Turpentine,	2 fl. dr.
Collodion,	8 fl. oz.

Dissolve the Iodine and Turpentine in the Collodion. Used as a substitute for Iodine Ointment.

Colors for Show Bottles

Dark Blue

Copper Nitrate,	4 oz. av.
Water,	16 pints
Ammonia Water, a sufficient quantity	

Dissolve the Copper salt, add Ammonia as long as it deepens the color; filter.

Dark Green

Copper Sulphate,	8 oz. av.
Potassium Dichromate,	60 grains
Water,	16 pints

Mix and filter.

Red

Fuchsine,	20 grains
Acetic Acid,	2 fl. oz.
Water,	8 pints

Mix.

Yellow

Potassium Dichromate,	4 oz. av.
Nitric Acid,	4 fl. oz.
Water,	16 pints

Mix and filter.

Confection, Aromatic

CONFECTIO AROMATICA. U. S. 1870

Aromatic Powder,	4 oz. troy
Clarified Honey,	4 oz. troy

Rub the Aromatic Powder with Clarified Honey until a uniform mass of the proper consistence is obtained.

Confection of Black Pepper

(Ward's Paste)

Black Pepper,	2 oz. troy
Powdered Inula,	2 oz. troy
Powdered Fennel,	6 oz. troy
Honey,	4 fl. oz.
Sugar,	4 oz. troy

Rub the dry ingredients together into a very fine powder, and keep them in a covered vessel; but, whenever the confection is to be used, add the powder gradually to the Honey, and beat them until thoroughly incorporated. Dose, 60 to 120 grains three times a day.

Confection, Laxative

Potassium Bitartrate,	240 grains
Powdered Jalap,	240 grains
Confection of Senna,	1 oz. troy

Make into a mass, using Syrup of Ginger if too hard. Dose, a piece the size of a marble three times daily.

Confection of Opium

CONFECTIO OPII. U. S. 1870

Opium, in fine powder,	270 grains
Aromatic Powder,	6 oz. troy
Clarified Honey,	14 oz. troy

Rub the Opium with the Aromatic Powder, then add the Honey, and beat the whole together until thoroughly mixed.

Confection of Orange Peel

CONFECTIO AURANTII CORTICIS. U. S. 1870

Sweet Orange Peel, recently separated from the fruit by grating,	6 oz. troy
Sugar,	18 oz. troy

Beat the Orange Peel with the Sugar, gradually added, until they are thoroughly mixed.

Confection of Rhubarb, Compound

(Chelsea Pensioner)

Rhubarb,	120 grains
Powdered Guaiac,	60 grains
Potassium Bitartrate,	1 oz. troy
Sulphur,	2 oz. troy
Powdered Nutmeg,	60 grains
Honey,	10 fl. oz.

Make into a confection.

Conserve of Hollyhock

(Thomsonian Name)

Poplar Bark,	120 grains
Bayberry,	120 grains
Hydrastis,	120 grains
Cloves,	120 grains
Cinnamon,	120 grains
Cypripedium,	120 grains
Capsicum,	60 grains
Oil of Pennyroyal,	1 fl. dr.
Hollyhock Flowers,	4 oz. troy

Pound, and form into balls of the size of small marbles.

Cordial, Godfrey's

Tincture of Opium,	3 fl. oz.
Potassium Carbonate,	150 grains
Oil of Sassafras,	30 minims
Molasses (sugar house),	32 fl. oz.
Alcohol,	4 fl. oz.
Water,	52 fl. oz.

Dissolve the Potassium Carbonate in the Water, add the Molasses, and heat over a gentle fire till they simmer; remove the scum which rises, and add the Tincture of Opium, Alcohol, and Oil, having previously mixed them together.

Cotton, Boric Acid

Purified Cotton Wool, sufficient	
Boric Acid,	60 grains
Water,	9 fl. dr.

Dissolve the Boric Acid in the Water at a temperature of 60° C. (140° F.); saturate the Purified Cotton with this solution, press it, dry it, and preserve in wide mouth, cork stoppered vials.

Cotton, Iodized

Iodine,	60 grains
Purified Cotton,	1½ fl. oz.

Enclose the Iodine in filtering paper, and place it at the bottom of a flask with a wide mouth; then introduce the Cotton, and close the flask by covering the mouth. Place the flask in a moderately warm place until the Cotton appears to be uniformly colored by the Iodine.

Cotton, Iodoform

Purified Cotton,	360 grains
Iodoform,	24 grains
Ether,	2 fl. dr.
Alcohol,	4 fl. dr.
Glycerin,	2 fl. dr.

Dissolve the Iodoform in the Ether and Alcohol mixed, add the Glycerin to this solution, and saturate the Cotton with this Liquid. Let it dry by exposure to the air.

Cotton, Salicylic Acid

Purified Cotton,	600 grains
Salicylic Acid,	60 grains
Alcohol,	10 fl. dr.
Glycerin,	6 minims

Dissolve the Salicylic Acid in the Alcohol, add the Glycerin to this solution, and saturate the Cotton with the liquid; press out the superfluous liquid, and dry.

Cream of Camphor

(Revised formula 1909)

Castile Soap, dry and grated,	120 grains
Ammonium Carbonate, (*fresh*)	120 grains
Powdered Camphor,	120 grains
Oil of Thyme,	1 fl. dr.
Oil of Turpentine,	2 fl. oz.
Tincture of Opium,	2 fl. dr.
Water, a sufficient quantity to make	1 pint

Dissolve the Soap and the Ammonium Carbonate in 10 fl. oz. of hot Water and pour in a pint bottle. Dissolve the Camphor in the mixed oils, add to the soap solution, shaking the mixture. Add the Tincture of Opium and sufficient Water to make 1 pint.

Cream for Chilblains

(Vance's)

Ointment of Mercuric Nitrate,	1 oz. troy
Camphor,	60 grains
Oil of Turpentine,	2 fl. dr.
Olive Oil,	4 fl. dr.

Mix well. To be applied with gentle friction before the chilblains break.

Cream, Chloral

Hydrated Chloral,	300 grains
Sugar,	1¼ oz. troy
Water,	15 fl. dr.

Dissolve the Hydrated Chloral in the Water, and triturate with the Sugar in a mortar.

Decoction of Barley

DECOCTUM HORDEI. U. S. 1870

Barley,	240 grains
Water, sufficient	

Having washed away extraneous matters which adhere to the Barley, boil it with 2 fl. oz. of Water for a short time, and throw away the resulting liquid; then, having poured on it 16 fl. oz. of boiling Water, boil down to 8 fl. oz., and strain.

Decoction, Zimmerman's

Rhubarb,	30 grains
Potassium Bitartrate,	240 grains
Barley,	240 grains
Water,	16 fl. oz.

Boil for fifteen or twenty minutes, strain, and add enough simple syrup or sugar to sweeten the decoction.

Draught, Effervescing

Potassium Bicarbonate,	80 grains
Water,	2 fl. oz.

Make a solution. Take a tablespoonful of lemon juice diluted with a tablespoonful of Water, and add to it in a tumbler a tablespoonful of this solution, then drink immediately.

Drops, Bateman's Pectoral

Opium,	120 grains
Catechu,	120 grains
Camphor,	120 grains
Oil of Anise,	30 minims
Caramel,	1½ fl. oz.
Diluted Alcohol,	64 fl. oz.

Digest for ten days.

Drops, Bishop or Cardinal

(Tinctura Episcopalis)

Orange Peel,	720 grains
Orange Berries,	720 grains
Cloves,	120 grains
Cinnamon,	120 grains
Water,	3 fl. oz.
Bitter Almond Water,	2 fl. dr.
Alcohol,	12 fl. oz.

Mix, and macerate seven days.

Drops, Red

(Whitwith's)

Oil of Thyme,	2 fl. dr.
Tincture of Myrrh,	1 fl. oz.
Tincture of Camphor,	1 fl. dr.
Compound Tincture of Lavender,	1 fl. oz.
Alcohol,	4 fl. oz.

Dose, 25 drops in a suitable vehicle, two, three, or four times a day.

Electuary, Tamarind

(Fuller's)

Sugar,	300 grains
Manna,	1½ oz. troy
Tamarind,	210 grains
Potassium Bitartrate,	30 grains
Powdered Senna,	120 grains
Boiling Water,	3 fl. oz.

Dissolve the Sugar and Manna in the Boiling Water, and filter, then add the other ingredients.

Elixir of Calisaya

Quinine Sulphate,	72 grains
Cinchonine Sulphate,	24 grains
Quinidine Sulphate,	20 grains
Cinchonidine Sulphate,	12 grains
Elixir of Orange,	128 fl. oz.
Caramel, a sufficient quantity to color	

Triturate the mixed Sulphates with 1 pint of the Elixir; pour the mixture into a glass flask, and heat in a water bath until the solution is effected; while still hot, add the remainder of the Elixir and Caramel; when cold, filter.

Elixir of Calisaya, Ferrated

Iron and Ammonium Citrate,	512 grains
Elixir of Calisaya,	32 fl. oz.

Dissolve.

Elixir of Chloroform

(Dr. Hartshorn's Chloroform Paregoric)

Chloroform,	1½ fl. oz.
Tincture of Opium,	1½ fl. oz.
Spirit of Camphor,	1½ fl. oz.
Aromatic Spirit of Ammonia,	1½ fl. oz.
Oil of Cinnamon,	20 minims
Brandy,	2 fl. oz.

Mix. Dose, ½ fl. dr. or less.

Elixir of Chloroform

Chloroform,	6 fl. dr.
Oil of Cinnamon,	10 minims
Tincture of Opium, Tincture of Camphor, Aromatic Spirit of Ammonia, of each,	6 fl. dr.
Brandy,	1 fl. oz.

Mix. Dose, half a teaspoonful.

Elixir Clauderi

Potassium Carbonate,	240 grains
Aloes,	60 grains
Guaiac,	60 grains
Myrrh,	60 grains
Saffron,	60 grains
Rhubarb,	60 grains
Water,	9 fl. oz.

Macerate a few days, and decant. Dose, a tablespoonful.

Elixir of Gentian with Chloride of Iron

Compound Fluidextract of Gentian,	4 fl. dr.
Tincture of Chloride of Iron (tasteless),	2½ fl. dr.
Elixir of Orange, a sufficient quantity to make	8 fl. oz.

Mix.

Elixir of Orange Simple Elixir

ELIXIR AURANTII. U. S. 1880

Oil of Orange Peel, 1 part, or	2½ fl. dr.
Cotton, 2 parts, or	4 drachms
Sugar, in coarse powder, 100 parts, or	25 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 300 parts, or about	4 pints

Mix Alcohol and Water in the proportion of one part [or 1 pint] of Alcohol to 3 parts [or 2½ pints] of Water. Add the Oil of Orange Peel to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack tightly in a conical percolator, and gradually pour on the mixture of Alcohol and Water, until 200 parts [or 3½ pints] of filtered liquid are obtained. In this liquid dissolve the sugar by agitation, without heat, and strain.

Elixir of Paraldehyde

Paraldehyde,	160 minims
Alcohol,	14 fl. dr.
Tincture of Vanilla,	30 minims
Water,	1 fl. oz.
Syrup,	1½ fl. oz.

Dose, 1 to 2 teaspoonfuls.

Elixir, Red

Compound Tincture of Cochineal,	6 fl. dr.
Elixir of Orange,	24 fl. oz.

Mix.

Elixir of Turkey Corn, Compound

Fluidextract of Corydalis,	4 fl. dr.
Fluidextract of Stillingia,	4 fl. dr.
Fluidextract of Prickly Ash,	2 fl. oz.
Fluidextract of Iris,	6 fl. oz.
Potassium Iodide,	180 grains
Alcohol,	1 fl. oz.
Elixir of Orange,	5 fl. oz.

Mix the Elixir and Alcohol, and add the Fluidextracts; dissolve the Iodide in the mixture, and allow it to stand twenty-four hours, then filter.

Emulsion of Aspidium

Fluidextract of Aspidium,	1 fl. dr.
Tincture of Quillaja,	30 minims
Distilled Water, sufficient to make	1 fl. oz.

Mix.

Emulsion of Cod Liver Oil, Pancreatic

Cod Liver Oil,	3 fl. oz.
Powdered Pancreatin,	60 grains
Syrup,	1 fl. oz.

Digest at a moderate heat. The emulsion is miscible with water, and may be given in chocolate, milk, coffee, or both.

Emulsion of Cod Liver Oil with Hypophosphite of Calcium

Cod Liver Oil,	8 fl. oz.
Powdered Acacia,	2 oz. av.
Calcium Hypophosphite,	128 grains
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Calcium Hypophosphite in the Water, and add all at once to the above, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Hypophosphite of Calcium and Sodium

Calcium Hypophosphite,	128 grains
Sodium Hypophosphite,	96 grains
Powdered Acacia,	2 oz. av.
Cod Liver Oil,	8 fl. oz.
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Hypophosphites in the Water, and add all at once to the above mixture, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Lactophosphate of Calcium

Calcium Lactate,	256 grains
Acacia,	2 oz. av.
Diluted Phosphoric Acid,	2 fl. oz.
Cod Liver Oil,	8 fl. oz.
Water,	2 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Calcium Lactate in Acid and Water, and add all at once to the above mixture, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Phosphate of Calcium and Sodium

Calcium Phosphate,	256 grains
Sodium Phosphate,	64 grains
Acacia,	2 oz. av.
Hydrochloric Acid,	128 minims
Cod Liver Oil,	8 fl. oz.
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Phosphates in the Water by the aid of the Acid, and add all at once to the above mixture, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Wild Cherry Bark

Acacia,	2 oz. av.
Oil of Bitter Almond,	8 minims
Fluidextract of Wild Cherry,	1 fl. oz.
Cod Liver Oil,	8 fl. oz.
Water,	3 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Mix the Fluidextract with the Water, and add all at once to the above mixture; then add the Oil of Bitter Almond, and, lastly, sufficient Water to make 16 fl. oz.

Emulsion of Cubeb

Oleoresin of Cubeb,	120 drops
Yolk of Egg,	1
Sugar,	120 grains
Peppermint Water,	3 fl. oz.

Triturate the Oleoresin with the Sugar and Yolk of Egg, and then dilute with Peppermint Water. Dose, a teaspoonful four times a day.

Emulsion of Guaiac

Guaiac (powdered),	12 grains
Tincture of Quillaja,	1 fl. dr.
Distilled Water,	1 fl. oz.

Dissolve the Guaiac in the Tincture, filter, and then mix with the Water.

Emulsion of Pumpkin Seed

Pumpkin Seed (fresh),	2 oz. av.
Powdered Acacia,	60 grains
Sugar,	240 grains
Water,	4 fl. oz.

Blanch the seeds, after soaking them in hot water, beat them into a mass with the Sugar, then add the Acacia, and gradually the Water.

Emulsion of Turpentine

(J. W. Forbes)

Oil of Turpentine,	1 fl. oz.
Powdered Acacia,	20 grains
Water,	4 fl. dr.

Place the Oil in a dry bottle, add the Powdered Acacia, shake well, and mix thoroughly with the Oil; lastly, add the Water, and shake the whole thoroughly.

Emulsion of Turpentine

Oil of Turpentine,	20 minims
Tincture of Quillaja,	20 minims
Distilled Water,	1 fl. oz.

Mix.

Extract of Mezereum

Extractum Mezerei. U. S. 1880

Mezereum, in No. 30 powder, 100 parts, or	16 oz. av.
Alcohol, a sufficient quantity	

Moisten the powder with 40 parts [or 6 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until 300 parts [or 3 pints] of tincture are obtained, or the Mezereum is exhausted. Reserve the first 90 parts [or 13 fl. oz.] of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.) to 10 parts [or 2 fl. oz.]; mix this with the reserved portion, and evaporate, at or below the before mentioned temperature, in a porcelain capsule, on a water bath, to a pilular consistence.

Eyewash of Sodium Borate

Sodium Borate,	4 grains
Camphor Water,	1 fl. oz.

Mix.

Eye-Water

(Thomas's)

Zinc Sulphate,	20 grains
Sodium Chloride,	20 grains
Rose Water,	1 fl. oz.

Mix.

Fluid, Muller's

Potassium Dichromate,	200 grains
Sodium Sulphate,	80 grains
Water,	16 fl. oz.

Fluidextract of Buchu, Compound

Oil of Juniper,	12 minims
Spirit of Nitrous Ether,	3 fl. oz.
Fluidextract of Cubeb,	3 fl. oz.
Fluidextract of Buchu,	10 fl. oz.

Dissolve the Oil of Juniper in the Spirit of Nitrous Ether, and mix with the Fluidextracts. Do not filter; but shake well before dispensing.

Fluidextract of Cornus

Extractum Cornus Fluidum. U. S. 1880

Cornus, in No. 60 powder, 100 grammes, or	50 oz. av.
Glycerin, 20 grammes, or	7½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints

Mix the Glycerin with 80 Gm. [or 41 fl. oz.] of Diluted Alcohol. Moisten the powder with 30 Gm. [or 15 fl. oz.] of the mixture, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterwards, Diluted Alcohol, until the Cornus is exhausted. Reserve the first 85 Cc. [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure 100 Cc. [or 3 pints].

Fluidextract of Lactucarium

Extractum Lactucarii Fluidum. U. S. 1880

Lactucarium, in coarse pieces, 100 Gm., or	12½ oz. av.
Ether, 100 Gm., or	1 pint
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 Cc., or	12 fl. oz.

Add the Lactucarium to the Ether contained in a tared flask having the capacity of 600 Cc. [or about 4½ pints], and let it macerate for twenty-four hours; then add 300 Gm. [or 2¼ pints] of Water, and shake the mixture well. Fit a bent glass tube into the neck of the flask, and, having immersed the flask in hot water, recover the Ether by distillation. When all the Ether has distilled over, remove the tube, and, after thoroughly shaking the contents of the flask, continue the heat for half an hour. Let the mixture cool, add 100 Gm. [or 14½ fl. oz.] of Alcohol, and enough Water to make the whole mixture weigh 500 Gm. [or 64 oz. av.]; after maceration for twenty-four hours, with occasional agitation, express and filter the liquid. Return the dregs to the flask and macerate them with 200 Gm. [or 28 fl. oz.] of a mixture of Alcohol and Water made in the proportion of 1 part [or 8 fl. oz.] of Alcohol to 3 parts [or 20 fl. oz.] of Water; repeat the maceration two or three times, successively, with fresh portions of the mixture, until the dregs are tasteless, or nearly so. Mix, and filter the liquids thus obtained, and concentrate them, by means of a water bath (the first expressed liquid by itself), until the combined weight of the liquids is 60 Gm. [or 7½ oz. av.]; mix the liquids, add 40 Gm. [or 6 fl. oz.] of Alcohol, and let the mixture cool in the evaporating vessel, stirring the mixture frequently, and during the intervals keeping the vessel well covered. When cool, add enough Alcohol to make the mixture weigh 100 Gm. [or 12½ oz. av.], transfer the liquid to a flask, and add enough Water to make the mixture measure 100 Cc. [or 12 fl. oz.], using the Water so required to rinse the evaporating vessel. Shake the mixture occasionally, during several hours (and frequently, if a portion of the precipitate is found to be tenacious), and, when a uniform mixture results, set it aside for twenty-four hours, so that any precipitate formed may subside. Decant the clear liquid, transfer the precipitate to a filter, and, after thoroughly draining it into the decanted liquid, wash it with a mixture of Alcohol and Water made in the proportion of 3 parts [or 10 fl. dr.] of Alcohol to 4 parts [or 11 fl. dr.] of Water, until the washings pass tasteless. Concentrate the washings, by evaporation, to a syrupy consistence, mix with the decanted liquid, and add enough of the last-named mixture of Alcohol and Water to make the whole measure 100 Cc. [or 12 fl. oz.]. Lastly, after twenty-four hours, having meanwhile shaken the fluidextract occasionally, filter it through paper.

Gargle of Alum

Alum,	120 grains
Honey,	1 fl. oz.
Infusion of Flaxseed,	3 fl. oz.

Make a gargle.

Gauze, Corrosive Sublimate

Corrosive Chloride of Mercury,	2 grains
Glycerin,	50 minims
Water,	1 fl. oz.

Immerse bleached absorbent muslin in this solution for about twelve hours; then wring it out, and allow it to dry as far as the Glycerin will permit.

Gauze, Eucalyptus

(Lister's)

Oil of Eucalyptus,	60 minims
Damar,	180 grains
Paraffin,	180 grains

The Damar and Paraffin are melted, the Oil is added, and the mixture sprinkled or squirted over the muslin laid together in folds. It is then placed in an air tight heating apparatus, compressed by weights, and exposed to a dry heat. The finished gauze contains 10 to 11 percent. of mixture.

Glycerin, Iodized

Iodized Oil of Bitter Almond,	1 fl. dr.
Glycerin,	7 fl. dr.

Mix. See Iodized Oil of Bitter Almond, page 1291.

Glycerite of Birch Tar

Birch Tar,	1 oz. troy
Glycerin,	8 fl. oz.

Dilute the Glycerin with one-fifth of its volume of water, and mix.

Glycerite of Borax

GLYCERITUM SODII BORATIS. U.S. 1870

Sodium Borate,	2 oz. troy
Glycerin,	8 fl. oz.

Rub them together in a mortar until the Sodium Borate is dissolved.

Glycerite of Carbolic Acid

GLYCERITUM ACIDI CARBOLICI. U.S. 1870

Carbolic Acid.	2 oz. troy
Glycerin,	8 fl. oz.

Rub them together in a mortar until the Carbolic Acid is dissolved.

Glycerite of Gallic Acid

GLYCERITUM ACIDI GALLICI. U.S. 1870

Gallic Acid,	2 oz. troy
Glycerin,	8 fl. oz.

Rub them together in a mortar, then transfer to a glass or porcelain capsule, and heat gently until the Acid is dissolved.

Glycerole of Bismuth Nitrate

Bismuth Nitrate (Cryst),	120 grains
Glycerin,	1 fl. oz.

Dissolve the Bismuth Nitrate in the Glycerin, without heat.

Glycerole of Chloral and Camphor

(C. Pavesi)

Camphor (in powder),	75 grains
Hydrated Chloral,	60 grains
Oil of Juniper,	30 minims
Glycerin,	4 fl. dr.
Alcohol,	5 fl. dr.

Mix in a vial, and expose to a gentle heat (not over 40° C. = 104° F.) until solution has been effected. Let cool, and keep the vial well stoppered.

Glycerole of Lead Subacetate

(Dr. Balmanno Squire)

Lead Acetate,	1 oz. troy
Lead Oxide,	336 grains
Glycerin,	4 fl. oz.

Mix, and expose for some time to a temperature of 176.6° C. (350° F.). Filter through paper in a hot water funnel.

Hæmostatic, Pavesi's

Sulphocarbolic Acid,	3 fl. dr.
Benzoic Acid,	37 grains
Tannic Acid,	37 grains
Alcohol,	3 fl. dr.
Glycerin,	3 fl. dr.
Rose Water,	3 fl. oz.

The Sulphocarbolic Acid is prepared by mixing 1 part Sulphuric Acid and ½ part Phenol and heating for a few minutes on a water bath; the Benzoic Acid is dissolved in the Alcohol and Glycerin, the Tannic Acid in the Water, and both mixed.

Honey of Borate of Sodium

MEL SODII BORATIS. U.S. 1870

Borate of Sodium, in fine powder,	60 grains
Clarified Honey,	1 oz. troy

Mix them.

Infusion of Brayera

INFUSUM BRAYERÆ. U.S. 1880

Brayera, in No. 20 powder, 6 parts, or	1 oz. av.
Boiling Water, 100 parts, or	1 pint

Pour the Boiling Water upon the Brayera, and let it macerate in a covered vessel until cool. This infusion should be dispensed without straining.

Infusion of Catechu, Compound

INFUSUM CATECHU COMPOSITUM. U.S. 1870

Catechu, in fine powder,	240 grains
Cinnamon, in moderately fine powder,	60 grains
Boiling Water,	16 fl. oz.

Macerate in a covered vessel, and strain.

Infusion of Flaxseed, Compound

INFUSUM LINI COMPOSITUM. U.S. 1870

Flaxseed,	½ oz. troy
Glycyrrhiza (bruised),	120 grains
Boiling Water,	16 fl. oz.

Macerate for two hours in a covered vessel, and strain.

Infusion of Myrrh, Compound

Myrrh,	23 grains
Aloes,	23 grains
Saffron,	23 grains
Potassium Carbonate,	15 grains
Powdered Extract of Glycyrrhiza,	120 grains
Water,	6 fl. oz.
Compound Tincture of Cardamom,	2 fl. oz.

Boil slowly to 4 fl. oz., strain, and add the Compound Tincture of Cardamom.

Infusion of Tar Tar Water

Infusum Picis Liquidæ. U. S. 1870

Tar,	4 oz. troy
Water,	16 fl. oz.

Mix them, and shake the mixture frequently during twenty-four hours; then pour off the infusion, and filter through paper.

Inhalation, Bromine

(Nettolitzky's)

Bromine,	16 grains
Potassium Bromide,	16 grains
Distilled Water,	7 fl. oz.

Dissolve. To be poured, a small quantity at a time, upon a sponge or lint for inhalation in croup.

Inhalation, Thymol

(Warren)

Thymol,	8 grains
Sodium Borate,	300 grains
Glycerin,	10 fl. dr.
Camphor Water,	2½ fl. oz.
Tar Water,	7 fl. oz.

Mix. To be used as an inhalation by means of an atomizer.

Injection for Gonorrhœa

Zinc Sulphate,	15 grains
Lead Acetate,	30 grains
Extract of Opium,	5 grains
Tannin,	2 grains
Rose Water,	3 fl. oz.

Mix, and dispense without filtering.

Iodine, Camphorated Chloro-tannate of

Hydrated Chloral,	60 grains
Iodine,	30 grains
Oil of Camphor,	6 fl. dr.
Tannic Acid, sufficient	

Dissolve, and add sufficient Tannic Acid to bring the mixture to the consistence of thick syrup.

Iodine, Carbolate of

(Dr. Holtz's formula)

Phenol (Cryst.),	60 grains
Alcohol,	1 fl. dr.
Tincture of Iodine,	4 fl. dr.
Water,	5 fl. dr.

Mix.

Iodoform, Carbolized

Iodoform,	150 grains
Phenol,	1 minim
Oil of Peppermint,	2 minims

Mix the Iodoform and Phenol by trituration, and then add the volatile oil.

Lemonade Iron

(Goodell's)

Tincture of Chloride of Iron,	2 fl. dr.
Diluted Phosphoric Acid,	6 fl. dr.
Spirit of Lemon,	2 fl. dr.
Syrup, sufficient to make	6 fl. oz.

Mix. A dessertspoonful in water after meals.

Liniment of Aconite

Linimentum Aconiti. U. S. 1870

Aconite, in fine powder,	8 oz. troy
Glycerin,	1 fl. oz.
Alcohol, a sufficient quantity	

Moisten the powder with 4 fl. oz. of Alcohol, and let it macerate for twenty-four hours, then pack in a conical percolator, and gradually pour Alcohol upon it until 2 pints of tincture have been obtained. Distil off a pint and a half of Alcohol, and evaporate the remainder until it measures 7 fl. oz.; to this add the Glycerin, and mix them thoroughly.

Liniment, Arnica

Arnica Flowers,	2 oz. av.
Glycerin,	8 fl. oz.

Digest at a moderate temperature on a water bath, express, and strain.

Liniment, Cantharides

Linimentum Cantharidis. U. S. 1880

Cantharides, in No. 60 powder, 15 parts, or	1 oz. av.
Oil of Turpentine, a sufficient quantity, or	8 fl. oz.
To make 100 parts, or	½ pint

Digest the Cantharides with 100 parts [or ½ pint] of Oil of Turpentine, in a closed vessel, by means of a water bath, for 3 hours; then strain and add enough Oil of Turpentine through the strainer to make the Liniment weigh 100 parts [or measure ½ pint].

Liniment, Croup

Camphor,	320 grains
Oil of Turpentine,	2 fl. oz.

Make a solution.

Liniment, Fever

(Saint Barthelemy's)

Oil of Turpentine,	34 fl. dr.
Tincture of Opium,	80 minims
Camphor,	50 grains
Olive Oil,	2 fl. oz.

Mix. Apply for six minutes every six hours to the whole spine.

Liniment of Hypericum

Red Oil

Flowers of Hypericum (fresh),	8 oz. troy
Olive Oil, a sufficient quantity to cover the flowers	

Macerate in the sun for fourteen days, express, and strain.

Liniment of Iodide of Potassium

Soap,	420 grains
Potassium Iodide,	360 grains
Oil of Lavender,	15 minims
Alcohol,	4 fl. oz.
Water,	6 fl. dr.

Dissolve the Soap in the Alcohol by means of a gentle heat, and filter it if it is not perfectly transparent; then add the Oil and the Potassium Iodide dissolved in the Water; mix, and bottle it while warm.

Liniment of Iodoform

Iodoform,	80 grains
Camphor,	80 grains
Oil of Sassafras,	1 fl. dr.
Expressed Oil of Almond,	4 fl. oz.

Powder the Iodoform and Camphor, introduce into a dry vial, add the Oils, and heat in a water bath, shaking frequently until dissolved.

Liniment of Mercury

Liniment of Camphor,	1 fl. oz.
Tincture of Quillaja,	3 fl. oz.
Stronger Ammonia Water,	160 minims
Water,	140 minims
Mercurial Ointment,	1 oz. troy

Mix.

Liniment of Subacetate of Lead

LINIMENTUM PLUMBI SUBACETATIS. U. S. 1880

Solution of Subacetate of Lead, 40 parts, or	2 oz. av.
Cotton Seed Oil, 60 parts, or	3 oz. av.
To make 100 parts, or	5 oz. av.

Mix them.

Liniment of Stillingia

Oil of Stillingia,	1 fl. oz.
Oil of Cajuput,	4 fl. dr.
Oil of Lobelia,	2 fl. dr.
Alcohol,	2 fl. oz.

Mix. Used as a local application in croup, and as a cough medicine, in doses of 1 drop on a lump of sugar.

Lobelia, Brown

The Thomsonian name for the *seed*.

Lobelia, Green

The Thomsonian name for the *herb*.

Lotion, Calamine

(Dr. Tilbury Fox's)

Levigated Calamine,	40 grains
Zinc Oxide,	20 grains
Glycerin,	20 minims
Rose Water,	1 fl. oz.

Mix.

Lotion, Green Soap

(Hebra's)

Green Soap,	240 grains
Oil of Lavender,	15 minims
Boiling Water,	8 fl. oz.

Mix.

Lotion, Palmer's

Corrosive Chloride of Mercury,	4 grains
Alum,	6 grains
Water,	8 fl. oz.

Dissolve. For external use.

Lotion for Sore Nipples

(Dr. Atlee's)

Sodium Borate,	60 grains
Acacia,	120 grains
Tincture of Myrrh,	2 fl. dr.
Rose Water,	2 fl. oz.

Dissolve the Borate in the Rose Water; make a thick mucilage with the Acacia, and emulsify the Tincture of Myrrh; then add the rest of the solution.

Lotion for Sore Nipples

(Dr. Thomas's)

Alum,	1 oz. troy
Tincture of Galls,	1 fl. oz.

Triturate together, and dispense without straining or filtering.

Lozenges, Ammonia

(Dr. Jackson's)

Ammonium Chloride,	90 grains
Morphine Hydrochloride,	3 grains
Powdered Elm,	360 grains
Powdered Acacia,	420 grains
Powdered Sugar,	420 grains
Powdered Extract of Glycyrrhiza,	420 grains
Oil of Sassafras,	4 minims
Tincture of Tolu,	3 fl. dr.

To be made with syrup into 180 lozenges, or into lozenges of 10 grains each, containing $\frac{1}{2}$ grain of Ammonium Chloride and $\frac{1}{60}$ grain of Morphine Hydrochloride.

Lozenges, Cough

(Keating's)

Lactucarium,	120 grains
Ipecac,	60 grains
Squill,	45 grains
Extract of Glycyrrhiza,	120 grains
Sugar,	2 oz. troy

Mix. Make into a mass with Tragacanth and Mucilage, and divide into 20-grain lozenges.

Lozenges, Pectoral

(Dr. Jackson's)

Powdered Ipecac,	5 grains
Sulphurated Antimony,	$2\frac{1}{2}$ grains
Morphine Hydrochloride,	3 grains
Powdered Acacia,	330 grains
Powdered Sugar,	330 grains
Powdered Extract of Glycyrrhiza,	330 grains
Oil of Sassafras,	2 minims
Tincture of Tolu,	2 minims

To be made into a stiff mass with Simple Syrup, and divided into 100 lozenges, or into lozenges of 10 grains each. Each lozenge contains $\frac{1}{20}$ grain of Ipecac, $\frac{1}{40}$ grain of Antimony, $\frac{1}{33}$ grain of Morphine. One every three or four hours.

Mixture, Acetone

(Dr. W. L. Atlee)

Acetone,	1 fl. dr.
Camphorated Tincture of Opium,	1 fl. oz.
Wine of Antimony,	1 fl. oz.
Wine of Tar,	2 fl. oz.

Mix. Dose, a teaspoonful.

Mixture, Alcoholic

(Gubler's)

Alcohol (85 percent.),	
Water,	
Syrup of Orange, of each,	2 fl. oz.

A tablespoonful to be given every two hours.

Mixture, Alkaline Copaiba

Copaiba,	4 fl. dr.
Acacia,	240 grains
Sugar,	240 grains
Solution of Potassium Hydroxide,	4 fl. dr.
Spearmint Water, a sufficient quantity to make	8 fl. oz.

Mix the Copaiba and Solution of Potassium Hydroxide; add the Water, and triturate with the Acacia and Sugar.

Mixture, Antimonial and Saline

(Prof. Gross's)

Antimony and Potassium Tartrate,	2½ grains
Magnesium Sulphate,	2 oz. troy
Morphine Sulphate,	1¼ grains
Aromatic Sulphuric Acid,	30 minims
Tincture of Veratrum Viride,	90 minims
Syrup of Ginger,	2 fl. oz.
Distilled Water,	10 fl. oz.

Mix. Average dose, a tablespoonful; to be diminished in case of vomiting or much nausea.

Mixture, Antidiphtheritic

(Warren's)

Thymol,	4 grains
Potassium Chlorate,	75 grains
Quinine Sulphate,	45 grains
Hydrochloric Acid,	15 minims
Glycerin,	2 fl. oz.
Brandy,	9 fl. oz.

Dose, a teaspoonful every hour for children between two and five years.

Mixture, Antispasmodic

(Sydenham's)

Tincture of Valerian,	5 fl. dr.
Compound Spirit of Ether,	1 fl. dr.
Tincture of Castor,	10 fl. dr.
Fennel Water,	12½ fl. oz.

Mix. Dose, a tablespoonful every three or four hours.

Mixture of Apium, Compound

(Dr. W. A. Hammond's)

Fluidextract of Erythroxylon	2 fl. oz.
Fluidextract of Viburnum,	1 fl. oz.
Fluidextract of Celery,	1 fl. oz.

Mix.

Mixture, Asthma

(Fothergill's)

Ammonium Iodide,	120 grains
Ammonium Bromide,	180 grains
Syrup of Tolu,	3 fl. oz.
Tincture of Lobelia,	5 fl. oz.

Mix. Teaspoonful every one, two, three, or four hours.

Mixture, Benzoated Alkaline

(Dr. Ellwood Wilson)

Potassium Bicarbonate,	90 grains
Benzoic Acid,	30 grains
Syrup of Orange,	4 fl. dr.
Water,	2½ fl. oz.

Rub the solids with 4 fl. dr. of Water until effervescence ceases, then add the rest of the Water, filter, and add the Syrup. Dose, a tablespoonful three times a day after meals.

Mixture, Brandy

Yolk of Eggs,	2
Sugar,	240 grains
Oil of Cinnamon,	2 minims
Cinnamon Water,	4 fl. oz.
Brandy,	4 fl. oz.

Mix. Dose, a tablespoonful as occasion may require.

Mixture, Brown-Sequard's Anti-Epileptic

Sodium Bromide,	180 grains
Potassium Bromide,	180 grains
Ammonium Bromide,	180 grains
Potassium Iodide,	90 grains
Ammonium Iodide,	90 grains
Ammonium Carbonate,	60 grains
Tincture of Calumba,	1½ fl. oz.
Water, sufficient to make	8 fl. oz.

Mix. Adult dose, 1½ teaspoonfuls before each meal, and 3 teaspoonfuls at bedtime.

Mixture, subcarbonate Bismuth

Bismuth Subcarbonate,	120 grains
Cinnamon Water,	2 fl. oz.
Syrup of Acacia,	2 fl. oz.

Mix them. A teaspoonful for infants in cholera infantum.

Mixture, Carbonate of Ammonium

Carbonate of Ammonium,	90 grains
Powdered Acacia,	90 grains
Sugar,	90 grains
Aromatic Spirit of Ammonia,	2 fl. dr.
Compound Tincture of Cardamom,	2 fl. dr.
Water,	3½ fl. oz.

Mix. A tablespoonful every two or three hours.

Mixture, Chalk

(Richard's)

Precipitated Calcium Carbonate,	1 oz. troy
Sugar,	1 oz. troy
Tincture of Opium,	1 fl. dr.
Spirit of Cinnamon,	15 minims
Compound Tincture of Lavender,	1 fl. oz.
Tincture of Kino,	1 fl. oz.
Water,	3 fl. oz.

Mix.

Mixture, Charcoal and Blue Mass

Sodium Bicarbonate,	30 grains
Charcoal,	60 grains
Mass of Mercury,	8 grains
Aromatic Syrup of Rhubarb,	2 fl. oz.
Water,	2 fl. oz.

Triturate together into a uniform mixture. Dose, a tablespoonful.

Mixture, Copaiba

(Chapman's original formula)

Copaiba,	1 fl. oz.
Powdered Acacia,	120 grains
Sugar,	60 grains
Spirit of Nitrous Ether,	1 fl. oz.
Compound Tincture of Lavender,	2 fl. dr.
Tincture of Opium,	2 fl. dr.
Distilled Water,	6 fl. oz.

Mix. Dose, a tablespoonful three times a day.

Mixture, Cough

(Prof. Pancoast)

Wild Cherry Bark,	240 grains
Senega,	240 grains
Ipecac,	120 grains
Extract of Conium,	15 grains
Compound Tincture of Cardamom,	1 fl. oz.
Compound Spirit of Juniper,	1 fl. oz.
Water, sufficient to make	10 fl. oz.

Percolate the solid ingredients with sufficient Water to make 8 fl. oz., then add the other ingredients. Two teaspoonfuls in water constitute the usual dose to relieve cough.

Mixture, Cubeb

(Dr. J. Wm. White's)

Oleoresin of Cubeb,	4 fl. dr.
Potassium Bromide,	1 oz. troy
Syrup of Acacia,	2 fl. oz.
Oil of Sassafras,	10 minims
Water, sufficient to make	6 fl. oz.

Mix.

Mixture, Diarrhœa

(Dr. Wm. Gould)

Compound Tincture of Rhubarb,	1 fl. oz.
Tincture of Opium,	4 fl. dr.
Spirit of Camphor,	2 fl. dr.
Ammonia Water,	1 fl. dr.
Oil of Peppermint,	30 minims

Mix. Dose, a teaspoonful in hot, sweetened water. Repeat as often as necessary till relieved.

Mixture, Diarrhœa

(Squibb's)

Tincture of Opium,	1 fl. oz.
Tincture of Capsicum,	1 fl. oz.
Spirit of Camphor,	1 fl. oz.
Purified Chloroform,	3 fl. dr.
Alcohol, sufficient to make	5 fl. oz.

Mix. Dose, from 30 to 60 minims.

Mixture, Diphtheria

(Dr. Bergeron's)

Copaiba,	20 minims
Syrup of Orange,	4 fl. dr.
Peppermint Water,	3 fl. dr.
Alcohol,	6 fl. oz.

Mix. Dose, a tablespoonful every two hours, in non-infectious diphtheria, to aid the disappearance of the false membrane.

Mixture of Gentian and Iron

(Meigs's)

Iron and Ammonium Citrate,	60 grains
Sugar,	1½ oz. troy
Fluidextract of Gentian,	30 minims
Compound Tincture of Lavender,	1 fl. oz.
Alcohol,	4 fl. dr.
Water, sufficient to make	8 fl. oz.

Mix the Fluidextract with 1 fl. oz. of Water and add the Compound Tincture of Lavender; treat this with ferric hydroxide, and, having filtered it, mix with the other ingredients, and filter.

Mixture, Gout

(Laville's)

Quinine Sulphate,	30 grains
Cinchonine Sulphate,	22 grains
Extract of Colocynth,	195 grains
Diluted Alcohol,	3 fl. oz.
Red Wine, sufficient to make	16 fl. oz.

Mix.

Mixture, Gout

(Scudamore's)

Magnesium Sulphate,	240 grains
Magnesium Oxide,	80 grains
Vinegar of Colchicum,	4 fl. dr.
Syrup of Saffron,	4 fl. dr.
Peppermint Water,	5 fl. oz.

Mix. Dose, 1 to 3 tablespoonfuls every two hours till four to six evacuations are produced in twenty-four hours.

Mixture, Hydrobromic Acid Cough

(Dr. J. Milner Fothergill's)

Spirit of Chloroform, B. P.,	40 minims
Hydrobromic Acid (Diluted),	60 minims
Syrup of Squill,	2 fl. dr.
Water, sufficient to make	2 fl. oz.

Mix. Dose for an adult, a tablespoonful.

Mixture of Iron and Conium

(Dr. King's Am. Disp.)

Precipitated Carbonate of Iron,	300 grains
Inspissated Juice of Conium,	150 minims
Sugar,	1 oz. av.
Oil of Cinnamon,	6 minims
Oil of Gaultheria,	6 minims
Tincture of Tolu,	3 fl. oz.
Madeira Wine,	4 fl. oz.
Water,	4 fl. oz.

Mix together, and allow to stand for a week, when it will be ready for use.

Mixture of Iron and Conium

(Tully's)

Iron Subcarbonate,	600 grains
Extract of Conium,	300 grains
Sugar,	8 oz. troy
Oil of Cassia,	18 minims
Oil of Gaultheria,	20 minims
Compound Tincture of Cinnamon,	2 fl. oz.
Tincture of Tolu,	4 fl. dr.
Water, sufficient to make	16 fl. oz.

Mix thoroughly.

Mixture of Magnesia and Asafetida

Mistura Magnesiæ et Asafœtidæ.
U. S. 1880

(Dewees's Carminative)

Carbonate of Magnesium, 5 parts, or	360 grains
Tincture of Asafetida, 7 parts, or	10 fl. dr.
Tincture of Opium, 1 part, or	75 minims
Sugar, 10 parts, or	1½ oz. av.
Distilled Water, a sufficient quantity,	
To make 100 parts, or about	1 pint

Rub the Carbonate of Magnesium and Sugar in a mortar, with the Tincture of Asafetida and Tincture of Opium. Then gradually add enough Distilled Water to make the mixture weigh 100 parts [or measure 15 fl. oz.].

Mixture, Magnesia

(Dr. Isaac Remington's)

Magnesia (Husband's),	90 grains
Blue Mass,	30 grains
Aromatic Spirit of Ammonia,	2 fl. dr.
Sugar,	60 grains
Peppermint Water,	2 fl. oz.
Lime Water,	3 fl. oz.

Mix. A tablespoonful every two hours.

Mistura Pini Sylvestris

(Dr. Piffard's)

Tar,	100 grains
Oil of Lavender,	100 grains
Oil of Scotch Fir (*Pinus sylvestris*),	300 grains

Mix and filter.

Mixture of Citrate of Potassium

Mistura Potassii Citratis. Neutral Mixture. U. S. 1880

Fresh Lemon Juice, strained, 100 parts, or	4 fl. oz.
Bicarbonate of Potassium, about 10 parts, or a sufficient quantity,	170 grains

Add the Bicarbonate of Potassium gradually to the Lemon Juice until it is neutralized.

This preparation should be freshly made, when wanted for use.

Mixture, Salicylic

(Thiersch's)

Salicylic Acid,	80 grains
Syrup of Orange Peel,	2 fl. oz.
Alcohol,	3 fl. oz.
Water, sufficient to make	10 fl. oz.

Mix. Dose, a teaspoonful.

Mixture, Spleen

(Gadberry's)

Potassium Nitrate,	300 grains
Quinine Sulphate,	65 grains
Iron Sulphate,	65 grains
Nitric Acid,	65 minims
Water,	16 fl. oz.

Mix. Dose, a tablespoonful three times a day.

Mixture, Startin's

Iron Sulphate,	60 grains
Magnesium Sulphate,	1 oz. troy
Tincture of Gentian,	1 fl. oz.
Diluted Sulphuric Acid,	4 fl. dr.
Water,	3 fl. oz.

A teaspoonful to be taken after eating.

Mixture, Stronger Laxative

(Bossu's)

Resin of Scammony,	
Resin of Jalap, of each,	½ grain
Sugar,	15 grains
Croton Oil,	2 minims
Mucilage,	30 minims
Orange Flower Water,	90 minims
Compound Syrup of Senna,	1 fl. oz.
Peppermint Water,	3 fl. oz.

Dose, a tablespoonful.

Mixture, Sun Cholera

Tincture of Opium,	
Tincture of Capsicum,	
Tincture of Rhubarb,	
Spirit of Camphor,	
Spirit of Peppermint, of each,	1 fl. oz.

Mix. Dose, a teaspoonful in water after each evacuation of the bowels.

Mixture of Thymol

(L. Lewin)

Thymol,	1½ grains
Orange Flower Water,	1½ fl. oz.
Distilled Water,	3½ fl. oz.

Mix. Dose, a tablespoonful several times a day.

Mixture, Tolu Cough

Syrup of Squill,	4 fl. dr.
Tincture of Tolu,	1 fl. dr.
Syrup,	3 fl. oz.

Mix. Dose, a teaspoonful.

Mixture, Townsend's

(New York Hospital)

Red Iodide of Mercury,	1 grain
Potassium Iodide,	300 grains
Syrup of Orange Peel,	2 fl. oz.
Compound Tincture of Cardamom,	2 fl. dr.
Water, sufficient to make	4 fl. oz.

Mix. Dose, 1 to 4 teaspoonfuls.

Mucilage of Cydonium

Mucilago Cydonii. U. S. 1880

Cydonium, 2 parts, or	36 grains
Distilled Water, 100 parts, or	4 fl. oz.

Macerate the Cydonium for half an hour, in a covered vessel, with the Distilled Water, frequently agitating. Then drain the liquid through muslin, without pressure. This preparation should be freshly made, when required for use.

Number One

(Thomsonian name)

Lobelia inflata.

Number Five

RESTORATIVE CORDIAL

(Thomsonian name)

White Aspen,	
Black Aspen,	
Poplar Bark, of each,	8 oz. av.
Bayberry Root Bark,	16 oz. av.

Boil a few minutes in 2 gallons of Water, strain, add 7 pounds of Sugar, skim, and then add 3 quarts of Brandy.

Oil of Bitter Almond, Iodized

Iodine,	20 grains
Oil of Bitter Almond,	1 fl. dr.

Mix, and shake occasionally for two months.

Oil, British

Petroleum (Barbados),	1 fl. oz.
Petroleum (American),	1 fl. oz.
Oil of Turpentine,	2 fl. oz.
Oil of Linseed,	24 fl. oz.
Oil of Amber,	8 fl. oz.
Oil of Juniper	2 fl. dr.

Mix them well together.

Oil, Haarlem

Sulphurated Oil,	12 fl. oz.
Petroleum (Barbados),	4 fl. oz.
Oil of Amber (crude),	6 fl. oz.
Oil of Turpentine,	32 fl. oz.
Linseed Oil,	16 fl. oz.

Mix. The Sulphurated Oil is made by boiling 1 part of Sulphur with 8 parts of Olive Oil until they are united.

Ointment, Antimonial

UNGUENTUM ANTIMONII. U. S. 1870

Tartrate of Antimony and Potassium,	100 grains
Lard,	400 grains

Rub the Tartrate of Antimony and Potassium with the Lard, gradually added, until they are thoroughly mixed.

Ointment, Bismuth Oxide

(McCall Anderson)

Bismuth Oxide,	50 grains
Oleic Acid,	1 fl. oz.
White Wax,	150 grains
Vaseline,	1 oz. troy
Oil of Rose,	1 minim

Mix.

Ointment, Boric Acid

Boroglyceride,	2 fl. dr.
White Wax,	240 grains
Vaseline,	3 fl. oz.

Heat the Wax and Vaseline together, and while hot add the Glyceride slowly; use constant stirring while cooling.

Ointment, Boric Acid

(Lister's)

Boric Acid,	240 grains
White Wax,	240 grains
Paraffin,	1 oz. troy
Almond Oil,	1 fl. oz.

Mix.

Ointment of Cantharides

UNGUENTUM CANTHARIDIS. U. S. 1870

Cantharides,	
Yellow Wax, of each,	1 oz. av.
Olive Oil	6 fl. oz.

Infuse the Cantharides in the Oil in a covered vessel for twelve hours; then place the vessel in boiling water for fifteen minutes, strain through muslin with strong pressure, add the product to the Wax, previously melted, and stir constantly while the mixture cools.

Ointment, Chalk

Prepared Chalk,	120 grains
Olive Oil,	90 minims
Lard,	270 grains

Mix.

Ointment of Creasote

UNGUENTUM CREASOTI. U. S. 1870

Creasote,	1 fl. dr.
Lard,	2 oz. troy

Mix thoroughly.

Ointment of Croton Oil

Croton Oil,	30 minims
Lard,	1 oz. troy

Mix gradually.

Ointment, Elemi

Elemi (Resin),	60 grains
Cerate,	1 oz. troy
Rosin Cerate,	120 grains
Balsam of Peru,	120 minims

Fuse together, and mix thoroughly.

Ointment of Gallic Acid

UNGUENTUM ACIDI GALLICI. U. S. 1880

Gallic Acid, 10 parts, or	48 grains
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz. av.

Rub the Gallic Acid with the Benzoinated Lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.

Ointment, Garlic

Fresh Garlic,	6 bulbs
Lard,	2 oz. troy

Digest at a moderate heat for an hour, and strain.

Ointment, Glycerin

Spermaceti,	240 grains
White Wax,	60 grains
Glycerin,	1 fl. oz.
Expressed Oil of Almond,	3 fl. oz.

Melt the Wax and Spermaceti with the Oil at a moderate heat; put these in a Wedgwood mortar, add the Glycerin, and triturate until cold.

Ointment of Iodide of Sulphur

UNGUENTUM SULPHURIS IODIDI. U. S. 1870

Iodide of Sulphur,	30 grains
Prepared Lard,	1 oz. troy

Triturate the Iodide of Sulphur in a porcelain mortar, and gradually add the Lard, rubbing them together until the ointment is perfectly smooth and free from grittiness.

Ointment, Iodine Compound

Unguentum Iodinii Compositum. U. S. 1870

Iodine,	15 grains
Iodide of Potassium,	30 grains
Water,	30 minims
Lard,	1 oz. troy

Dissolve the Iodine and Iodide of Potassium in the Water, then incorporate the solution with the Lard.

Ointment, Iodoform Compound

(Dr. J. William White's)

Iodoform,	60 grains
Oil of Anise,	20 minims
Oil of Rose,	5 minims
Oil of Ylang-Ylang,	5 minims
Ointment of Rose Water,	1 oz. troy

Mix.

Ointment, Iodoform Compound

(New York Hospital)

Iodoform,	
Tannic Acid, of each,	60 grains
Vaseline,	1 oz. troy

Mix.

Ointment, Judkin's

Lead Acetate,	360 grains
Lead Oxide (Red),	1 oz. troy
Sodium Borate,	60 grains
Oil of Turpentine,	15 minims
Olive Oil,	2 fl. dr.
Linseed Oil,	4 fl. oz.

Boil the first two oils together for four hours, remove from the fire, add, with stirring, the Lead Oxide, Sodium Borate, and Lead Acetate; when nearly cool, add the Turpentine.

Ointment of Mercury, Compound

Mercurial Ointment,	120 grains
Ointment of Belladonna,	120 grains
Iodine Ointment,	120 grains

Mix.

Ointment, Mezereum

Unguentum Mezerei. U. S. 1880

Fluidextract of Mezereum, 25 parts, or	2 fl. dr.
Lard, 80 parts, or	360 grains
Yellow Wax, 12 parts, or	54 grains
To make about	1 oz. av.

Melt together the Lard and Wax with a moderate heat, add the Fluidextract, and stir the mixture constantly until the alcohol has evaporated; then continue to stir until cool.

Ointment, Naphthol

(Hardy's)

Naphthol,	120 grains
Vaseline,	2½ oz. troy

Dissolve the Naphthol in half its weight of Ether; mix this solution with a portion of the Vaseline, and heat to about 40° C. (104° F.) until the Ether is completely evaporated; then add the remainder of the Vaseline, and triturate thoroughly; finally, preserve the ointment in a well covered vessel.

Ointment, Pile

Morphine Acetate,	5 grains
Tannic Acid,	30 grains
Solution of Lead Subacetate,	1 fl. dr.
Ointment,	420 grains

Incorporate the Solution with the Ointment, then add the other ingredients.

Ointment of Red Iodide of Mercury

Unguentum Hydrargyri Iodidi Rubri.
U. S. 1870

Red Iodide of Mercury, in fine powder,	16 grains
Simple Ointment,	1 oz. av.

Mix thoroughly.

Ointment, Scott's

Strong Mercurial Ointment,	1 oz. troy
Soap Cerate,	1 oz. troy
Powdered Camphor,	60 grains

Mix.

Ointment, Sulphur Alkaline

Unguentum Sulphuris Alkalinum. U. S. 1880

Washed Sulphur, 20 parts, or	96 grains
Carbonate of Potassium, 10 parts, or	48 grains
Water, 5 parts, or	½ fl. dr.
Benzoinated Lard, 65 parts, or	312 grains
To make 100 parts, or about	1 oz.

Rub the Sulphur with the Carbonate of Potassium and the Water, gradually add the Benzoinated Lard, and mix thoroughly.

Ointment, Tobacco

Tobacco, in fine powder,	120 grains
Lard,	4 oz. troy
Water, sufficient	

Percolate the Tobacco with Water until 2 fl. oz. have been obtained, evaporate to an extract, and mix with the Lard.

Ointment, Tetter

(Dr. S. G. Morton)

Alum,	120 grains
Lead Carbonate,	120 grains
Calomel,	120 grains
Oil of Turpentine,	2 fl. dr.
Ointment,	1½ oz. troy

Triturate the powders together till they are impalpable and thoroughly mixed; then incorporate them with the Oil and Ointment.

Paper, Cantharides

Charta Cantharidis. U. S. 1880

White Wax, 8 parts, or	4 oz. av.
Spermaceti, 3 parts, or	1½ oz. av.
Olive Oil, 4 parts, or	2 fl. oz.
Canada Turpentine, 1 part, or	½ oz. av.
Cantharides, in No. 40 powder, 1 part, or	½ oz. av.
Water, 10 parts, or	5 fl. oz.

Mix all the substances in a tinned vessel, and boil gently for two hours, constantly stirring. Strain through a woollen strainer without expressing, and, by means of a water bath, keep the mixture in a liquid state in a shallow, flat bottomed vessel with an extended surface. Coat strips of sized paper with the melted plaster, on one side only, by passing them successively over the surface of the liquid; when dry, cut the strips into rectangular pieces.

Paste, Canquoin's

Fused Zinc Chloride,	300 grains
Wheat flour,	420 grains
Alcohol,	1 fl. dr.

Rub the Zinc Chloride to a fine powder, and make a paste with the Alcohol; then add the Wheat Flour, using strong pressure with the pestle. When the paste is homogeneous, spread with a roller into sheets about one-eighth of an inch thick, and, after a few hours' exposure, preserve in well corked bottles.

Paste, Zinc Chloride

(Latour's)

Zinc Chloride,	300 grains
Zinc Nitrate,	600 grains
Water,	1 fl. oz.

Dissolve with the aid of heat, and when cool add to each ounce 300 grains of Wheat Flour. Make a paste, and then roll into sheets one-eighth of an inch thick. Preserve in well stoppered bottles.

Paste, Coster's

Iodine Pigment,	120 grains
Oil of Cade,	1 oz. troy

Mix. For an embrocation. This preparation should not be used until it has stood four weeks. The Iodine Pigment is made by dissolving 60 grains of Iodine in 1 fl. oz. of Alcohol, and allowing the solution to stand in a glass bottle for several months before use.

Paste, Iodoform

Iodoform,	60 grains
Mucilage of Acacia,	10 minims
Glycerin,	10 minims
Oil of Peppermint,	1 minim

Mix.

Pencils, Croton Oil

(Limousin's)

Croton Oil,	2 fl. dr.
White Wax,	60 grains
Oil of Theobroma,	60 grains

Melt the Wax and Oil of Theobroma together, by means of a water bath, in a flask, adding the Croton Oil, and keep the flask corked until the mixture begins to congeal; then pour into suitable cylindrical moulds, one-fourth to one-third of an inch in diameter. The pencils are covered with tin foil and kept in closed vessels.

Pencils, Iodoform

Iodoform,	
Oil of Theobroma, of each,	31 grains

Triturate together, and roll the mass into 5 pencils, one-twelfth of an inch thick, then dust with lycopodium.

Pencils of Sulphate of Copper, Cauterizing

Sulphate of Copper,	240 grains
Borate of Sodium,	60 grains

Triturate together in a warm mortar; the mass becomes soft from the liberation of water of crystallization, and it may be readily rolled into sticks. If it becomes too dry, a little water may be added.

Phenol, Iodized

(Battey's formula)

Iodine,	240 grains
Phenol,	1 fl. oz.

Mix. It is to be diluted generally with equal parts of Glycerin, and applied twice a day.

Pills of Lead Acetate

(University College, London)

Lead Acetate,	12 grains
Morphine Hydrochloride	6 grains
Extract of Hyoscyamus,	48 grains

Make a mass, and divide into 24 pills.

Pills of Aloin and Podophyllin

Aloin,	24 grains
Podophyllin,	12 grains
Oleoresin of Ginger,	4 minims

Triturate the solid ingredients into a uniform powder, add the Oleoresin, make a mass, and divide into 24 pills. Dose, 1 to 3 pills.

Pills, Anderson's Scots

Aloes,	1 oz. troy
Soap,	80 grains
Colocynth,	20 grains
Gamboge,	20 grains
Oil of Anise,	10 minims

Let the Aloes, Colocynth, and Gamboge be reduced to a very fine powder; then beat them and Soap with Water into a mass of a proper consistence to divide into pills each containing 3 grains.

Pills, Anti-Gout

(Corlieu's)

Sodium Silicate,	20 grains
Extract of Colchicum,	12 grains
Extract of Aconite,	25 grains
Sodium Benzoate,	40 grains
Powdered Soap,	40 grains

Mix, and make into 100 pills.

Pills, Aperient

(Dr. Mitchell's)

Powdered Aloes,	24 grains
Powdered Rhubarb,	48 grains
Mild Chloride of Mercury,	4 grains
Antimony and Potassium Tartrate,	2 grains

Make into a mass and divide into 24 pills.

Pills, Barker's

Compound Extract of Colocynth,	20 grains
Extract of Hyoscyamus,	15 grains
Aloes,	10 grains
Extract of Nux Vomica,	5 grains
Podophyllum,	1 grain
Powdered Ipecac,	1 grain

Mix, and make into 12 pills.

Pills, Boisragon

(Dr. Hewson's formula)

Mild Chloride of Mercury,	12 grains
Powdered Scammony,	12 grains
Compound Extract of Colocynth,	40 grains
Oil of Caraway,	4 minims
Aloes,	8 grains

Mix, and make into 14 pills.

Pills of Camphor and Opium

Camphor,	48 grains
Powdered Opium,	12 grains
Alcohol,	12 minims
Confection of Rose, sufficient	

Make a mass and divide into 24 pills. Dose, 1 to 2 pills.

Pills of Chinoidine

Chinoidine,	60 grains
Diluted Sulphuric Acid, sufficient	

Soften the Chinoidine with the Acid, in a mortar, and divide into 20 pills.

Pills, Cobb's

Extract of Hyoscyamus,	30 grains
Extract of Conium,	30 grains
Extract of Colocynth,	40 grains
Extract of Nux Vomica,	4 grains

Mix, and divide into 30 pills.

Pills of Copaiba, Compound

Copaiba,	30 grains
Powdered Cubeb,	50 grains
Wax,	15 grains

Melt the Wax by a gentle heat, then add the Copaiba, and immediately afterwards sift in the Cubeb, stirring thoroughly; while it is yet warm, roll out into 25 pills.

Pills of Croton Oil

Croton Oil,	6 minims
Crumb of Bread,	24 grains

Make into 24 pills.

Pills, Cutter's

(For habitual costiveness)

Powdered Ipecac,	10 grains
Mild Chloride of Mercury,	3 grains
Extract of Taraxacum,	40 grains

Make into a mass and divide into 30 pills. Dose, 1 three times a day.

Pills, Gout

(Becquerel's)

Quinine Sulphate,	60 grains
Extract of Digitalis,	7½ grains
Powdered Colchicum Seed,	20 grains

Make into a mass and divide into 25 pills. Dose, 1 to 3 pills each day for several days.

Pills, Gout

(Lartigue's)

Compound Extract of Colocynth,	96 grains
Acetic Extract of Colchicum,	10 grains
Extract of Digitalis,	5 grains

Make into a mass and divide into 24 pills. Take 2 for a dose.

Pills of Bromide of Nickel

(Dr. Da Costa's)

Bromide of Nickel,	60 grains
Powdered Althæa,	6 grains
Extract of Gentian,	6 grains
Alcohol, sufficient	

Mix, and make into 12 pills.

Pills, Diarrhœa

(Prof. William Thompson's)

Lead Acetate,	16 grains
Powdered Camphor,	12 grains
Powdered Opium,	3 grains
Bismuth Subcarbonate,	12 grains
Extract of Gentian, sufficient	

Mix, and make into 12 pills.

Pills, Dinner

(Fothergill's)

Powdered Ipecac,	20 grains
Strychnine,	1 grain
Oil of Black Pepper,	40 minims
Pill of Aloes and Myrrh,	50 grains

Mix, and make into 20 pills.

Pills, Emmenagogue

(Dr. Otto's)

Dried Iron Sulphate,	48 grains
Powdered Aloes,	12 grains
Turpentine,	32 grains
Oil of Turpentine,	10 minims

Make a mass, and divide into 30 pills. Dose, two, three times a day.

Pills of Galbanum, Compound

Pilulæ Galbani Compositæ. U. S. 1880

Galbanum,	150 grains
Myrrh,	150 grains
Asafetida,	50 grains

Syrup, a sufficient quantity to make 100 pills.

Pills, Grissolle's

Alcoholic Extract of Nux Vomica,	4 grains
Iron Phosphate,	46 grains
Extract of Quassia,	31 grains
Extract of Gentian, sufficient	

Mix, and make into 25 pills. One pill three times a day, in conjunction with cold hip baths, and abstention from drink during the evening. Used for incontinence of urine.

Pills, Hooper's

Powdered Ginger,	60 grains
Powdered Canella,	60 grains
Extract of Black Hellebore,	120 grains
Myrrh,	120 grains
Soap,	120 grains
Dried Iron Sulphate,	130 grains
Aloes,	1 oz. troy

Beat them well together into a mass with syrup or water, and divide into pills each containing 2½ grains.

Pills of Iodide of Mercury, Compound

Green Iodide of Mercury,	10 grains
Guaiac Resin,	40 grains
Extract of Gentian,	30 grains

Triturate the Guaiac Resin into a mass with a little Alcohol; then incorporate with it the Extract and Iodide of Mercury, and divide into 20 pills.

Pills, Iron

Reduced Iron,	100 grains
Manna,	30 grains
Glucose, sufficient	

Make a mass, and divide into 50 pills.

Pills of Iron, Compound

PILULÆ FERRI COMPOSITÆ. U. S. 1880

Myrrh, in fine powder,	150 grains
Carbonate of Sodium,	75 grains
Sulphate of Iron,	75 grains
Syrup, a sufficient quantity to make	100 pills

Pills of Iron, Compound

(Thomson's)

Iron Subcarbonate,	60 grains
Extract of Conium,	60 grains

Mix, and divide into 24 pills.

Pills, Knight's

Powdered Aloes,	54 grains
Powdered Scammony,	27 grains
Powdered Gamboge,	9 grains

Mix, and make into 20 pills.

Pills, Laxative

(Cole's)

Compound Extract of Colocynth,	60 grains
Mild Chloride of Mercury,	20 grains
Resin of Podophyllum,	2 grains

Mix, and make into 20 pills.

Pills, Liver

(Dr. Chapman)

Powdered Rhubarb,	60 grains
Powdered Ipecac,	10 grains
Oil of Caraway,	10 minims
Powdered Acacia, sufficient	

Mix, and make into 20 pills.

Pills, Marshall's

Compound Extract of Colocynth,	
Mass of Mercury,	
Powdered Aloes,	
Powdered Soap,	
Powdered Rhubarb, of each,	60 grains

Make into 60 pills.

Pills, Neuralgia

(Prof. Gross's)

Quinine Sulphate,	60 grains
Morphine Sulphate,	1½ grains
Strychnine,	1 grain
Arsenic Trioxide,	1½ grains
Extract of Aconite,	15 grains

Mix, and make into 30 pills.

Pills of Nitrate of Silver

Nitrate of Silver,	20 grains
Powdered French Chalk,	80 grains
Petrolatum, q. s.	

Make a mass, and divide into 40 pills.

Pills No. 3 (Anti-Canker)

(Thomsonian name)

Capsicum,	1 oz. av.
Extract of Bayberry,	1 oz. av.

Make into pills.

Pills, Rheumatic

(Dr. Isaac Remington's)

Acetic Extract of Colchicum,	
Compound Extract of Colocynth,	
Extract of Rhubarb, of each,	60 grains
Veratrine,	5 grains
Oil of Anise,	10 drops

Make into 40 pills. Take 1 or 2 at bedtime.

Pills, Sedative

(Gunther's)

Powdered Asafetida,	57 grains
Extract of Valerian,	57 grains
Extract of Belladonna,	3 grains
Zinc Oxide,	1 grain
Castor,	2 grains

Mix, and make into 24 pills. Dose, 1 to 2 pills twice daily in chorea.

Pill of Soap, Compound

PILULA SAPONIS COMPOSITA. U. S. 1870

Opium, in fine powder,	60 grains
Soap, in fine powder,	240 grains

Beat them together with water so as to form a pilular mass.

Pills of Squill, Compound

PILULÆ SCILLÆ COMPOSITÆ. U. S. 1870

Squill, in fine powder,	12 grains
Ginger, in fine powder,	
Ammoniac, in fine powder, of each,	24 grains
Soap, in fine powder,	36 grains
Syrup, a sufficient quantity	

Mix the powders, then beat them with Syrup so as to form a pilular mass. To be divided into 24 pills.

Pills, Tonic

(Aitken's)

	Each pill contains
Reduced Iron,	$\frac{2}{3}$ grain
Quinine Sulphate,	1 grain
Strychnine, alkaloid,	$\frac{1}{60}$ grain
Arsenic Trioxide,	$\frac{1}{60}$ grain

(See Pilulæ Metallorum. N. F.)

Pills, Tonic Laxative

(Dr. C. H. Thomas)

Powdered Aloes,	24 grains
Dried Iron Sulphate,	24 grains
Alcoholic Extract of Hyoscyamus,	6 grains
Extract of Nux Vomica,	6 grains
Oleoresin of Capsicum,	4 grains

Make into a mass, and divide into 24 pills.

Plaster, Ammoniac

EMPLASTRUM AMMONIACI. U. S. 1880

Ammoniac, 100 parts, or	5 oz. av.
Diluted Acetic Acid, 140 parts, or	½ pint

Digest the Ammoniac in the Diluted Acetic Acid, in a suitable vessel, avoiding contact with metals, until it is entirely emulsionized; then strain, and evaporate the strained liquid, by means of a water bath, stirring constantly, until a small portion, taken from the vessel, hardens on cooling.

Plaster, Antimonial

EMPLASTRUM ANTIMONII. U. S. 1870

Tartrate of Antimony and Potassium, in fine powder,	1 oz. troy
Burgundy Pitch,	4 oz. troy

Melt the Pitch by means of a water bath, and strain; then add the powder, and stir them well together until the mixture thickens on cooling.

Plaster, Asafetida

Emplastrum Asafœtidæ. U. S. 1880

Asafetida, 35 parts, or	13 oz. av.
Lead Plaster, 35 parts, or	13 oz. av.
Galbanum, 15 parts, or	5½ oz. av.
Yellow Wax, 15 parts, or	5½ oz. av.
Alcohol, 120 parts, or	3 pints

Digest the Asafetida and Galbanum with the Alcohol on a water bath, separate the liquid portion, while hot, from the coarser impurities by straining, and evaporate it to the consistence of honey; then add the Lead Plaster and the Wax, previously melted together, stir the mixture well, and evaporate to the proper consistence.

Plaster, Breast

(Dewees's)

Ammoniac Plaster,	120 grains
Lead Plaster,	1½ oz. troy
Logan's Plaster,	360 grains
Spermaceti,	60 grains
Camphor,	60 grains

Melt the Plaster, then add the Spermaceti and Camphor, and remove from the fire.

Plaster, Canada Pitch, Hemlock Pitch Plaster

Emplastrum Picis Canadensis. U. S. 1880

Canada Pitch, 90 parts, or	9 oz. av.
Yellow Wax, 10 parts, or	1 oz. av.
To make 100 parts, or	10 oz. av.

Melt them together, strain the mixture, and stir constantly until it thickens on cooling.

Plaster, Galbanum

Emplastrum Galbani. U. S. 1880

Galbanum, 16 parts, or	8 oz. av.
Turpentine, 2 parts, or	1 oz. av.
Burgundy Pitch, 6 parts, or	3 oz. av.
Lead Plaster, 76 parts, or	38 oz. av.
To make 100 parts, or	50 oz. av.

To the Galbanum and Turpentine, previously melted together and strained, add, first, the Burgundy Pitch, then the Lead Plaster, melted over a gentle fire, and mix the whole thoroughly.

Plaster, Logan's

Lead Oxide,	2 oz. av.
Lead Carbonate,	2 oz. av.
Soap,	1½ oz. av.
Fresh Butter,	240 grains
Olive Oil,	5 fl. oz.
Powdered Mastic,	20 grains

Mix the Soap, Oil, and Butter together, then add the Lead Oxide, and boil it gently over a slow fire for an hour and a half, or until it has a pale brown color, stirring constantly; the heat may then be increased, and the boiling continued, till a portion of the melted plaster, being dropped on a smooth board, is found not to adhere; then remove it from the fire, and add the mastic.

Plaster, Mercurial

(De Vigo's)

Lead Plaster,	2000 grains
Yellow Wax,	100 grains
Resin,	100 grains
Powdered Olibanum,	30 grains
Ammoniac,	30 grains
Powdered Bdellium,	30 grains
Powdered Myrrh,	30 grains
Powdered Saffron,	20 grains
Mercury,	600 grains
Turpentine,	100 grains
Storax,	300 grains
Oil of Lavender,	10 grains

Mix.

Potion of Todd

(Dorvault's)

Brandy,	6 fl. dr.
Distilled Water,	9 fl. dr.
Syrup,	4 fl. dr.
Tincture of Canella,	1 fl. dr.

Mix.

Poultice, Charcoal

(Thomsonian name)

Charcoal,	1 oz. troy
Ginger,	
Bayberry, of each,	240 grains
Elm,	1 oz. troy
Hot Water, sufficient	

Mix.

Powder of Aloes and Canella

Pulvis Aloes et Canellæ. U. S. 1870

(Hiera Picra)

Socotrine Aloes, in fine powder,	6 oz. troy
Canella, in fine powder,	1½ oz. troy

Rub them together until they are thoroughly mixed.

Powder, Antimonial

(Tyson's)

Antimony Oxide,	20 grains
Calcium Phosphate,	180 grains

Mix. Dose, 5 to 10 grains.

Powders, Antispasmodic

(Dr. Otto's)

Ground Black Mustard,	240 grains
Powdered Salvia,	240 grains
Powdered Ginger,	240 grains

Mix. Dose, in epilepsy, three teaspoonfuls for three mornings in succession; discontinue three mornings, and then give as before. To be mixed in water or molasses.

Powder of Camphor, Compound

(Gallop's Powder)

Camphor,	
Powdered Acacia,	
Sugar, of each,	1 oz.

Mix.

Powders, Chalk

Prepared Chalk,	180 grains
Acacia,	60 grains
Sugar,	60 grains
Cinnamon (powdered),	15 grains

Mix, and divide into 12 powders.

Powder, Cough

(Thomsonian name)

Lobelia,	
Glycyrrhiza,	
Skunk Cabbage,	
Sugar, of each,	1 oz. troy

Mix.

Powders, Diarrhœa

Powdered Alum,	240 grains
Powdered Kino,	60 grains
Powdered Opium,	3 grains

Mix and divide into 12 powders. For use in obstinate cases. Dose, 1 every two or three hours.

Powder, Dover's Camphorated

(Dr. Eli Ives's)

Potassium Bitartrate,	1 oz. troy
Powdered Camphor,	120 grains
Powdered Ipecac,	60 grains
Powdered Opium,	60 grains

Mix, and pass through a fine sieve.

Powder, Laxative

(Jeannel's)

Potassium and Sodium Tartrate,	600 grains
Sodium Bicarbonate,	240 grains
Tartaric Acid,	240 grains
Oil of Lemon, sufficient	
Sugar,	2½ oz. troy

Dose, a teaspoonful in sweetened water.

Powder, Nerve

(Thomsonian name)

Powdered Cypripedium.

Powder, Neutralizing

Sodium Bicarbonate,	120 grains
Powdered Rhubarb,	120 grains
Oil of Peppermint,	2 minims

Dose, a teaspoonful, as an antacid in diarrhœa and dyspepsia.

Powder, Pectoral

(Wedel's)

Benzoic Acid,	8 grains
Washed Sulphur,	75 grains
Glycyrrhiza,	250 grains
Iris,	30 grains
Sugar,	300 grains
Oil of Anise,	4 minims
Oil of Fennel,	4 minims

Mix. A tablespoonful three or four times a day in bronchitis, severe cough, or croup.

Powder, Potter's

Prepared Chalk,	3 oz. troy
Powdered Camphor,	240 grains
Ammonium Carbonate,	1 oz. troy

Mix.

Powder, Schuyler's

Morphine Sulphate,	15 grains
Camphor,	90 grains
Powdered Ipecac,	90 grains
Powdered Glycyrrhiza,	1½ oz. troy
Sugar,	1½ oz. troy

Mix.

Powder of Senna, Compound

Powdered Senna,	2 oz. troy
Potassium Bitartrate,	2 oz. troy
Powdered Scammony,	240 grains
Powdered Ginger,	120 grains

Mix. Dose, twenty to thirty grains.

Remedy, Cholera

(Dr. Dwight's)

Tincture of Camphor,	1 fl. oz.
Tincture of Opium,	1 fl. oz.
Compound Tincture of Rhubarb,	1 fl. oz.

Mix. Dose, half a teaspoonful.

Remedy for Tape-Worm

(Schafhirt's)

Pomegranate,	240 grains
Pumpkin Seed,	1 oz. troy
Ethereal Extract of Aspidium,	60 grains
Powdered Ergot,	30 grains
Powdered Acacia,	120 grains
Croton Oil,	2 minims

Mix.

Remedy, Whooping Cough

(Dr. J. J. Caldwell's)

Ammonium Bromide,	20 grains
Potassium Bromide,	40 grains
Fluidextract of Belladonna,	6 minims
Distilled Water,	2 fl. oz.

Used with steam atomizer for ten or fifteen minutes morning, noon, and bedtime.

Salve, Mother's

Emplastrum Fuscum Onguent de la Mère

Lead Oxide,	60 grains
Burgundy Pitch,	12 grains
Yellow Wax,	60 grains
Mutton Tallow,	60 grains
Lard,	60 grains
Olive Oil,	120 grains
Butter,	60 grains

Place the fatty substances in a suitable vessel, and heat them until they begin to smoke; then add the Lead Oxide in small portions, constantly stirring the mass with a wooden spatula. Keep the mixture over the fire, constantly agitating, until it acquires a brown color, then mix in the Pitch and pour into moulds.

Salve, Naphthol

(Kaposi's)

Naphthol,	180 grains
Green Soap,	600 grains
Prepared Chalk,	120 grains
Lard,	2½ oz. av.

Mix. Used in itch. The affected part to be rubbed twice a day.

Salve, Thomson's

(Thomsonian name)

Yellow Wax,	2 oz. troy
Fresh Butter,	2 oz. troy
Turpentine,	4 oz. troy
Balsam of Fir,	2 oz. troy

Mix.

Sedative, Battley's

Extract of Opium,	360 grains
Boiling Water,	7 fl. oz.
Alcohol,	1½ fl. oz.
Cold Water, sufficient to make	10 fl. oz.

Dissolve the Extract in Boiling Water; when cold, add to the solution the Alcohol and enough Water to make 10 fl. oz., and, lastly, filter through paper. Dose, 5 minims.

Snuff, Bismuth Catarrh

Bismuth Subnitrate,	360 grains
Morphine Hydrochloride,	2 grains
Acacia,	120 grains

Mix.

Snuff, Hay-Fever

(Dr. Mortimer Granville's)

Sodium Borate,	20 grains
Capsicum,	15 grains
Ammonium Carbonate,	10 grains

Mix.

Soda Mint

Sodium Bicarbonate,	336 grains
Spearmint Water,	1 pint

Dissolve and filter. Dose, a tablespoonful.

Solution of Ammonium Arsenate

(Biette's Arsenical Solution)

Ammonium Arsenate,	2 grains
Distilled Water,	2 fl. oz.

Mix. Dose, 20 drops.

Solution of Ammonium Valerianate

TASTELESS AND ODORLESS

(Rother's)

Ammonium Valerianate,	119 grains
Sodium Borate (Powdered),	191 grains
Ammonia Water, sufficient,	
Distilled Water, sufficient to make	8 fl. oz.

Mix the Ammonium Valerianate with 1 fl. oz. of Distilled Water, and add Ammonia Water, drop by drop, until a clear and slightly alkaline solution is produced; then add 2 fl. oz. of Distilled Water and the Sodium Borate, and when all has dissolved, except the few contaminating crystals of Calcium Borate, add Distilled Water to make 8 fl. oz., and filter.

Solution, Antiseptic

(Volkman's)

Thymol,	30 grains
Alcohol,	5 fl. dr.
Glycerin,	10 fl. dr.
Water,	6 fl. oz.

Mix.

Solution of Arsenic Chlorophosphide

Arsenic Trioxide,	4 grains
Phosphorus,	8 grains
Diluted Hydrochloric Acid,	12 grains
Water, sufficient to make	18 fl. oz.

Mix. Digest on a water bath for twenty-four hours, and decant the supernatant liquid.

Solution of Arsenite of Sodium

(Harle's Solution)

Arsenic Trioxide,	15 grains
Sodium Carbonate (Exsiccated),	15 grains
Cinnamon Water,	1 fl. oz.
Distilled Water, sufficient to make	4 fl. oz.

Boil the solids with 3 fl. oz. of Distilled Water until they are dissolved, make up the measure of 3 fl. oz. with Distilled Water, and add the Cinnamon Water. Dose, 4 minims.

Solution of Bromide of Arsenic

(Clemens's)

Arsenic Trioxide,	80 grains
Potassium Carbonate,	80 grains
Bromine,	160 grains
Distilled Water,	15½ oz.

Boil the Potassium Carbonate and the Acid with most of the Water until dissolved; when cold, add the Bromine, and Water enough to make the prescribed quantity. It is said to improve by age, owing to the combination of the Bromine. Dose, 1 to 4 drops, in water, once or twice daily.

Solution of Bromine

(Dr. J. Lawrence Smith's)

Bromine,	240 grains
Potassium Bromide,	80 grains
Distilled Water,	2 fl. oz.

Dissolve the Potassium Bromide in about 1 fl. oz. of the Distilled Water, add the Bromine, agitate, and finally add the remainder of the Distilled Water. It should be kept in small, ground stoppered vials. Dose, 1 to 2 drops.

Solution of Bromine

ANTIDOTE TO THE POISON OF THE RATTLESNAKE

(Bibron's)

Bromine,	150 grains
Potassium Iodide,	2 grains
Corrosive Chloride of Mercury,	1 grain
Diluted Alcohol,	4 fl. oz.

Dissolve. Take 10 drops in a tablespoonful of brandy, repeated as required.

Solution, Burrow's

Lead Acetate,	600 grains
Alum,	360 grains
Sodium Sulphate,	60 grains
Water,	10 fl. oz.

Dissolve the Lead Acetate in 3 fl. oz. of Water, and the Sodium Sulphate and Alum in the remaining Water; mix the solutions and stir; allow it to stand for two days, and filter without washing the residue.

Solution of Butyl-Chloral

CROTON-CHLORAL

Butyl-Chloral,	7 grains
Alcohol,	30 minims
Distilled Water,	2½ fl. oz.
Syrup of Orange,	2 fl. oz.

Mix. A tablespoonful every two hours.

Solution of Citrate of Iron and Quinine

LIQUOR FERRI ET QUININÆ CITRATIS. U. S. 1880

Citrate of Iron and Ammonium, 65 parts, or	568 grains
Quinine, dried at 100° C. (212° F.), until it ceases to lose weight, 12 parts, or	105 grains
Citric Acid, 28 parts, or	245 grains
Alcohol, 30 parts, or	6 fl. dr.
Distilled Water, a sufficient quantity,	
To make 200 parts, or	4 oz. av.

Dissolve the Citrate of Iron and Ammonium in 200 parts (or 4 fl. oz.) of Distilled Water, contained in a tared porcelain capsule, heat the solution to 60° C. (140° F.) on a water bath, add the Citric Acid, and, when it is dissolved, add the Quinine, stirring the mixture until a perfect solution has been obtained. Evaporate this to 160 parts (or 3 oz. av.), allow it to cool, add the Alcohol, and finally enough Distilled Water to make the solution weigh 200 parts (or 4 oz. av.).

Solution of Chloride of Barium

Liquor Barii Chloridi. U. S. 1870

Chloride of Barium,	1 oz. troy
Distilled Water,	3 fl. oz.

Dissolve the Chloride in the Distilled Water, and filter through paper.

Solution of Coal-Tar

Liquor Picis Carbonis Liquor Carbonis Detergens

Coal-Tar,	4 oz. av.
Tinct. Quillayæ (N.F.),	8 fl. oz.
Alcohol,	8 fl. oz.

Digest for two days, decant, and filter.

Solution, Dobell's

Phenol,	45 minims
Sodium Borate,	60 grains
Sodium Bicarbonate,	60 grains
Glycerin,	1 fl. oz.
Water, sufficient to make	16 fl. oz.

Solution of Gutta-Percha

Liquor Gutta-Perchæ. U. S. 1880

Gutta-Percha, in thin slices, nine parts,	9
Commercial Chloroform, ninety-one parts,	91
Carbonate of Lead, in fine powder, ten parts,	10
To make one hundred parts,	100

Add the Gutta-Percha to 70 parts of the Chloroform, contained in a bottle, cork it well, and shake it occasionally until the Gutta-Percha is dissolved. Then add the Carbonate of Lead, previously mixed with the remainder of the Chloroform, and, having several times shaken the whole together, at intervals of half an hour, set the mixture aside until the insoluble matters have subsided and the solution has become perfectly clear. Lastly, decant the liquid and preserve it in small, cork-stoppered bottles.

Solution of the Hypophosphites

(Hayes's)

Calcium Hypophosphite,	128 grains
Potassium Hypophosphite,	128 grains
Sodium Hypophosphite,	32 grains
Quinine Hypophosphite,	32 grains
Manganese Hypophosphite,	32 grains
Iron Hypophosphite,	64 grains
Strychnine Hypophosphite,	1 grain
Glycerin,	384 minims
Solution of Hypophosphorous Acid,	256 minims
Water, sufficient to make	16 fl. oz.

Dissolve.

Solution of the Hypophosphites of Iron, Soda, Lime, and Magnesium, Compound

Calcium Hypophosphite,	11 oz. 80 gr. av.
Oxalic Acid,	1½ oz. av.
Ferrous Sulphate,	2 oz. av. 260 gr.
Sodium Sulphate,	5 oz. av. 120 gr.
Magnesium Sulphate,	1 oz. av. 420 gr.
Boiling Water,	5 pints
Water, a sufficient quantity to make	100 fl. oz.

Dissolve the Calcium Hypophosphite in the Boiling Water, add the Oxalic Acid, stirring for a minute, and then the other ingredients in the order given. Agitate for two or three minutes, allow the mixture to become cold, filter into a bottle marked 100 fl. oz., and wash the Calcium Oxalate and Sulphate, which remain on the filter, with Water until 100 fl. oz. of liquid are obtained.

Solution, Iodine

(Magendie's)

Potassium Iodide,	240 grains
Iodine,	2 grains
Peppermint Water,	6 fl. oz.

Dissolve. Dose, a teaspoonful.

Solution of Magnesium Acetate

Liquor Magnesii Acetatis

(Neynaber's)

Calcined Magnesia,	126 grains
Acetic Acid, sufficient to saturate,	
Syrup of Citric Acid,	2 fl. oz.
Potassium Bicarbonate	40 grains
Water, to make	12 fl. oz.

Made and used like Solution of Magnesium Citrate (see page 586).

Solution of Sulphate of Morphia

Liquor Morphiæ Sulphatis. U. S. 1870

Sulphate of Morphia,	8 grains
Distilled Water,	8 fl. oz.

Dissolve the Sulphate in the Distilled Water.

Solution of Opium, Compound

Liquor Opii Compositus

(Squibb's)

Deodorized Solution of Opium,	14 fl. dr.
Alcohol,	13 fl. dr.
Purified Chloroform,	1 fl. dr.
Acetic Ether,	2 fl. dr.

Mix. See Am. Jour. Pharmacy, 1870, p. 47. Dose, 15 to 30 minims.

Solution of Pepsin Liquid Pepsin

Liquor Pepsini. U. S. 1880

Saccharated Pepsin, 40 parts, or	400 grains
Hydrochloric Acid, 12 parts, or	100 minims
Glycerin, 400 parts, or	7 fl. oz.
Water, 548 parts, or	12 fl. oz.
To make 1000 parts, or about	20 fl. oz.

Dissolve the Saccharated Pepsin in the Water, previously mixed with the Hydrochloric Acid, add the Glycerin, let the mixture stand twenty-four hours, and filter.

Solution of Permanganate of Potassium

LIQUOR POTASSII PERMANGANATIS. U. S. 1870

Permanganate of Potassium,	64 grains
Distilled Water,	16 fl. oz.

Dissolve the Permanganate in the Distilled Water.

Solution of Phosphates

(Dr. Pepper's)

Calcium Phosphate,	6 grains
Magnesium Phosphate,	4 grains
Potassium Phosphate,	3 grains
Phosphoric Acid (Concent.),	10 minims
Water, sufficient to make	2 fl. dr.

Make a solution and filter.

Solution of Phosphates, Compound

Calcium Carbonate,	369 grains
Magnesia (Calc.),	29 grains
Potassium Carbonate,	25 grains
Iron Phosphate,	64 grains
Phosphoric Acid (60 percent.),	1705 grains
Water, sufficient to make	16 fl. oz.

Mix the Acid with half a pint of Water, add the Iron Phosphate, and stir until dissolved; then add gradually the Calcium Carbonate, stirring until effervescence ceases and the freshly formed Phosphate is dissolved, and finally add the Magnesia and Potassium Carbonate; stir until dissolved, and make up the measure to 1 pint. Used as an *acid phosphate*.

Solution of Santal, Copaiba, and Cubeb

(Nesbit's specific)

Oil of Santal,	5 fl. oz.
Oil of Copaiba,	4 fl. dr.
Oil of Cubeb,	4 fl. dr.
Oil of Pimenta,	1 fl. dr.
Oil of Cassia,	1 fl. dr.
Alcohol, sufficient to make	16 fl. oz.

Mix. Dose, a teaspoonful twice a day in water.

Solution of Sulphide of Zinc

(Dr. Duhring's)

Zinc Sulphate,	30 grains
Potassium Sulphide,	30 grains
Alcohol,	3 fl. dr.
Rose Water,	3½ fl. oz.

Mix. Used for lupus.

Solution of Tar, Alkaline

(Dr. L. D. Bulkley)

Tar,	2 fl. dr.
Potassium Hydroxide,	60 grains
Distilled Water,	5 fl. dr.

Mix.

Solution, Van Swieten's

SOLUTION ANTISYPHILITIQUE DE VAN SWIETEN LIQUEUR D'OXYMURIATE DE MERCURE

Corrosive Chloride of Mercury,	15 grains
Alcohol (80 percent.),	3½ fl. oz.
Distilled Water, sufficient to make	32 fl. oz.

A tablespoonful contains nearly ¼ grain of Corrosive Chloride of Mercury.

Solution, Vleminckx's

Lime,	240 grains
Sublimed Sulphur,	1 oz. troy
Water,	10 fl. oz.

Boil down to 6 fl. oz. and filter. Used externally in acne.

Spirits, Bathing

(Jackson's)

Soap,	8 oz. troy
Camphor	3 oz. troy
Oil of Rosemary,	3 fl. dr.
Oil of Thyme,	3 fl. dr.
Alcohol,	64 fl. oz.

Mix.

Spirit of Cajuput, Compound

Oil of Cajuput,	
Oil of Cloves,	
Oil of Peppermint,	
Oil of Anise, of each,	4 fl. dr.
Alcohol,	2 fl. oz.

Mix. A powerful stimulant.

Spirit, Perfumed

SPIRITUS ODORATUS. U. S. 1880

(Cologne Water)

Oil of Bergamot, 16 parts, or	2 fl. oz.
Oil of Lemon, 8 parts, or	1 fl. oz.
Oil of Rosemary, 8 parts, or	1 fl. oz.
Oil of Lavender flowers, 4 parts, or	½ fl. oz.
Oil of Orange flowers, 4 parts, or	½ fl. oz.
Acetic Ether, 2 parts, or	2 fl. dr.
Water, 158 parts, or	18 fl. oz.
Alcohol, 800 parts, or	6½ pints
To make 1000 parts, or about	8 pints

Dissolve the Oils and the Acetic Ether in the Alcohol, and add the Water. Set the mixture aside, in a well closed bottle, for eight days then filter through paper, in a well covered funnel.

Starch, Iodized

AMYLUM IODATUM. U. S. 1880

Starch, 95 parts, or	418 grains
Iodine, 5 parts, or	22 grains
Distilled Water, a sufficient quantity,	
To make 100 parts, or about	1 oz. av.

Triturate the Iodine with a little Distilled Water; add the Starch gradually and continue triturating until the compound assumes a uniform blue color, approaching black. Dry it at a temperature not exceeding 40° C. (104° F.) and rub it to a fine powder.

Starch, Iodide of, Soluble

Iodine,	360 grains
Starch,	6 oz. troy
Ether,	10 fl. dr.

Dissolve the Iodine in the Ether, pour the solution over the Starch; then triturate till the Ether is evaporated; introduce into a water bath, and continue the heat for half an hour with occasional stirring. A portion of the Iodine vapor has escaped, but the Starch, which has now become soluble, will be combined with about 4 percent. of Iodine.

Styptic, Pancoast's

Potassium Carbonate,	120 grains
Soap,	30 grains
Alcohol,	1 fl. oz.

Mix.

Suppositories, Wade's

Iodoform,	60 grains
Subnitrate of Bismuth,	60 grains
Hydrated Chloral,	8 grains
Morphine,	2½ grains
Oil of Rose,	10 minims
Oil of Theobroma,	240 grains

Mix, and divide into 12 suppositories one-eighth of an inch in diameter. One to be inserted into the urethra three times daily.

Syrup, Anthelmintic

Fluidextract of Senna,	1 fl. dr.
Oil of Chenopodium,	1 fl. dr.
Syrup of Rhubarb,	2 fl. oz.

Mix. Dose, a teaspoonful three times a day.

Syrup of Anthemis

Anthemis,	240 grains
Sugar,	10 oz. av.
Water,	6 fl. oz.

Make an infusion of the flowers with the Water, and add the Sugar, dissolving without heat.

Syrup of Asafetida

Asafetida,	240 grains
Sugar,	16 oz. av.
Boiling Water,	8 fl. oz.

Rub the Asafetida with part of the Boiling Water, until a uniform paste is made, then gradually add the rest of the Water, strain, and add the Sugar, using a gentle heat to dissolve it. Dose, a tablespoonful.

Syrup of Bayberry

(Thomsonian name)

Bayberry,	12 oz. troy
Sugar,	12 oz. troy
Diluted Alcohol,	64 fl. oz.

Digest the Bayberry in the Diluted Alcohol for two days, strain, and evaporate to 16 fl. oz.; add the Sugar.

Syrup of Bromide of Iron

Syrupus Ferri Bromidi. U. S. 1880

A syrupy liquid containing 10 percent. of Ferrous Bromide [$FeBr_2$; 215.5].

Iron, in the form of fine wire, and cut into small pieces, 30 parts, or	1½ oz. av.
Bromine, 75 parts, or	9 fl. dr.
Sugar, in coarse powder, 600 parts, or	28 oz. av.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or about	2 pints

Introduce the Iron into a flask of thin glass of suitable capacity, add to it 200 parts [or 9 fl. oz.] of Distilled Water and afterwards the Bromine. Shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color and has lost the odor of Bromine. Place the Sugar in a porcelain capsule, and filter the solution of bromide of iron into the Sugar. Rinse the flask and Iron wire with 90 parts [or 4 fl. oz.] of Distilled Water, and pass the washings through the filter into the Sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling point on a sand bath, and, having strained the Syrup through linen into a tared bottle, add enough Distilled Water to make the product weigh 1000 parts [or measure 2 pints]. Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.

Syrup of Bromide of Nickel

(Dr. Da Costa's)

Bromide of Nickel,	160 grains
Glycerin,	4 fl. dr.
Sugar,	8 oz. av.
Water,	4 fl. oz.

Dissolve the Bromide of Nickel in the Water, and add the Glycerin. Make a syrup by cold percolation or agitation.

Syrup of Cubeb

(Mitchell's)

Fluidextract of Cubeb,	2 fl. oz.
Magnesium Carbonate,	240 grains
Sugar,	12 oz. troy
Oil of Bitter Almond,	1 minim
Orange Flower Water,	2 fl. oz.
Water, a sufficient quantity to make	16 fl. oz.

Rub the Fluidextract with the Magnesium Carbonate, and then add 2 fl. oz. of the Sugar in small portions; when thoroughly mixed, add gradually first the Orange Flower Water and then 7 fl. oz. of Water, constantly triturating the mixture until the Sugar is dissolved; filter, and add sufficient Water to measure 11 fl. oz., in which dissolve the remainder of the Sugar, without heat; add the Oil dissolved in a little Alcohol, and sufficient Water to make 16 fl. oz.

Syrup of Galls, Aromatic

Nutgall,	240 grains
Cinnamon,	120 grains
Nutmeg,	120 grains
Glycerin,	6 fl. dr.
Syrup,	6 fl. oz.
Brandy, sufficient	

Mix the powders, and, having moistened the mixture with a sufficient quantity of Brandy, pack it firmly in a small conical glass percolator, and gradually pour Brandy upon it until it commences to drop; then insert a cork tightly in the lower orifice of the percolator, and let it stand twenty-four hours; then withdraw the cork, and continue the percolation with Brandy until 6 fl. oz. of tincture are obtained. Mix this with the Glycerin, and evaporate by a water bath, at a temperature not exceeding 125° F., to 3 fl. oz., filter, and thoroughly mix with the Syrup.

Syrup of Gillenia

Gillenia,	1 oz. troy
Sugar,	15 oz. troy
Diluted Alcohol,	8 fl. oz.
Water,	5 fl. oz.

Reduce the Gillenia to a coarse powder, percolate with Diluted Alcohol until 8 fl. oz. are obtained, evaporate to 3 fl. oz., filter, and add sufficient Water to make the liquid measure 8 fl. oz.; then add the Sugar, and dissolve by a gentle heat.

Syrup of Ginger

Tincture of Ginger,	4 fl. oz.
Syrup, a sufficient quantity to make	128 fl. oz.

Mix.

Syrup of Guaiac

Guaiac (powdered),	640 grains
Potassium Hydroxide,	58 grains
Sugar,	16 oz. av.
Water, sufficient to make	8 fl. oz.

Dissolve the Potassium Hydroxide in 8 fl. oz. of Water, add the Guaiac, macerate seven days, filter, add the Sugar, and strain.

Syrup of Hypophosphite of Calcium

(Procter's)

Hypophosphite of Calcium,	2 oz. troy
Sugar,	24 oz. troy
Tincture of Vanilla,	1 fl. oz.
Water,	19 fl. oz.

Dissolve the salt in the Water, filter, add the Sugar, dissolve by aid of heat, and add the Tincture. Dose, a teaspoonful to a tablespoonful three times a day.

Syrup of the Hypophosphites

(Parrish's)

Calcium Hypophosphite,	360 grains
Sodium Hypophosphite,	120 grains
Potassium Hypophosphite,	120 grains
Sugar,	13 oz. troy
Hot Water,	10 fl. oz.
Orange Flower Water,	4 fl. dr.

Dissolve the salts in the Hot Water, filter through paper, dissolve the Sugar in the solution by the aid of heat, strain, and add the Orange Flower Water. Dose, a teaspoonful, containing nearly 5 grains of the mixed salts.

Syrup of Hypophosphites, Compound

(Containing Ferric Hypophosphite Procter's)

Calcium Hypophosphite,	256 grains
Sodium Hypophosphite,	192 grains
Potassium Hypophosphite,	128 grains
Ferric Hypophosphite,	96 grains
Hypophosphorous Acid Solution,	240 minims
Sugar,	9 oz. av.
Extract of Vanilla,	4 fl. dr.
Water, sufficient	

Dissolve the salts of Calcium, Sodium, and Potassium in 6 fl. oz. of Water; put the Iron salt in a mortar, and gradually add solution of Hypophosphorous Acid till it is dissolved; to this add the solution of the other salts, after it has been rendered slightly acidulous with the same acid, and then Water, till the whole measures 12 fl. oz. Dissolve in this the Sugar, with heat, and add the Vanilla. Dose, a teaspoonful.

Syrup of Iodide of Manganese

(Procter's)

Manganese Sulphate,	1 oz. troy
Potassium Iodide,	285 grains
Sugar,	6 oz. av.
Water,	
Syrup, of each, sufficient	

Dissolve the Sulphate and Iodide, each, in 1½ fl. oz. of cold Water, to which 1 fl. dr. of Syrup has been added. Mix them in a glass stoppered bottle, and, after the crystals of Potassium Sulphate cease to precipitate, throw the solution on a filter of fine muslin, and allow it to pass into an 8-oz. bottle containing the Sugar; add sufficient Water to the filter to bring up the measure of the resulting Syrup to exactly 8 fl. oz. This contains about 60 grains of the Iodide to each fl. oz. Dose, 10 minims.

Syrup of Iodide of Starch

Iodide of Starch (soluble),	360 grains
Sugar,	19 oz. troy
Water,	12 fl. oz.

Dissolve the Iodide in the Water, and add the Sugar. This syrup contains 1 part of Iodine in 1000. Dose, a teaspoonful.

Syrup of Iodohydrargyrate of Iron

Red Mercuric Iodide,	1 grain
Syrup of Ferrous Iodide,	4 fl. oz.

Mix. Dose, 20 to 30 minims, as an alterative tonic.

Syrup of Iodohydrargyrate of Potassium

Sirop Gibert

Red Mercuric Iodide,	5 grains
Potassium Iodide,	260 grains
Distilled Water,	6 fl. dr.
Syrup, sufficient to make	16 fl. oz.

Dose, 1 teaspoonful.

Syrup of Juglans, Compound

Syrupus Antirhachiticus

(Vanier's)

Extract of Walnut Leaves,	152 grains
Extract of Cinchona,	75 grains
Potassium Iodide,	40 grains
Anise Oil Sugar,	115 grains
Alcohol,	2½ fl. dr.
White Wine,	4 fl. dr.
Syrup,	12 fl. oz.

Dose, for small children, a teaspoonful four to five times a day; for older children, half a tablespoonful. Vanier's syrup is said to contain, in addition to the above, 5 percent. of Cod Liver Oil.

Syrup of Lactucarium

(Aubergier's modified)

Fluidextract of Lactucarium (U.S.),	4 fl. dr.
Syrup of Orange Flowers,	4 fl. oz.
Syrup,	10 fl. oz.

Mix.

Syrup, Laxative

(Amussart's)

Rasped Guaiac Wood,	
Chicory Root,	
Lappa,	
Water Dock Root,	
Fumitory Tops,	
Tops of Viola Tricolor, of each,	154 grains
Senna,	770 grains
Sugar,	
Honey, of each,	10½ oz. av.
Boiling Water, sufficient	

Bruise the materials, and infuse for twelve hours with 18 fl. oz. of Boiling Water; strain, and make a second infusion with 10 fl. oz. of Water; strain under pressure, filter through paper (evaporate to one-fourth), then add the Honey and Sugar and shake until dissolved; strain. Dose, 1 to 2 tablespoonfuls a day.

Syrup of Lemon

Syrupus Limonis. U. S. 1880

Lemon Juice, recently expressed and strained, 40 parts, or	17 fl. oz.
Fresh Lemon Peel, 2 parts, or	1 oz. av.
Sugar, in coarse powder, 60 parts, or	28 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or about	2 pints

Heat the Lemon Juice to the boiling point; then add the Lemon Peel, and let the whole stand, closely covered, until cold. Filter, add enough Water through the filter to make the filtrate weigh 40 parts [or measure 17 fl. oz.], dissolve the Sugar in the filtered liquid by agitation, without heat, and strain.

Syrup of Licorice Root

Fluidextract of Glycyrrhiza,	4 fl. oz.
Syrup, a sufficient quantity to make	16 fl. oz.

Mix.

Syrup of Lobelia

(Thomsonian name)

Lobelia Seed,	1 oz. av.
Sugar,	16 oz. av.
Tincture of Lobelia,	4 fl. oz.
Vinegar,	1 fl. oz.
Water,	16 fl. oz.

Boil the Seed with the Vinegar and Water for half an hour; add the Sugar, and, lastly, when cold, add the Tincture of Lobelia.

Syrup of Manna

Manna,	1 oz. troy
Sugar,	5 oz. troy
Water,	4 fl. oz.

Dissolve the Manna in the Water, filter, add the Sugar, and heat to boiling, then strain.

Syrup of Morphine

Sirop de Morphine Fr. Codex

Morphine Hydrochloride,	1 grain
Distilled Water,	20 minims
Syrup, sufficient to make	27 fl. dr.

Mix. A tablespoonful contains about ¼ gr. morphine.

Syrup, Jackson's Pectoral

Oil of Sassafras,	64 minims
Tincture of Tolu,	8 fl. oz.
Magnesium Carbonate,	2 oz. troy
Water,	8 pints
Sugar,	14 lb. av.
Morphine Hydrochloride,	64 grains

Rub up the Tincture of Tolu and Oil of Sassafras with the Carbonate, gradually add ¼ lb. of the Sugar and then the Water, filter, recovering 8 pints, in which dissolve the remainder of the Sugar. Dissolve the Morphine in 1 fl. oz. of Water, add to the Syrup, and make the measure up to 16 pints.

Syrup of Phosphate of Calcium

(Wiegand's)

Precipitated Phosphate of Calcium,	1 oz. troy
Hydrochloric Acid,	4 fl. oz.
Sugar,	12 oz. troy
Water,	7 fl. oz.

Dissolve the Phosphate of Calcium, previously mixed with an ounce of Water, by means of the Acid, and filter; add the Sugar, then the remaining Water, until the bulk is increased to 12 fl. oz., and strain. Dose, a teaspoonful.

Syrup of Phosphate of Manganese

(Wiegand's)

Manganese Sulphate (cryst.),	735 grains
Sodium Phosphate,	1200 grains
Hydrochloric Acid,	4 fl. dr.
Sugar,	10 oz. troy
Water, sufficient	

Dissolve the salts separately, each in 8 fl. oz. of Water, and add the solution of Sodium Phosphate to the solution of Manganese Sulphate, as long as it produces a precipitate, which wash with cold Water and dissolve by means of the Acid; dilute till it measures 7 fl. oz., then add the Sugar. Each fl. dr. contains 5 gr. of the salt.

Syrup of the Phosphates, Compound

Syrupus Phosphatum Compositus

(Chemical Food)

Precipitated Carbonate of Calcium,	256 grains
Phosphate of Iron (U. S. P. 1880),	128 grains
Phosphate of Ammonium,	128 grains
Bicarbonate of Potassium,	32 grains
Bicarbonate of Sodium,	32 grains
Citric Acid,	1 oz. troy
Glycerin,	1 fl. oz.
Phosphoric Acid (50 percent.),	2 fl. oz.
Orange Flower Water,	2 fl. oz.
Tincture of Cudbear (N. F.),	120 minims
Sugar,	8 oz. troy
Water, enough to make	16 fl. oz.

Triturate the Precipitated Carbonate of Calcium with the Bicarbonates of Potassium and Sodium, the Citric Acid, Glycerin, and Orange Flower Water, and gradually add the Phosphoric Acid, stirring until solution has been effected. Dissolve the Phosphate of Iron and the Phosphate of Ammonium in *four* (4) *fluidounces* of hot Water, cool, and add the solution to that previously prepared. Filter the whole through a pellet of absorbent cotton placed in the neck of a funnel, and receive the filtrate in a graduated bottle containing the Sugar. Agitate until the latter is dissolved, then add the Tincture of Cudbear, and, lastly, enough Water to make *sixteen* (16) *fluidounces*.

Each fluidrachm contains about 2 grains of Phosphate of Calcium, 1 grain, each, of the Phosphates of Iron and Ammonium, and smaller quantities of the Phosphates of Potassium and Sodium.

Syrup of Pipsissewa

Fluidextract of Chimaphila,	4 fl. oz.
Syrup, a sufficient quantity to make	16 fl. oz.

Mix.

Syrup, Strengthening

(Thomsonian name)

Comfrey Root,	2 oz. av.
Inula,	1 oz. av.
Marrubium,	240 grains
Beth Root,	120 grains
Brandy,	8 fl. oz.
Sugar,	8 oz. av.
Water,	3 pints

Add the Water to the Comfrey Root, Inula, and Marrubium, and boil until the liquid measures 24 fl. oz., then strain, and add the remaining ingredients.

Syrups for Soda Water

Chocolate Syrup

Best Chocolate,	8 oz. av.
Sugar,	64 oz. av.
Water,	32 fl. oz.

Mix the Chocolate in the Water, and stir thoroughly over a slow fire; strain, and add the Sugar.

Coffee Syrup

Coffee (roasted),	8 oz. av.
Boiling Water,	8 pints
Sugar,	112 oz. av.

Make an infusion, filter, add the Sugar, and strain.

Lemon Syrup

Solution of Citric Acid (1 in 10),	3 fl. oz.
Spirit of Lemon,	1½ fl. oz.
Syrup,	8 pints
Tincture of Curcuma, a sufficient quantity to color.	

Mix.

Nectar Syrup

Vanilla Syrup,	40 fl. oz.
Pineapple Syrup,	8 fl. oz.
Strawberry Syrup,	16 fl. oz.

Mix.

Orange Syrup

Oil of Orange (fresh),	10 minims
Citric Acid,	120 grains
Syrup,	64 fl. oz.

Mix.

Pineapple Syrup

Pineapple Juice,	32 fl. oz.
Sugar,	128 oz. av.
Water,	32 fl. oz.

Mix the Juice and Water, and dissolve the Sugar by percolating with the mixture.

Raspberry Syrup

Raspberry Juice,	32 fl. oz.
Sugar,	128 oz. av.
Water,	32 fl. oz.

Mix the Juice and Water, and dissolve the Sugar by percolating with the mixture.

Sarsaparilla Syrup

Fluidextract of Sarsaparilla,	2 fl. oz.
Oil of Sassafras,	
Oil of Anise, of each,	12 minims
Oil of Gaultheria,	9 minims
Syrup, a sufficient quantity to make	8 pints

Mix.

Sherbet Syrup

Vanilla Syrup,	48 fl. oz.
Pineapple Syrup,	16 fl. oz.
Lemon Syrup,	16 fl. oz.

Mix.

Strawberry Syrup

Strawberry Juice,	32 fl. oz.
Sugar,	128 oz. av.
Water,	32 fl. oz.

Mix the Juice and Water, and dissolve the Sugar by percolating with the mixture.

Vanilla Syrup

Fluidextract of Vanilla,	2 fl. oz.
Syrup, a sufficient quantity to make	32 fl. oz.

Mix.

Tea, Tonic

(Gerhard's)

Gentian,	1 oz. troy
Rhubarb,	120 grains
Ginger,	240 grains
Sodium Bicarbonate,	120 grains
Boiling Water,	32 fl. oz.

Bruise the Gentian, Rhubarb, and Ginger, mix them, and add the Sodium Bicarbonate; then infuse in 32 fl. oz. of Boiling Water. Dose, a wineglassful three times a day.

Tea, Worm

Spigelia,	240 grains
Manna,	240 grains
Senna,	120 grains
Fennel,	60 grains

Contuse the Spigelia and mix it with the other ingredients; infuse in 16 fl. oz. of Boiling Water. Give a child, two years old or upward, half a teacupful, warm, morning, noon, and night, before eating.

Third Preparation

(Thomsonian name)

Lobelia Seed,	
Capsicum, of each,	1 oz. av.
Cypripedium Powder,	10 grains

Add 12 fl. oz. of Number Six (page 1407), macerate, and keep on the dregs.

Tincture, Asiatic

(For cholera)

Opium,	240 grains
Camphor,	240 grains
Capsicum,	240 grains
Oil of Cloves,	4 fl. dr.
Compound Spirit of Ether,	8 fl. oz.

Macerate from ten to twenty days, or prepare by percolation in a close percolator. Dose, 20 to 60 drops every second, third, or fourth hour in sweetened water.

Tincture, Astringent

Aromatic Tincture of Galls

(Gilbert's)

Nutgall,	16 oz. av.
Oil of Citron,	30 minims
Oil of Bergamot,	30 minims
Oil of Lemon,	30 minims
Oil of Thyme,	8 minims
Oil of Lavender,	8 minims
Oil of Rosemary,	8 minims
Tincture of Benzoin,	1 fl. dr.
Alcohol (90 percent.), sufficient	

Exhaust the Gall by percolation with Alcohol, distil off the Alcohol, and evaporate to 8 fl. oz.; redissolve this extract in 8 fl. oz. of Alcohol, add the Oils, and filter.

Tincture of Black Hellebore

Tinctura Hellebori. U. S. 1870

Black Hellebore, in moderately fine powder,	4 oz. troy
Diluted Alcohol, a sufficient quantity	

Moisten the powder with 1 fl. oz. of Diluted Alcohol, pack it in a cylindrical percolator, and gradually pour Diluted Alcohol upon it until 2 pints of tincture are obtained.

Tincture of Burdock Seed

Ground Burdock Seed,	4 oz. troy
Water,	4 fl. oz.
Alcohol,	12 fl. oz.

Mix the liquids, and percolate in the usual way until 16 fl. oz. of tincture are obtained. Dose, a teaspoonful three or four times a day.

Tincture of Cannabis Indica, Ethereal

Extract of Cannabis (Squire's),	240 grains
Spirit of Nitrous Ether,	8 fl. oz.

Triturate together in a mortar till the Extract is dissolved. Dose, 5 to 15 drops.

Tincture of Cantharides, Ethereal

Cantharides,	1 oz. troy
Spirit of Nitrous Ether,	14 fl. oz.

Macerate for eight days, and filter.

Tincture of Castor

Tinctura Castorei. U. S. 1870

Castor (bruised),	1 oz. troy
Alcohol,	16 fl. oz.

Macerate for seven days, express, and filter through paper.

Tincture of Colchicum, Ethereal

Colchicum,	3 oz. troy
Spirit of Nitrous Ether, sufficient to make	8 fl. oz.

Made by percolation. Dose, 20 to 30 drops.

Tincture of Conium

Tinctura Conii. U. S. 1880

Conium in No. 30 powder, 150 parts, or	4¾ oz. av.
Diluted Hydrochloric Acid, 4 parts, or	1 fl. dr.
Diluted Alcohol, a sufficient quantity,	
To make 1000 parts, or	2 pints

Moisten the powder with 45 parts [or 2 fl. oz.] of Diluted Alcohol, previously mixed with the Diluted Hydrochloric Acid, and macerate for twenty-four hours; then pack it moderately in a conical glass percolator, and gradually pour Diluted Alcohol upon it, until 1000 parts [or 2 pints] of Tincture are obtained.

Tincture of Cubeb, Ethereal

Cubeb,	2 oz. troy
Spirit of Nitrous Ether,	16 fl. oz.

Macerate for eight days, and filter.

Tincture of Ferric Acetate Tincture of Acetate of Iron

Tinctura Ferri Acetatis. U. S. 1880

Solution of Acetate of Iron, 50 parts, or	4 fl. oz.
Alcohol, 30 parts, or	3 fl. oz. 3 fl. dr.
Acetic Ether, 20 parts, or	2 fl. oz.
To make 100 parts, or	9 fl. oz.

Mix the Alcohol and Acetic Ether, and gradually add the Solution of Acetate of Iron, taking care that the mixture remains cool. Keep the Tincture in glass stoppered bottles, in a cool and dark place.

Tincture, Golden

Ether,	2 fl. oz.
Tincture of Opium,	2 fl. oz.
Chloroform,	4 fl. dr.
Alcohol,	2 fl. oz.

Mix. Dose, 3 to 20 drops.

Tincture of Green Soap, Compound

(Tilbury Fox)

Green Soap,	1 oz. troy
Oil of Lavender,	90 minims
Oil of Cade,	
Alcohol, of each,	1 fl. oz.

Mix.

Tincture of Green Soap with Tar

(Hebra's)

Green Soap,	1 oz. troy
Tar,	
Alcohol, of each,	1 fl. oz.

Tincture of Guaiac, Ethereal

Guaiac,	1½ oz. troy
Spirit of Nitrous Ether,	8 fl. oz.

Make by maceration. Dose, a teaspoonful.

Tincture of Ignatia

Tincture Ignatiæ. U. S. 1880

Ignatia, in No. 60 powder, 10 parts, or	8 oz. av.
Alcohol,	
Water, each, a sufficient quantity	

Mix Alcohol and Water in the proportion of 8 parts [or 4½ pints] of Alcohol to 1 part [or ½ pint] of Water. Moisten the powder with 10 parts [or ½ pint] of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the Ignatia is exhausted. Reserve the first 90 parts [or 4½ pints] of the percolate, evaporate the remainder to 10 parts [or ½ pint], and mix with the reserved portion. Of this Tincture take any convenient number of parts, and, by means of a water bath, evaporate it to dryness. Weigh the resulting extract, and from its weight calculate the quantity of extract contained in the 100 parts of Tincture obtained; then dissolve the dried extract in the remainder of the Tincture, and add enough of the above menstruum to make the product weigh so many parts that each 100 parts of Tincture shall contain 1 part of dry extract. Lastly, mix thoroughly, and filter through paper.

Tincture of Ignatia, Compound

Gouttes Amères. Bitter Drop

Ignatia,	8 oz. troy
Alcohol, 60 percent.,	16 oz. (by weight)
Potassium Carbonate,	30 grains
Charcoal,	6 grains
Oil of Wormwood,	6 fl. dr.

Macerate fifteen days, and then recover 16 fl. oz. by percolation.

Tincture of Iodine, Compound

Tinctura Iodinii Composita. U. S. 1870

Iodine,	240 grains
Iodide of Potassium,	1 oz. troy
Alcohol,	16 fl. oz.

Dissolve the Iodine and Iodide of Potassium in the Alcohol.

Tincture of Iodine, Ethereal

(Magendie's)

Iodine,	32 grains
Ether,	1 fl. oz.

Dissolve. Used externally.

Tincture of Iodoform, Compound

Iodoform,	15 grains
Potassium Iodide,	120 grains
Glycerin,	2 fl. dr.
Alcohol,	6 fl. dr.

Rub the Iodoform and the Potassium Iodide in a mortar until a fine powder is produced, then add the Glycerin and rub to the consistency of cream; then add the Alcohol, and stir briskly until all is dissolved. Dose, 15 drops three times a day, on sugar or in syrup.

Tincture of Iron, Bitter

(Physick's)

Iron (filings),	3 oz. av.
Ginger (bruised),	
Gentian (bruised), of each,	1 oz. av.
Orange Peel,	½ oz. av.
Strong Old Cider,	16 fl. oz.

Macerate for two weeks or longer, express, and filter.

Tincture of Jalap

Tinctura Jalapæ. U. S. 1870

Jalap, in fine powder,	6 oz. troy
Alcohol,	
Water, each, a sufficient quantity	

Mix two measures of Alcohol with one of Water; then moisten the powder with 2 fl. oz. of the mixture; pack it moderately in a cylindrical percolator, and gradually pour the mixture upon it until 32 fl. oz. of tincture are obtained.

Tincture of Jalap, Compound

Tinctura Purgans

Jalap,	1 oz. troy
Turpeth Root,	60 grains
Scammony,	120 grains
Alcohol (60 percent.),	12 fl. oz.

Macerate for ten days, express, and filter. Dose, 1 to 4 tablespoonfuls. Known in France as *Eau-de-Vie Allemande*, also *Lavolley's Purgative Elixir*. Sweetened with Sugar it is the *Elixir Antiglaireux de Guillie*.

Tincture of Kino, Compound

Powdered Opium,	60 grains
Powdered Kino,	60 grains
Camphor,	90 grains
Cloves,	90 grains
Diluted Alcohol,	16 fl. oz.

Make a tincture by percolation.

Tincture of Lupulin

Tinctura Lupulinæ. U. S. 1870

Lupulin,	4 oz. troy
Alcohol, a sufficient quantity	

Pack the Lupulin in a narrow cylindrical percolator, and gradually pour Alcohol upon it until 32 fl. oz. of tincture are obtained.

Tincture of Opium, Acetated

Tinctura Opii Acetata. U. S. 1870

Powdered Opium,	2 oz. troy
Distilled Vinegar,	12 fl. oz.
Alcohol,	8 fl. oz.

Macerate for a week, express, and filter.

Tincture, Purgative

(Dobell's)

Resin of Podophyllum,	8 grains
Tincture of Ginger,	5 fl. dr.
Alcohol,	8 fl. dr.

Mix. Dose, a teaspoonful at night, when lying down.

Tincture of Rhubarb and Senna

Tinctura Rhei et Sennæ. U. S. 1870

(Warner's Gout Cordial)

Rhubarb,	1 oz. troy
Senna,	120 grains
Coriander,	
Fennel, of each,	60 grains
Glycyrrhiza,	30 grains
Raisins, deprived of their seeds,	6 oz. troy
Diluted Alcohol,	48 fl. oz.

Macerate for seven days, express, and filter through paper.

Tonic, Hair

(Prof. Gross)

Tinture of Cantharides,	90 minims
Tincture of Capsicum,	20 minims
Glycerin,	30 minims
Perfumed Spirit, sufficient to make	6 fl. oz.

Mix.

Troches of Borax

Sodium Borate,	150 grains
Powdered Sugar,	1800 grains
Carmine, No. 40,	1½ grains
Tragacanth (in flakes),	5 grains
Distilled Water,	120 minims
Tincture of Benzoin,	20 minims

Prepare a mucilage from the Tragacanth, with the addition of the Water and Tincture. Dissolve the Carmine in 30 minims of Water of Ammonia. Mix the dry ingredients together, add the Carmine solution and sufficient Tragacanth mucilage to form a mass. Divide the mass into 100 troches, each weighing 20 grains and containing 1½ grains of Sodium Borate.

Troches of Magnesia

Trochisci Magnesiæ. U. S. 1880

Magnesium Oxide,	300 grains
Nutmeg, in fine powder,	15 grains
Sugar, in fine powder,	900 grains
Mucilage of Tragacanth, a sufficient quantity, to make 100 troches	

Rub the Magnesium Oxide and the powders together until they are thoroughly mixed; then, with Mucilage of Tragacanth, form a mass, to be divided into 100 troches.

Troches of Santoninate of Sodium

Trochisci Sodii Santoninatis. U. S. 1880

Santoninate of Sodium, in fine powder,	100 grains
Sugar, in fine powder,	2000 grains
Tragacanth, in fine powder,	50 grains
Orange Flower Water, a sufficient quantity, to make 100 troches	

Rub the powders together until they are thoroughly mixed; then, with Orange Flower Water, form a mass, to be divided into 100 troches.

Vinegar, Aromatic

Glacial Acetic Acid,	
Oil of Cloves,	
Camphor, of each,	1 fl. oz.

Mix.

Vinegar of Lobelia

Acetum Lobeliæ. U. S. 1880

Lobelia, in No. 30 powder, ten parts, or	1¾ oz. av.
Diluted Acetic Acid, a sufficient quantity,	
To make 100 parts, or	1 pint

Moisten the powder with 5 parts [or 1 fl. oz.] of Diluted Acetic Acid, pack it firmly in a conical glass percolator, and gradually pour Diluted Acetic Acid upon it until 100 parts [or 1 pint] of filtered liquid are obtained.

Vinegar, Raspberry

Raspberry Syrup,	16 fl. oz.
Glacial Acetic Acid,	1 fl. dr.

Mix. Dilute with sufficient water.

Vinegar of Sanguinaria

Acetum Sanguinariæ. U. S. 1880.

Sanguinaria, in No. 30 powder, 10 parts, or	1¾ oz. av.
Diluted Acetic Acid, a sufficient quantity,	
To make 100 parts, or	1 pint

Moisten the powder with 5 parts [or 1 fl. oz.] of Diluted Acetic Acid, pack it firmly in a conical glass percolator, and gradually pour Diluted Acetic Acid upon it until 100 parts [or 1 pint] of filtered liquid are obtained.

Water, Carbolic Acid

Aqua Acidi Carbolici. U. S. 1870

Glycerite of Carbolic Acid,	5 fl. dr.
Water, a sufficient quantity to make	8 fl. oz.

Mix the Glycerite with the Water. Used as a gargle, and as a wash in various skin diseases.

Wine of Aloes

Vinum Aloes. U. S. 1880

Purified Aloes, 6 parts, or	2 oz. av.
Cardamom, 1 part, or	146 grains
Ginger, 1 part, or	146 grains
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	2 pints

Mix the Aloes, Cardamom, and Ginger, and reduce them to a moderately coarse (No. 40) powder. Macerate the powder with 90 parts [or 26 fl. oz.] of Stronger White Wine for 7 days, with occasional agitation, and filter through paper; adding, through the filter, enough Stronger White Wine to make the filtered liquid weigh 100 parts [or measure 2 pints].

Wine, Aromatic

Vinum Aromaticum. U. S. 1880

Lavender, 1 part, or	72 grains
Origanum, 1 part, or	72 grains
Peppermint, 1 part, or	72 grains
Rosemary, 1 part, or	72 grains
Sage, 1 part, or	72 grains
Wormwood, 1 part, or	72 grains
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	1 pint

Mix the solid ingredients, and reduce them to a coarse (No. 20) powder. Moisten the powder with 4 parts [or 6 fl. dr.] of Stronger White Wine, pack it moderately in a conical glass percolator, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh 100 parts [or measure 1 pint].

Wine of Rhubarb

Vinum Rhei. U. S. 1880

Rhubarb, in No. 30 powder, 10 parts, or	3¼ oz. av.
Calamus, in No. 30 powder, 1 part, or	140 grains
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	2 pints

Moisten the mixed powders with 5 parts [or 1½ fl. oz.] of Stronger White Wine, pack the mixture in a conical glass percolator, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh 100 parts [or measure 2 pints].

Wine of Tobacco

Vinum Tabaci. U. S. 1870

Tobacco,	240 grains
White Wine,	8 fl. oz.

Macerate and filter.

THE NATIONAL FORMULARY OF UNOFFICIAL PREPARATIONS

THE National Formulary, 3rd, edition, is issued by the American Pharmaceutical Association and is here printed in abstract, with the permission of the Council of the Association, the printing of the *full text* of this edition of the Formulary by any publisher except their own being forbidden by a resolution passed by the Association at its annual meeting in Indianapolis in 1906.

The National Formulary is intended to serve as a guide to pharmacists and physicians for preparations which are unofficial and not in the United States Pharmacopœia but which are in use in this country. A bound copy of the 3rd edition, revised and corrected, should be in the hands of every pharmacist, and can be purchased for a small sum from booksellers, wholesale druggists or from the General Secretary of the American Pharmaceutical Association.

Acetum Aromaticum. N. F.

AROMATIC VINEGAR

The formula of this preparation is identical with that of the 2d ed. N. F. It contains the volatile oils of lavender, rosemary, juniper, peppermint, cinnamon, lemon and cloves, dissolved in alcohol, acetic acid and water.

Acidum Carbolicum Iodatum. N. F.

IODIZED CARBOLIC ACID

[Phenol Iodatum, Iodized Phenol]

The formula for Iodized Carbolic Acid was not changed in the last revision of the N. F., with the exception that the quantities are expressed in parts by weight instead of grammes. It is made from iodine, phenol and glycerin. It is used externally as a convenient form of applying iodine and phenol when indicated.

Acidum Citricum Saccharatum. N. F.

SACCHARATED CITRIC ACID

The formula for this preparation does not differ from that of the 2d ed. N. F. This powder is used by mixing it with an equal weight of saccharated sodium bicarbonate (see page 1337) and adding to water to form an effervescing solution which is refrigerant and laxative.

Acidum Hypophosphorosum. N. F.

(U. S. P. = 30 per cent.)

HYPOPHOSPHOROUS ACID

The 3d ed. N. F. introduces a process for making hypophosphorous acid by decomposing potassium hypophosphite with tartaric acid, the liquids used being distilled water and diluted alcohol. The strength is the same as that of the U. S. P. (8th Rev.), 30 per cent. (see page 482). The 2d ed. N. F. preparation was a 10 per cent. acid. It is intended to be used for making diluted hypophosphorous acid.

Acidum Metaphosphoricum Dilutum. N. F.

DILUTED METAPHOSPHORIC ACID

[Acidum Phosphoricum Glaciale Dilutum, Diluted Glacial Phosphoric Acid]

This diluted acid is intended to be of the same strength as the official diluted phosphoric acid. Inasmuch as glacial phosphoric acid, from which it is made, as found in commerce usually contains sodium phosphate in large quantity as an impurity, a similar formula was abandoned by the U. S. Pharmacopœia because of its uncertain strength, and this diluted acid should not be used in place of the official diluted phosphoric acid. (See page 482.)

Acidum Tartaricum Saccharatum. N. F.

SACCHARATED TARTARIC ACID

The formula for this preparation does not differ from that of the 2d ed. N. F. Used by dissolving in water with an equal weight of saccharated sodium bicarbonate (see page 1337) to form an effervescing mixture which is refrigerant and laxative.

Aqua Sedativa. N. F.

SEDATIVE WATER

[Lotio Ammoniacalis-Camphorata (Codex), Eau Sedative de Raspail]

The formula for this preparation is the same as that found in the 2d ed. N. F.

Average dose: 8 Cc. (2 fluidrachms).

Balsamum Traumaticum. N. F.

TRAUMATIC BALSAM

[Turlington's Balsam, Friar's Balsam]

The official Tinctura Benzoini Composita (see page 346) is a simplified form of Turlington's Balsam and is preferred to this preparation.
Average dose: 2 Cc. (30 minims).

Bismuthi Oxidum Hydratum. N. F.

HYDRATED OXIDE OF BISMUTH

This form of bismuth is a creamy white powder well adapted for mixing with water to form a *Cream of Bismuth* to be used externally as an application to the skin.

Boroglycerinum. N. F.

BOROGLYCERIN

[Glyceryl Borate, Boroglyceride]

This is a solid or semi-solid, intended for use in making a glycerite of boroglycerin by adding to it an equal weight of glycerin and heating with a gentle heat until dissolved. The process in the 2d ed. N. F. was the same as that of the 3d ed. Used as a preservative for animal and vegetable products.

Caffeinæ Sodio-Benzoas. N. F.

CAFFEINE SODIO-BENZOATE

This powder contains 50 per cent. of caffeine with 50 per cent. of sodium benzoate, as in the 2d ed. N. F. It is used as a nerve stimulant.
Average dose: 0.2 Gm. (3 grains).

Caffeinæ Sodio-Salicylas. N. F.

CAFFEINE SODIO-SALICYLATE

This powder contains 50 per cent. of caffeine with sodium salicylate, as in the 2d ed. N. F. It is used in rheumatism.
Average dose: 0.2 Gm. (3 grains).

Camphor-Menthol. N. F.

CAMPHOR AND MENTHOL

A new preparation in the 3d ed. N. F. Equal parts by weight of camphor and menthol. Applied locally in neuralgia.

Ceratum Camphoræ Compositum. N. F.

COMPOUND CAMPHOR CERATE

[Ceratum Camphoratum, Camphor Ice]

Largely used at one time as a healing application to chapped skin. It contains camphor, white wax, castor oil, spermaceti, phenol, oil of bitter almond and benzoic acid.

Chloral Camphoratum. N. F.

CAMPHORATED CHLORAL

[Chloral et Camphora, Chloral and Camphor]

Equal parts by weight of hydrated chloral and camphor as in the 2d ed. N. F. Used locally to relieve pain.

Collodium Iodatum. N. F.

IODIZED COLLODION

A five per cent., by weight, solution of iodine in flexible collodion as in the 2d ed. N. F. Used externally as a discutient.

Collodium Iodoformatum. N. F.

IODOFORM COLLODION

A five per cent. by weight solution of iodoform in flexible collodion as in 2d ed. N. F. Used locally.

Collodium Salicylatum Compositum. N. F.

COMPOUND SALICYLATED COLLODION

[Corn Collodion]

The proportions of the ingredients are the same as in the 2d ed. N. F. It contains salicylic acid, extract of Indian hemp, alcohol and flexible collodion. Used in the treatment of corns.

Collodium Tiglii. N. F.

CROTON OIL COLLODION

A ten per cent. by weight solution of croton oil in flexible collodion as in 2d ed. N. F. Used locally as a counter-irritant.

Cordiale Rubi Fructus. N. F.

BLACKBERRY CORDIAL

The proportions of the ingredients are nearly the same as in the 2d ed. N. F. It contains cinnamon, cloves, nutmeg, fresh blackberry juice, syrup, and diluted alcohol, and is used as a remedy in diarrhœa.
Dose: 8 to 16 Cc. (2 to 4 fluidrachms).

Decoctum Aloes Compositum. N. F.

COMPOUND DECOCTION OF ALOES

The formula for this decoction does not differ from that of the 2d ed. N. F. It contains extract of aloes, myrrh, saffron, potassium carbonate, extract of glycyrrhiza, compound tincture of cardamon and water. It is used as a laxative or purgative in the *dose* of 8 Cc. to 32 Cc. (2 to 8 fluidrachms).

Elixir Acidi Salicylici. N. F.

ELIXIR OF SALICYLIC ACID

The formula for this elixir is the same as that of the 2d ed. N. F. It contains five grains of salicylic acid in 1 fluidrachm of finished elixir, and is used in the treatment of rheumatism.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Ammonii Bromidi. N. F.

ELIXIR OF AMMONIUM BROMIDE

The formula for this elixir was changed in the 3d ed. N. F. by dropping the citric acid which was directed in the 2d ed. N. F. It contains 5 grains of ammonium bromide in 1 fluidrachm of finished elixir, and is used as a nerve sedative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Ammonii Valerianatis. N. F.

Elixir of Ammonium Valerianate

The title of this elixir should have been changed to Elixir Ammonii Valeratis, to conform to the name of the salt in the U. S. P. 8th Rev., "valerate." The formula for this elixir was changed in the 3d ed. N. F. by increasing the proportion of chloroform about 40 per cent. It contains 2 grains of ammonium valerate in 1 fluidrachm of finished elixir.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Ammonii Valerianatis et Quininæ. N. F.

Elixir of Ammonium Valerianate and Quinine

The title should have been changed as in the elixir preceding this, for the reasons there given. It contains ¼ of a grain of quinine hydrochloride and 2 grains of ammonium valerate in 1 fluidrachm of finished elixir.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Anisi. N. F.

Elixir of Anise

[Aniseed Cordial]

The formula for this elixir was changed in the 3d ed. N. F. by using purified talc instead of magnesium carbonate as a clarifying substance. It contains anethol, oil of fennel, spirit of bitter almond, alcohol, syrup and water. Used as a vehicle, also as a carminative for infants.

Average dose: Infants, 1 Cc. (15 minims).

Elixir Apii Graveolentis Compositum. N. F.

Compound Elixir of Celery

This elixir should always be prescribed under its full name, "Apii Graveolentis," to avoid the possibility of "Apii" being mistaken in handwriting for "Opii." The formula is the same as that of the 2d ed. N. F. It contains fluidextracts of celery seed, coca, kola, viburnum prunifolium, with alcohol and aromatic elixir. Used as a stimulant in nervous affections.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Bismuthi. N. F

Elixir of Bismuth

This formula has been improved in the 3d ed. N. F., bismuth and ammonium citrate being replaced by glycerite of bismuth. Two grains of bismuth and sodium tartrate are contained in one fluidrachm of finished elixir.

Average dose; 4 Cc. (1 fluidrachm).

Elixir Buchu. N. F.

Elixir of Buchu

In this elixir magnesium carbonate has been replaced in the 3d ed. N. F. by purified talc as a clarifying agent. It contains fluidextract of buchu, alcohol, syrup and aromatic elixir. About 7½ grains of buchu are represented by 1 fluidrachm of finished elixir. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Buchu Compositum. N. F.

Compound Elixir of Buchu

The comments on Elixir of Buchu apply to this elixir. Compound fluidextract of buchu (page 1321) is used instead of the simple fluidextract. About 15 minims of compound fluidextract of buchu are represented in 1 fluidrachm of finished elixir. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Buchu Et Potassii Acetatis. N. F.

Elixir of Buchu and Potassium Acetate

The formula for this elixir is the same as that of the 2d ed. N. F. It contains 5 grains of potassium acetate and the equivalent of 7½ grains of buchu in 1 fluidrachm of finished elixir. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Caffeinæ. N. F.

Elixir of Caffeine

The formula for this elixir is nearly the same as that of the 2d ed. N. F. It contains 1 grain of caffeine in 1 fluidrachm of finished elixir. It is used as a nerve stimulant.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Calcii Bromidi. N. F.

Elixir of Calcium Bromide

The formula for this elixir was changed in the 3d ed. N. F., diluted hydrobromic acid being used to aid in dissolving the calcium bromide instead of the citric acid used in the 2d ed. N. F.

It contains 5 grains of calcium bromide in 1 fluidrachm of finished elixir, and is used as a nervine.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Calcii Hypophosphitis. N. F.

Elixir of Calcium Hypophosphite

The formula for this elixir was changed in the 3d ed. N. F., hypophosphorous acid being used to aid in dissolving the calcium hypophosphite instead of the citric acid used in the 2d ed. N. F.

It contains 2 grains of calcium hypophosphite in 1 fluidrachm of finished elixir. It is used as an alterative.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Calcii Lactophosphatis. N. F.

Elixir of Calcium Lactophosphate

No change was made in the formula for this elixir, the ingredients and quantities being the same as those directed in the 2d ed. N. F.

It contains 1 grain of calcium lactate or about 1½ grains of so-called calcium lactophosphate in 1 fluidrachm of finished elixir. It is used as an alterative.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Catharticum Compositum. N. F.

Compound Cathartic Elixir

The formula for this elixir was completely revised for the 3d ed. N. F., the fluidextracts of frangula and rhubarb replacing those of podophyllum, leptandra and jalap used in the 2d ed. N. F., while spirit of peppermint, solution of potassium hydroxide, saccharin and aromatic elixir replace potassium and sodium tartrate, sodium bicarbonate, compound elixir of taraxacum, and elixir of glycyrrhiza of the 2d ed. N. F. Fluidextract of senna was used in both formulas.

Average dose: Aperient, 4 Cc. (1 fluidrachm); Cathartic, 12 Cc. (3 fluidrachms).

Elixir Chloroformi Compositum. N. F.

Compound Elixir of Chloroform.

The formula for this elixir was not changed in the 3d ed. N. F. It is recommended that the name "*Chloroform Paregoric*" formerly used as a synonym for this elixir be abandoned, in order that confusion with official paregoric may be prevented. It is used as an anodyne and carminative.

Average dose: 2 Cc. (½ fluidrachm).

Elixir Cinchonæ. N. F.

[Elixir of Cinchona from "Alkaloids."]

Elixir of Cinchona. Elixir Calisaya

[Compound Elixir of Quinine]

The formula for this elixir was completely changed in the 3d ed. N. F., the alkaloids of cinchona being employed instead of the tincture of cinchona used in the 2d ed. N. F., or in other words the old compound elixir of quinine is now called elixir of cinchona. This course is to be commended, notwithstanding the unfavorable criticism made by some writers, who insist that it is no longer entitled to the name of elixir of cinchona because it is not made directly from a preparation of the bark; the alkaloids are made *from the bark*, however, and there certainly can be no good reason for compelling the pharmacist to dispense the elixir of the 2d ed. N. F., which has the fault of precipitating continually, and which cannot be mixed with preparations containing salts of iron without producing inky compounds. The introduction of this new elixir of cinchona containing alkaloids in definite quantities makes it unnecessary to retain detannated elixir of cinchona and a separate formula for compound elixir of quinine, both of which were dropped. It is used as a tonic and vehicle for other preparations. This elixir now contains 1 grain of quinine sulphate and ½ grain each of cinchonidine and cinchonine sulphates in 1 fluidounce of finished elixir, and is used as a tonic.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Cinchonæ et Ferri. N. F.

Elixir of Cinchona and Iron

[Elixir of Calisaya and Iron, Ferrated Elixir of Calisaya]

The formula for this elixir was not changed in strength in the 3d ed. N. F. The color is darker than that of the 2d ed. N. F., due to the use of compound tincture of cudbear in the elixir of cinchona now used.

It contains 2 grains of soluble ferric phosphate in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Cinchonæ et Hypophosphitum. N. F.

Elixir of Cinchona and Hypophosphites
Elixir of Calisaya and Hypophosphites

The formula for this elixir was changed in the 3d ed. N. F. by replacing the citric acid in the 2d ed. N. F. with hypophosphorous acid. The use of the elixir of cinchona (made now from alkaloids) changes the taste and appearance of this elixir, which contains 1 grain each of calcium and sodium hypophosphites in 1 fluidrachm of finished elixir. It is used as a tonic and alterative.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Cinchonæ, Ferri, Bismuthi et Strychninæ. N. F.

Elixir of Cinchona, Iron, Bismuth and Strychnine

[Elixir of Calisaya, Iron, Bismuth and Strychnine]

The strength of this elixir was not changed in the 3d ed. N. F. It contains 1-100th of a grain of strychnine sulphate, 1 grain of bismuth and sodium tartrate and 2 grains of soluble ferric phosphate in 1 fluidrachm of finished elixir, and is used as a bitter tonic and stomachic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Cinchonæ, Ferri et Bismuthi. N. F.

Elixir of Cinchona, Iron and Bismuth

[Elixir of Calisaya, Iron and Bismuth]

The formula for this elixir was changed in the 3d ed. N. F., glycerite of bismuth replacing bismuth and ammonium citrate of the 2d ed. N. F. It contains 1 grain of bismuth and sodium tartrate, 1¾ grains of soluble ferric phosphate, in 1 fluidrachm of finished elixir, and is used as a bitter tonic and stomachic.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Cinchonæ, Ferri, et Calcii Lactophosphatis. N. F.

Elixir of Cinchona, Iron and Calcium Lactophosphate

[Elixir of Calisaya, Iron, and Lactophosphate of Lime]

The formula for this elixir is the same as that in the 2d ed. N. F. It contains ½ grain of calcium lactate (equivalent to about ¾ grain of the so-called calcium lactophosphate), nearly 2 grains of soluble ferric phosphate, and is tonic and alterative.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Cinchonæ, Ferri et Pepsini. N. F.

Elixir of Cinchona, Iron and Pepsin
Elixir of Calisaya, Iron and Pepsin

The formula for this elixir was changed in the 3d ed. N. F. by replacing the pepsin and hydrochloric acid used in the 2d ed. N. F. by glycerite of pepsin. It contains 1 grain of pepsin and about 1½ grains of soluble ferric phosphate in 1 fluidrachm of finished elixir, and is used as a tonic and stomachic.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Cinchonæ, Ferri et Strychninæ. N. F.

Elixir of Cinchona, Iron and Strychnine

[Elixir of Calisaya, Iron and Strychnine]

The formula for this elixir was very slightly changed in the 3d ed. N. F., 15 Cc. of water being replaced by 10 Cc. for dissolving the strychnine sulphate. This, of course, does not affect the strength. It contains 1-100th of a grain of strychnine sulphate and 2 grains of soluble ferric phosphate in 1 fluidrachm of finished elixir, and is used as a bitter tonic.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Cinchonæ, Pepsini et Strychninæ. N. F.

Elixir of Cinchona, Pepsin and Strychnine
Elixir of Calisaya, Pepsin and Strychnine

The formula for this elixir was improved in the 3d ed. N. F. by the addition of cinchonidine sulphate. It contains 1-100th grain of strychnine sulphate, ½ grain quinine sulphate, 1-16th grain each of cinchonidine and cinchonine sulphates, and 1 grain of pepsin in 1 fluidrachm of finished elixir. It is used as a tonic, stomachic, and digestive.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Cocæ. N. F.

Elixir of Coca

[Elixir of Erythroxylon]

This is a new title in the 3d ed. N. F. It is made from fluidextract of coca, tincture of vanilla, alcohol, syrup and aromatic elixir, about 7½ grains of coca leaf being represented in 1 fluidrachm of finished elixir. It is used as a stimulant.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Cocæ et Guaranæ. N. F.

Elixir of Coca and Guarana

[Elixir of Erythroxylon and Guarana]

This is a new title in the 3d ed. N. F. It contains fluidextracts of coca and guarana with compound elixir of taraxacum, about 7½ grains each of coca leaf and guarana being represented by 1 fluidrachm of finished elixir. It is used as a stimulant.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Corydalis Compositum. N. F.

Compound Elixir of Corydalis

The formula for this elixir is the same as that of the 2d ed. N. F. It contains about 3 grains of potassium iodide in 1 fluidrachm of finished elixir, with small quantities of the fluidextracts of corydalis, stillingia, xanthoxylum and iris.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Curassao. N. F.

Elixir of Curacao

[Curaçao Cordial]

The only change in the formula for this elixir in the 3d ed. N. F. is the slight increase in the proportion of spirit of curaçao. It contains spirit of curaçao, a little orris root, citric acid, alcohol, syrup and water. It is used solely as a vehicle.
Average dose: 16 Cc. (4 fluidrachms).

Elixir Digestivum Compositum. N. F.

Compound Digestive Elixir

[Compound Elixir of Pepsin]

The formula for this elixir was slightly changed in the 3d ed. N. F., the quantity of lactic acid and hydrochloric acid being reduced. It contains pepsin, pancreatin, diastase, lactic acid, hydrochloric acid, tincture of cudbear, glycerin, water and aromatic elixir. Pepsin and pancreatin should never be used in the same liquid. Digestive.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Eriodictyi Aromaticum. N. F.

Aromatic Elixir of Eriodictyon

[Aromatic Elixir of Yerba Santa, Elixir Corrigens]

The formula for this elixir was very slightly changed in the 3d ed. N. F., the quantities of fluidextract of eriodictyon and magnesium carbonate being slightly reduced. It is made from fluidextract of eriodictyon, syrup, powdered pumice, magnesium carbonate and compound elixir of taraxacum. It is used chiefly as a vehicle for disguising the taste of quinine sulphate and other bitter substances.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Eucalypti. N. F.

Elixir of Eucalyptus

The formula for this elixir is nearly the same as that in the 2d ed. N. F. The only change in the 3d ed. N. F. is the replacing of magnesium carbonate by purified talc. It contains about 7½ grains of eucalyptus in 1 fluidrachm of finished elixir, syrup of coffee and compound elixir of taraxacum being employed in the preparation. It is used as a tonic.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Euonymi. N. F.

Elixir of Euonymus

[Elixir of Wahoo]

The formula for this elixir is the same as that in the 2d ed. N. F. About 9½ grains of euonymus are represented in 1 fluidrachm of the finished elixir, which contains syrup of coffee and compound elixir of taraxacum. It is used as a diuretic and cholagogue.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Ferri Hypophosphitis. N. F.

Elixir of Hypophosphite of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferric Hypophosphite to Elixir of Hypophosphite of Iron. No change was made in the proportion of the ingredients, 1 grain of iron hypophosphite being contained in 1 fluidrachm of finished elixir. It is used as an alterative and chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Ferri Lactatis. N. F.

Elixir of Lactate of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferrous Lactate to Elixir of Lactate of Iron. The name "Lactate of Iron" also replaces "Ferrous Lactate" used in the 2d ed. N. F. No change was made in the ingredients or quantities. One grain of lactate of iron and 3 grains of potassium citrate are contained in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Ferri Phosphatis. N. F.

Elixir of Phosphate of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferric Phosphate to Elixir of Phosphate of Iron, and the word "soluble" has been added to ferric phosphate. Two grains of soluble ferric phosphate are contained in 1 fluidrachm of the finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Ferri Pyrophosphatis. N. F.

Elixir of Pyrophosphate of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferric Pyrophosphate to Elixir of Pyrophosphate of Iron. No change was made in the ingredients or quantities used in the 2d ed. N. F., except that the word "soluble" has been added to ferric pyrophosphate. It contains 2 grains of soluble ferric pyrophosphate in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Ferri Pyrophosphatis, Quininæ et Strychninæ. N. F.

Elixir of Pyrophosphate of Iron, Quinine, and Strychnine

This is a new preparation in the 3d ed. N. F., and differs from the official elixir of iron, quinine and strychnine phosphates in containing soluble ferric pyrophosphate instead of phosphate, while the quinine in the official elixir is replaced by quinine sulphate. It contains 1-128th grain of strychnine, ½ grain of quinine sulphate, and 2 grains of soluble ferric pyrophosphate in 1 fluidrachm of finished elixir. The additional ingredients are citric acid, oil of orange, alcohol, syrup, ammonia water and distilled water. Used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Ferri, Quininæ et Strychninæ. N. F.

Elixir of Iron, Quinine and Strychnine

This elixir does not differ greatly from that of the 2d ed. N. F. It contains about 1 grain of ferric chloride, ½ grain quinine hydrochloride, and 1-100th grain of strychnine sulphate in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Frangulæ. N. F.

Elixir of Frangula

[Elixir of Buckthorn]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of frangula, alcohol, compound elixir of taraxacum, and aromatic elixir. It represents about 15 grains of frangula in 1 fluidrachm of the finished elixir. It is used as a laxative.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Gentianæ. N. F.

Elixir of Gentian

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of gentian, compound spirit of cardamom, solution of ferric sulphate, ammonia water, alcohol, water and aromatic elixir, and represents about two grains of gentian in 1 fluidrachm of the finished elixir. It is used as a bitter tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Gentianæ cum Tinctura Ferri Chloridi. N. F.

Elixir of Gentian with Tincture of Chloride of Iron

The formula for this elixir does not differ from that of the 2d ed. N. F. The English name was changed in the 3d ed. from Elixir of Gentian with Tincture of Ferric Chloride, to Elixir of Gentian with Tincture of Chloride of Iron. The tincture of citro-chloride of iron, N. F., is used and not the official tincture. It represents ¾ of a grain of ferric chloride and nearly 2 grains of gentian in 1 fluidrachm of the finished elixir, and is used as a bitter tonic.

Average dose 4 Cc. (1 fluidrachm).

Elixir Gentianæ et Ferri Phosphatis. N. F.

Elixir of Gentian and Phosphate of Iron

[Elixir Gentianæ Ferratum, Ferrated Elixir of Gentian, Ferrophosphated Elixir of Gentian]

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Gentian and

Ferric Phosphate to Elixir of Gentian and Phosphate of Iron, but the formula does not differ from that of the 2d ed. N. F., except that the word "soluble" has been added to ferric phosphate. One grain of soluble ferric phosphate and about 2 grains of gentian are represented in 1 fluidrachm of the finished elixir. It is used as a chalybeate and tonic.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Gentianæ Glycerinatum. N. F.

Glycerinated Elixir of Gentian

This is a new elixir in the 3d ed. N. F. It is made from the fluidextracts of gentian and taraxacum, acetic ether, phosphoric acid, tincture of sweet orange peel, compound tincture of cardamom, solution of saccharin, glycerin, sugar and white wine. It is a tonic agreeable to the taste and will undoubtedly prove a valuable addition to the list of tonic elixirs. The use of saccharin, however, is questionable, in view of the prejudice against it, and as glycerin and sugar are both sweetening agents, its employment seems unnecessary.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Glycerophosphatum. N. F.

Elixir of Glycerophosphates

This is a new elixir in the 3d ed. N. F. It contains 1 grain of absolute sodium glycerophosphate, and ½ grain calcium glycerophosphate, in 1 fluidrachm of finished elixir. The additional ingredients are phosphoric acid, glycerin, aromatic elixir and distilled water. It is used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Glycyrrhizæ. N. F.

Elixir of Glycyrrhiza

[Elixir of Licorice]

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the addition of a small quantity of magnesium carbonate to aid in the filtration. It is made from fluidextract of glycyrrhiza and aromatic elixir. It is used as a vehicle and flavoring agent.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Glycyrrhizæ Aromaticum. N. F.

Aromatic Elixir of Glycyrrhiza

[Aromatic Elixir of Licorice]

The formula for this elixir was changed in the 3d ed. N. F., the quantity of volatile oils having been practically doubled. It contains fluidextract of glycyrrhiza, oil of cloves, cinnamon, myristica and fennel, with aromatic elixir; purified talc replaces magnesium carbonate. It is used as a vehicle.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Grindeliæ. N. F.

Elixir of Grindelia

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of grindelia, compound spirit of orange, alcohol and compound elixir of taraxacum. About 4 grains of grindelia are represented in 1 fluidrachm of the finished elixir. It is used in the treatment of asthma.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Guaranæ. N. F.

Elixir of Guarana

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of guarana, aromatic elixir and compound elixir of taraxacum. About 12 grains of guarana are represented in 1 fluidrachm of finished elixir. It is used as a nervous stimulant.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Humuli. N. F.

Elixir of Humulus

[Elixir of Hops]

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the substitution of purified talc for the magnesium carbonate. It is made from fluidextract of hops, purified talc, tincture of vanilla, compound elixir of taraxacum and aromatic elixir. About 7½ grains of hops are represented in 1 fluidrachm of finished elixir. It is used as a mild sedative.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Hypophosphitum. N. F.

Elixir of Hypophosphites

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the replacing of the citric acid used in the 2d ed. by hypophosphorous acid. It is made from calcium, sodium and potassium hypophosphites, hypophosphorous acid, water, glycerin, compound spirit of cardamom and aromatic elixir. It contains 3 grains of calcium hypophosphite and 1 grain each of sodium and potassium hypophosphites in 1 fluidrachm of finished elixir, and is used as an alterative.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Hypophosphitum cum Ferro. N. F.

Elixir of Hypophosphites with Iron

The formula for this elixir does not differ from that of the 2d ed. N. F., except the slight increase in the quantity of potassium hypophosphite and the replacement of citric acid by hypophosphorous acid. It is made from calcium, sodium and potassium hypophosphites, ferrous sulphate, hypophosphorous acid, water, syrup and aromatic elixir. It contains ½ grain each of potassium and ferrous hypophosphites and 1 grain each of calcium and sodium hypophosphites in one fluidrachm of finished elixir. It is used as an alterative and chalybeate.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Lithii Bromidi. N. F.

Elixir of Lithium Bromide

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the citric acid used in the 2d ed. was dropped. It contains 5 grains of lithium bromide in 1 fluidrachm of finished elixir. It is used in the treatment of gout and rheumatism.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Lithii Citratis. N. F.

Elixir of Lithium Citrate

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains 5 grains of lithium citrate in 1 fluidrachm of finished elixir, and is used in the treatment of gout and rheumatism.

Average dose: 6 Cc. (1½ fluidrachms).

Elixir Lithii Salicylatis. N. F.

Elixir of Lithium Salicylate

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains 5 grains of lithium salicylate in 1 fluidrachm of finished elixir, and is used in the treatment of gout and rheumatism.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Malti et Ferri. N. F.

Elixir of Malt and Iron

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the word "soluble" has been added to ferric phosphate. It contains 1 grain of soluble ferric phosphate and 15 minims of extract of malt in 1 fluidrachm of finished elixir, and is used as a nutrient and in anæmic conditions.

Average dose: 16 Cc. (4 fluidrachms).

Elixir Paraldehydi. N. F.

Elixir of Paraldehyde

(25 per cent.)

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from paraldehyde, glycerin, alcohol, tincture of cardamom, oils of orange and cinnamon, compound tincture of cudbear and aromatic elixir. It contains about 15 minims of paraldehyde in 1 fluidrachm of finished elixir, and is used as a hypnotic and sedative.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Pepsini. N. F.

Elixir of Pepsin

The formula for this elixir was materially changed in the 3d ed. N. F., glycerite of pepsin replacing pepsin and aromatic elixir replacing compound elixir of taraxacum. It contains about 1 grain of pepsin in 1 fluidrachm of finished elixir. It is used to aid digestion.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Pepsini, Bismuthi et Strychninæ. N. F.

Elixir of Pepsin, Bismuth and Strychnine

The formula for this elixir was changed in the 3d ed. N. F. by the addition of a trace of tartaric acid and the use of strychnine alkaloid instead of strychnine sulphate. It contains 1-100th of a grain of strychnine, ½ grain of pepsin and 2 grains of bismuth and sodium tartrate in 1 fluidrachm of finished elixir. It is used as a tonic in dyspepsia.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Pepsini et Bismuthi. N. F.

Elixir of Pepsin and Bismuth

The formula for this preparation was entirely changed in the 3d ed. N. F., the glycerite of bismuth replacing bismuth and ammonium citrate and ammonia water, and the glycerite of pepsin replacing pepsin. Aromatic elixir replaces compound elixir of taraxacum. It contains about ½ grain of pepsin and 2 grains of bismuth and sodium tartrate in 1 fluidrachm of finished elixir. It is used as a digestant.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Pepsini et Ferri. N. F.

Elixir of Pepsin and Iron

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains ½ grain of ferric chloride and nearly 1 grain of pepsin in one fluidrachm of the finished elixir. It is used as a chalybeate and digestive.

Average dose: 8 Cc. (2 fluidrachms).

Elixir Phosphori. N. F.

Elixir of Phosphorus

This elixir was official in the U. S. P. 1890, and was introduced into the 3d ed. N. F. It is made from spirit of phosphorus, oil of anise, glycerin and aromatic elixir. About 1-60th of a grain of phosphorus is contained in 1 fluidrachm of the finished elixir. It is used as an aphrodisiac and nervous stimulant.

Average dose: 4 Cc. (1 fluidrachm.)

Elixir Phosphori et Nucis Vomicæ. N. F.

Elixir of Phosphorus and Nux Vomica

The formula for this elixir was slightly changed in the 3d ed. N. F., the quantity of nux vomica being slightly decreased. About 2 minims of tincture of nux vomica and about 1-60th of a grain of phosphorus are represented in 1 fluidrachm of the finished elixir. It is used as a tonic and stimulant to the nerves.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Picis Compositum. N. F.

Compound Elixir of Tar

The formula for this elixir was greatly improved in the 3d ed. by dropping methyl alcohol and using ethyl alcohol in its place. Methyl alcohol should never be used in any pharmaceutical preparation. The elixir contains about 1-50th of a grain of morphine sulphate in 1 fluidrachm of finished elixir, with syrup of wild cherry, syrup of tolu, and wine of tar, alcohol and water. It is used as an expectorant and sedative.

Average dose: 4 Cc. (1 fluidrachm).

Elixir Pilocarpi. N. F.

Elixir of Pilocarpus

[Elixir of Jaborandi]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from

fluidextract of pilocarpus, syrup of coffee, tincture of vanilla and compound elixir of taraxacum, and represents about 3¾ grains of pilocarpus in 1 fluidrachm of the finished elixir. It is used as a diaphoretic.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Potassii Acetatis. N. F.

ELIXIR OF POTASSIUM ACETATE

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains about 5 grains of potassium acetate in 1 fluidrachm of finished elixir, and is used as a diuretic.
Average dose: 16 Cc. (4 fluidrachms).

Elixir Potassii Acetatis et Juniperi. N. F.

ELIXIR OF POTASSIUM ACETATE AND JUNIPER

This formula does not differ from that of the 2d ed. N. F., except the replacing of magnesium carbonate by purified talc. It is made from potassium acetate, fluidextract of juniper, purified talc and aromatic elixir, and 5 grains of potassium acetate and 7½ grains of juniper are represented in 1 fluidrachm of the finished elixir. It is used as a diaphoretic.
Average dose: 16 Cc. (4 fluidrachms).

Elixir Potassii Bromidi. N. F.

ELIXIR OF POTASSIUM BROMIDE

The formula for this elixir does not differ from that of the 2d ed. N. F., except that citric acid was dropped. It contains about 10 grains of potassium bromide in 1 fluidrachm of the finished elixir, and is used as a nervous sedative.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Quininæ et Phosphatum Compositum. N. F.

COMPOUND ELIXIR OF QUININE AND PHOSPHATES

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the word "soluble" is added to the words ferric phosphate used in the previous edition. It is made from quinine sulphate, soluble ferric phosphate, potassium citrate, syrup of calcium lactophosphate, water and aromatic elixir, and contains about ¼ grain of quinine sulphate, 1 grain of soluble ferric phosphate, and about ¾ of a grain of calcium lactophosphate in 1 fluidrachm of finished elixir. It is used as a tonic.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Quininæ Valerianatis et Strychninæ. N. F.

ELIXIR OF QUININE VALERIANATE AND STRYCHNINE

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from quinine valerate, strychnine sulphate, compound tincture of cudbear, and aromatic elixir, and contains 1 grain of quinine valerate and 1-100th of a grain of strychnine sulphate in 1 fluidrachm of finished elixir. It is used as a tonic and sedative in nervous affections.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Rhamni Purshianæ. N. F.

ELIXIR OF CASCARA SAGRADA. ELIXIR OF RHAMNUS PURSHIANA

The formula for this elixir was materially changed in the 3d ed. N. F. The quantity of fluidextract of cascara sagrada was doubled, the U. S. P. (8th Rev.) aromatic fluidextract of cascara sagrada is used, and aromatic elixir takes the place of compound elixir of taraxacum. About 30 grains of cascara sagrada are represented in 1 fluidrachm of the finished elixir. It is used as a laxative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Rhamni Purshianæ Compositum. N. F.

COMPOUND ELIXIR OF CASCARA SAGRADA

[Elixir Laxativum, Laxative Elixir]

The formula for this elixir was materially changed, the new U. S. P. (8th Rev.) aromatic fluidextract of cascara sagrada replacing the fluidextract of cascara sagrada used in the 2d ed. N. F., and aromatic elixir replacing compound elixir of taraxacum. It contains in addition the fluidextracts of senna and juglans, as in the 2d ed. It is used as a laxative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Rhei. N. F.

ELIXIR OF RHUBARB

The formula for this elixir does not differ from that of the 2d ed. N. F. Sweet tincture of rhubarb (U. S. P. 1890) is mixed with alcohol, water, glycerin and syrup. About 2¼ grains of rhubarb are represented in 1 fluidrachm of the finished elixir. It is used as a laxative.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Rhei et Magnesii Acetatis. N. F.

ELIXIR OF RHUBARB AND MAGNESIUM ACETATE

[Elixir of Rhei et Magnesiæ, Elixir of Rhubarb and Magnesia]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from calcined magnesia, acetic acid, fluidextract of rhubarb and aromatic elixir, and contains about 4 grains of magnesium acetate and 7½ grains of rhubarb in 1 fluidrachm of finished elixir. It is used as a laxative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Rubi Compositum. N. F.

COMPOUND ELIXIR OF BLACKBERRY

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains blackberry juice and blackberry root, galls, cinnamon, cloves, mace and ginger, with syrup, glycerin and diluted alcohol. It is used in the treatment of diarrhœa.
Average dose: 16 Cc. (4 fluidrachms).

Elixir Sodii Bromidi. N. F.

ELIXIR OF SODIUM BROMIDE.

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the citric acid was dropped. About 10 grains of sodium bromide are represented in 1 fluidrachm of finished elixir. It is used as a sedative for the nerves.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Sodii Hypophosphitis. N. F.

ELIXIR OF SODIUM HYPOPHOSPHITE

The formula for this elixir does not differ from that of the 2d ed. N. F., except that citric acid was replaced by hypophosphorous acid. Two grains of sodium hypophosphite are represented in I fluidrachm of the finished elixir. It is used as an alterative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Sodii Salicylatis. N. F.

ELIXIR OF SODIUM SALICYLATE

The formula for this elixir does not differ from that of the 2d ed. N. F. Five grains of sodium salicylate are represented in 1 fluidrachm of the finished elixir. It is used in the treatment of rheumatism.
Average dose: 4 Cc. (I fluidrachm .

Elixir Stillingiæ Compositum. N. F.

COMPOUND ELIXIR OF STILLINGIA

The formula for this elixir does not differ from that of the 2d ed. N. F. Fifteen minims of compound fluidextract of stillingia are represented in 1 fluidrachm of the finished elixir. It is used as an alterative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Strychninæ Valerianatis. N. F.

ELIXIR OF STRYCHNINE VALERIANATE

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from strychnine valerate, acetic acid, tincture of vanilla, compound tincture of cudbear and aromatic elixir, and contains 1–100th grain of strychnine valerate in 1 fluidrachm of the finished elixir. It is used as a nervine.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Taraxaci Compositum. N. F.

COMPOUND ELIXIR OF TARAXACUM

In the 3d ed. N. F. very little change was made in the formula for this elixir, the new tincture of sweet orange peel replacing the U. S. P. 1890 tincture, and the quantity of the tincture of cinnamon being increased (the strength of the new tincture is 20 per cent.). It is made from fluidextracts of taraxacum, wild cherry and glycyrrhiza, with the tinctures of sweet orange peel and cinnamon, compound tincture of cardamom and aromatic elixir, and is used mainly as a vehicle to cover the taste of bitter substances.
Average dose: 8 Cc. (2 fluidrachms).

Elixir Terpini Hydratis. N. F.

ELIXIR OF TERPIN HYDRATE

This is a new elixir introduced into the 3d ed. N. F. It contains terpin hydrate, tincture of sweet orange peel, solution of saccharin, alcohol, glycerin and syrup. The solution of saccharin might well have been omitted. About 1 grain of terpin hydrate is contained in 1 fluidrachm of the finished elixir. It is used as a stimulant and expectorant.
Average dose: 4 Cc. (I fluidrachm).

Elixir Terpini Hydratis cum Codeina. N. F.

ELIXIR OF TERPIN HYDRATE WITH CODEINE

This is a new elixir introduced into the 3d ed. N. F. It contains about 1 grain of terpin hydrate and ⅛ grain of codeine in 1 fluidrachm of the finished elixir. It is used as an expectorant and sedative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Terpini Hydratis cum Heroina. N. F.

ELIXIR OF TERPIN HYDRATE WITH HEROINE

This is a new elixir introduced into the 3d ed. N. F. It contains I grain of terpin hydrate and 1–24th of a grain of heroine in 1 fluidrachm of the finished elixir. It is used as an expectorant and sedative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Turneræ. N. F.

ELIXIR OF TURNERA

[Elixir of Damiana]

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the replacement of magnesium carbonate by purified talc. It is made from fluidextract of turnera, purified talc, alcohol, glycerin and aromatic elixir. About 9½ grains of turnera are represented in 1 fluidrachm of the finished elixir. It is used as an aphrodisiac.
Average dose: 4 Cc. (I fluidrachm).

Elixir Viburni Opuli Compositum. N. F.

COMPOUND ELIXIR OF VIBURNUM OPULUS

[Compound Elixir of Crampbark]

The formula for this elixir does not differ from that of the 2d ed. N. F. About 4¾ grains each of viburnum opulus and aletris and 9½ grains of trillium with compound elixir of taraxacum are represented in 1 fluidrachm of the finished elixir. It is used as an antispasmodic.
Average dose: 4 Cc. (1 fluidrachm.)

Elixir Viburni Prunifolii. N. F.

ELIXIR OF VIBURNUM PRUNIFOLIUM

[Elixir of Black Haw]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of viburnum prunifolium, compound tincture of cardamom, and aromatic elixir, and contains about 7½ grains of viburnum prunifolium in 1 fluidrachm of the finished elixir. It is used as an antispasmodic and sedative.
Average dose: 4 Cc. (1 fluidrachm).

Elixir Zinci Valerianatis. N. F.

ELIXIR OF ZINC VALERIANATE

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from zinc valerate, stronger solution of ammonium citrate, alcohol, spirit of bitter almond, compound tincture of cudbear, and aromatic elixir. About 1 grain of zinc valerate is represented in 1 fluidrachm of the finished elixir. It is used as a nervine.
Average dose: 4 Cc. (1 fluidrachm).

Emplastrum Aromaticum. N. F.

AROMATIC PLASTER

[Spice Plaster]

The formula for this plaster does not differ from that of the 2d ed. N. F., except that parts are substituted for grammes. It is made from cloves, ginger, cinnamon, capsicum, camphor, cotton seed oil and lead plaster. It is used as a counter-irritant and rubefacient.

Emplastrum Fuscum Camphoratum. N. F.

CAMPHORATED BROWN PLASTER

[Emplastrum Matris Camphoratum, Camphorated Mother Plaster]

The formula for this plaster has not been changed from that of the 2d ed. N. F., except that parts are substituted for grammes. It is made from red oxide of lead, olive oil, yellow wax and camphor. Used as a discutient.

Emplastrum Picis Liquidæ Compositum. N. F.

COMPOUND TAR PLASTER

The formula for this plaster was changed in the 3d ed. N. F. only by using parts for grammes. It is made from rosin, tar, powdered podophyllum, powdered phytolacca root and powdered sanguinaria, and is used as a rubefacient and counter-irritant.

Emulsum Olei Morrhuæ cum Calcii et Sodii Phosphatibus. N. F.

EMULSION OF COD-LIVER OIL WITH CALCIUM AND SODIUM PHOSPHATES

[Emulsion of Cod-Liver Oil with Phosphates of Lime and Soda]

The formula for this emulsion does not differ from that of the 2d ed. N. F. In the Latin title the word "Emulsio" has been changed to "Emulsum" in this class of preparations. It contains 50 per cent. of cod-liver oil, with calcium and sodium phosphates, syrup of tolu and flavoring. It is used as an alterative.
Average dose: 16 Cc. (4 fluidrachms).

Emulsum Olei Morrhuæ cum Calcii Lactophosphate. N. F.

EMULSION OF COD-LIVER OIL WITH CALCIUM LACTOPHOSPHATE

[Emulsion of Cod-Liver Oil with Lactophosphate of Lime]

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of cod-liver oil, with calcium lactate, phosphoric acid, syrup of tolu and flavoring. It is used as an alterative.
Average dose: 16 Cc. (4 fluidrachms).

Emulsum Olei Morrhuæ cum Calcii Phosphate. N. F.

EMULSION OF COD-LIVER OIL WITH CALCIUM PHOSPHATE

[Emulsion of Cod-Liver Oil with Phosphate of Lime]

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of cod-liver oil, with calcium phosphate, syrup of tolu and flavoring. Used as an alterative.
Average Dose: 16 Cc. (4 fluidrachms).

Emulsum Olei Morrhuæ cum Extracto Malti. N. F.

EMULSION OF COD-LIVER OIL WITH EXTRACT OF MALT

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of cod-liver oil with 37½ per cent. of extract of malt. It is used as a tonic and alterative.
Average dose: 16 Cc. (4 fluidrachms).

Emulsum Olei Morrhuæ cum Pruno Virginiana. N. F.

EMULSION OF COD-LIVER OIL WITH WILD CHERRY

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of cod-liver oil with fluidextract of wild cherry, syrup of tolu and flavoring. It is used as an an alterative.
Average dose: 16 Cc. (4 fluidrachms).

Emulsum Olei Ricini. N. F.

EMULSION OF CASTOR OIL

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 33 per cent. of castor oil, with tincture of vanilla, syrup and water. It is used as a cathartic.
Average dose: 48 Cc. (1½ fluidounces).

Emulsum Olei Terebinthinæ Fortior. N. F.

STRONGER EMULSION OF OIL OF TURPENTINE

[Forbes's Emulsion of Oil of Turpentine]

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of oil of turpentine, with acacia and water. It is used as an anthelmintic and diuretic.
Average dose: 2 Cc. (½ fluidrachm).

Emulsum Petrolei. N. F.

EMULSION OF PETROLEUM

This new emulsion of the 3d ed. N. F. should have been called Emulsion of Petrolatum, instead of Emulsion of Petroleum. It

contains about 5 per cent. of white petrolatum, about 25 per cent. of expressed oil of almond, with acacia, tragacanth and syrup, tincture of lemon peel and water.
Average dose: 16 Cc. (4 fluidrachms).

Emulsum Phosphaticum. N. F.

PHOSPHATIC EMULSION

[Mistura Phosphatica]

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 25 per cent. of cod liver oil, 5 per cent. of diluted phosphoric acid, with glycerite of yolk of egg, Jamaica rum, oil of bitter almond and orange flower water. Used as an alterative.
Average dose: 16 Cc. (4 fluidrachms).

Essentia Pepsini. N. F.

ESSENCE OF PEPSIN

This is a new preparation of the 3d ed. N. F. It contains pepsin, rennin (an enzyme from calves' rennets), lactic acid, tincture of sweet orange peel, glycerin, alcohol, syrup, white wine and water. It is used as an aid to digestion.
Average dose: 8 Cc. (2 fluidrachms).

Extractum Ferri Pomatum. N. F.

FERRATED EXTRACT OF APPLES

[Ferri Malas Crudas, Crude Malate of Iron]

This formula does not differ from that of the 2d ed. N. F. It is made from iron wire, ripe sour apples and water, and is used as a chalybeate.
Average dose: 0.65 Gm. (10 grains).

Extractum Glycyrrhizæ Depuratum. N. F.

PURIFIED EXTRACT OF GLYCYRRHIZA

PURIFIED EXTRACT OF LICORICE

The formula for this preparation does not differ from that of the 2d ed. N. F. This is a pilular extract made by the old German method and not to be confounded with the Extractum Glycyrrhizæ Purum, U. S. P. 8th Rev. Used as a flavoring and sweetening agent.
Average dose: 1 Gm. (15 grains).

Ferri Hypophosphis. N. F.

HYPOPHOSPHITE OF IRON

[Ferric Hypophosphite]

Ferric hypophosphite is now official in the U. S. P. 8th Rev., without a formula for its preparation. The process in the 3d ed. N. F. is the same as that found in the 2d ed. N. F. It is made from ferric ammonium sulphate, sodium hypophosphite and distilled water. It is used as an alterative and chalybeate.
Average dose: 0.2 Gm. (3 grains).

Fluidextractum Adonidis. N. F.

FLUIDEXTRACT OF ADONIS

From the root of *Adonis vernalis* Linné (Bird's Eye).
Made with alcohol; 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a heart stimulant.
Average dose: 0.13 Cc. (2 minims).

Fluidextractum Aletridis. N. F.

FLUIDEXTRACT OF ALETRIS

From the rhizome of *Aletris farinosa* Linné (Stargrass).
Made with diluted alcohol; 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as an alterative.
Average dose: 2 Cc. (30 minims).

Fluidextractum Angelicæ Radicis. N. F.

FLUIDEXTRACT OF ANGELICA ROOT

From the root of *Angelica Archangelica* Linné (Angelica).
Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as a stimulant and carminative.
Average dose: 2 Cc. (30 minims).

Fluidextractum Apii Graveolentis. N. F.

FLUIDEXTRACT OF CELERY

From the seed of *Apium graveolens* Linné (Celery).
Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as a diuretic and nervine.
Average dose: 2 Cc. (30 minims).

Fluidextractum Araliæ Racemosæ. N. F.

FLUIDEXTRACT OF ARALIA RACEMOSA

From the root of *Aralia racemosa* Linné (American Spikenard).
Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as an alterative.
Average dose: 2 Cc. (30 minims).

Fluidextractum Arnicæ Florum. N. F.

FLUIDEXTRACT OF ARNICA FLOWERS

From the flower heads of *Arnica montana* Linné (Arnica).
Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a stimulant and alterative.
Average dose: 1 Cc. (15 minims).

Fluidextractum Boldi. N. F.

FLUIDEXTRACT OF BOLDO

From the leaves of *Peumus Boldus* Molina (Boldo).
Made with alcohol 2 measures, water 1 measure; 1 Cc. represents 1 Gm. of the drug. It is used as an alterative and tonic.
Average dose: 0.5 Cc. (8 minims).

Fluidextractum Buchu Compositum. N. F.

COMPOUND FLUIDEXTRACT OF BUCHU

Made with alcohol 2 measures, water 1 measure. It contains buchu, cubeb, juniper and uva ursi. It is used as a diuretic.
Average dose: 2 Cc. (30 minims).

Fluidextractum Calendulæ. N. F.

FLUIDEXTRACT OF CALENDULA

From the flowering herb of *Calendula officinalis* Linné (Marigold).
Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as a stimulant and tonic.
Average dose: 1 Cc. (15 minims).

Fluidextractum Camelliæ. N. F.

FLUIDEXTRACT OF CAMELLIA

From the commercial dried leaves of *Camellia Thea* Link (Tea).
Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a nerve stimulant.
Average dose: 2 Cc. (30 minims).

Fluidextractum Caulophylli. N. F.

FLUIDEXTRACT OF CAULOPHYLLUM

From the rhizome and rootlets of *Caulophyllum thalictroides* Michaux (Blue Cohosh).
Made with alcohol 3 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an emmenagogue.
Average dose: 0.5 Cc. (8 minims).

Fluidextractum Coffeæ Tostæ. N. F.

FLUIDEXTRACT OF ROASTED COFFEE

From the commercial roasted seeds of *Coffea arabica* Linné (Coffee).
Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a nerve stimulant.
Average dose: 2 Cc. (30 minims).

Fluidextractum Coffeæ Viridis. N. F.

FLUIDEXTRACT OF GREEN COFFEE

From the commercial, unroasted seeds of *Coffea arabica* Linné (Coffee).
Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a nerve stimulant.
Average dose: 2 Cc. (30 minims).

Fluidextractum Convallariæ. N. F.

FLUIDEXTRACT OF CONVALLARIA FLOWERS

From the flowers of *Convallaria majalis* Linné (Lily of the Valley).
The word "Florum" has been dropped from the Latin title of this fluidextract. Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a cardiac stimulant and diuretic.
Average dose: 0.5 Cc. (8 minims).

Fluidextractum Coptis. N. F.

FLUIDEXTRACT OF COPTIS

From the rhizome and rootlets of *Coptis trifolia* Salisbury (Goldthread).
Made with diluted alcohol; 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a tonic and stimulant.
Average dose: 2 Cc. (30 minims).

Fluidextractum Cornus. N. F.

FLUIDEXTRACT OF CORNUS

From the bark of the root of *Cornus Florida* Linné (Dogwood).
Made with glycerin 150 Cc., diluted alcohol 850 Cc., finishing with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a tonic.
Average dose: 2 Cc. (30 minims).

Fluidextractum Cornus Circinatæ. N. F.

FLUIDEXTRACT OF CORNUS CIRCINATA

From the bark of *Cornus circinata* L'Héritier (Green Osier).
Made with diluted alcohol; 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as a tonic and antiperiodic.
Average dose: 1 Cc. (15 minims).

Fluidextractum Corydalis. N. F.

FLUIDEXTRACT OF CORYDALIS

From the tubers of *Dicentra canadensis* De Candolle (Turkey Corn),
Made with alcohol 3 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an alterative and diuretic.
Average dose: 0.65 Cc. (10 minims).

Fluidextractum Coto. N. F.

FLUIDEXTRACT OF COTO

From Coto bark, derived from an undetermined tree, native of tropical South America.
Made with alcohol 9 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an astringent and tonic.
Average dose: 0.3 Cc. (5 minims).

Fluidextractum Fuci. N. F.

FLUIDEXTRACT OF FUCUS

From the thallus of *Fucus vesiculosus* Linné (Bladder-wrack).
Made with alcohol 3 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a remedy for obesity.
Average dose: 0.65 Cc. (10 minims.)

Fluidextractum Helianthemi. N. F.

FLUIDEXTRACT OF HELIANTHEMUM

From the herb of *Helianthemum canadense* Michaux (Frost-wort).

Made with diluted alcohol; 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as an alterative and astringent.
Average dose: 4 Cc. (1 fluidrachm).

Fluidextractum Humuli. N. F.

Fluidextract of Hops

From the strobiles of *Humulus Lupulus* Linné (Hops).
Made with alcohol 5 measures, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a stimulant and sedative.
Average dose: 2 Cc. (30 minims).

Fluidextractum Hydrangeæ. N. F.

Fluidextract of Hydrangea

From the root of *Hydrangea arborescens* Linné (Seven Barks).
Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic.
Average dose: 2 Cc. (30 minims).

Fluidextractum Jalapæ. N. F.

Fluidextract of Jalap

From the tuberous root of *Exogonium Purga* Bentham (Jalap).
Made with alcohol; 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as a cathartic.
Average dose: 1 Cc. (15 minims).

Fluidextractum Juglandis. N. F.

Fluidextract of Juglans

From the inner bark of the root of *Juglans cinerea* Linné (Butternut).
Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a cathartic.
Average dose: 4 Cc. (1 fluidrachm).

Fluidextractum Juniperi. N. F.

Fluidextract of Juniper

From the fruit of *Juniperus communis* Linné (Juniper).
Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic.
Average dose: 4 Cc. (1 fluidrachm).

Fluidextractum Kavæ. N. F.

Fluidextract of Kava

From the root of *Piper methysticum* Forster (Kava; Kava-kava; Ava).
Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic and alterative.
Average dose: 1 Cc. (15 minims).

Fluidextractum Malti. N. F.

Fluidextract of Malt

This formula does not differ from that of the 2d ed. N. F. It is used as a tonic.
Average dose: 8 Cc. (2 fluidrachms).

Fluidextractum Menyanthis. N. F.

Fluidextract of Menyanthes

From the leaves of *Menyanthes trifoliata* Linné (Buckbean.—Trifolium fibrinum *G. P.*)
Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an alterative.
Average dose: 1 Cc. (15 minims).

Fluidextractum Petroselini Radicis. N. F.

Fluidextract of Parsley Root

From the root of *Petroselinum sativum* Hoffmann (Parsley).
Made with diluted alcohol; 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as an emmenagogue and diuretic.
Average dose: 2 Cc. (30 minims).

Fluidextractum Rhamni Purshianæ Alkalinum. N. F.

Bitterless Fluidextract of Cascara Sagrada

This is a new fluidextract in the 3d ed. N. F. It is made from cascara sagrada deprived of its bitterness by treatment with lime; the preparation contains sugar, oil of coriander and oil of anise. It differs from all other fluidextracts in containing no alcohol, and is really a syrup. It is used as a laxative.
Average dose: 1 Cc. (15 minims).

Fluidextractum Sterculiæ. N. F.

Fluidextract of Sterculia

From the seeds of *Sterculia acuminata* R. Brown (Cola; Kola).
Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures. One Cc. of fluidextract represents 1 Gm. of drug. It is used as a stimulant and nerve tonic.
Average dose: 1 Cc. (15 minims).

Fluidextractum Stillingiæ Compositum. N. F.

Compound Fluidextract of Stillingia

The formula for this fluidextract has been slightly changed in the 3d ed. N. F., the quantity of coriander being decreased, and that of xanthoxylum berries increased. Made with alcohol 500 Cc., water 250 Cc., glycerin 250 Cc., finishing with diluted alcohol. It contains stillingia, corydalis, iris, sambucus, chimaphila, coriander and xanthoxylum berries. It is used as an alterative.
Average dose: 2 Cc. (30 minims).

Fluidextractum Trillii. N. F.

Fluidextract of Trillium

From the rhizome of *Trillium erectum* Linné, and other species of *Trillium* (Bethroot).
Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an astringent and tonic expectorant.
Average dose: 2 Cc. (30 minims).

Fluidextractum Turneræ. N. F.

FLUIDEXTRACT OF TURNERA

From the leaves of *Turnera microphylla* De Candolle, and other species of *Turnera* (Damiana).

Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an aphrodisiac.

Average dose: 2 Cc. (30 minims).

Fluidextractum Urticæ. N. F.

FLUIDEXTRACT OF URTICA

From the root of *Urtica dioica* Linné (Nettle).

Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic and astringent.

Average dose: 1 Cc. (15 minims).

Fluidextractum Verbasci. N. F.

FLUIDEXTRACT OF VERBASCUM

From the leaves and flowers of *Verbascum Thapsus* Linné (Mullein).

Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an expectorant.

Average dose: 4 Cc. (1 fluidrachm).

Fluidextractum Verbenæ. N. F.

FLUIDEXTRACT OF VERBENA

From the root of *Verbena hastata* Linné (Vervain).

Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a tonic.

Average dose: 1 Cc. (15 minims).

Fluidextractum Zeæ. N. F.

FLUIDEXTRACT OF ZEA

[Extractum Stigmatum Maydis Fluidum, Fluidextract of Corn Silk]

From the stigmata of *Zea Mays* Linné (Indian Corn).

Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

Gelatinum Chondri. N. F.

IRISH MOSS GELATIN

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from Irish moss and water, and is used to make a transparent mucilage, and as a substitute for acacia in making emulsions.

Glyceritum Bismuthi. N. F.

GLYCERITE OF BISMUTH

The formula for this preparation was entirely changed in the 3d ed. N. F. The glycerite is made from bismuth subnitrate, nitric acid, tartaric acid, sodium bicarbonate, glycerin and distilled water. It contains 16 grains of bismuth and sodium tartrate in 1 fluidrachm of the finished glycerite, and is used in making other N. F. preparations containing bismuth and in the treatment of diarrhœa and gastric diseases.

Average dose: 0.6 Cc. (10 minims).

Glyceritum Guaiaci. N. F.

GLYCERITE OF GUAIAC

The formula for this glycerite does not differ from that of the 2d ed. N. F. It contains 5 grains of guaiac and about 4 minims of solution of potassium hydroxide in 1 fluidrachm of the finished glycerite. It is used as an alterative.

Average dose: 2 Cc. (30 minims).

Glyceritum Pepsini. N. F.

GLYCERITE OF PEPSIN

The formula for this glycerite does not differ from that of the 2d ed. N. F. Five grains of pepsin are represented by 1 fluidrachm of the finished glycerite. It is used as a digestive.

Average dose: 3 Cc. (45 minims).

Glyceritum Picis Liquidæ. N. F.

GLYCERITE OF TAR

The quantity of tar in this glycerite was very slightly reduced in the 3d ed. N. F. It is made from tar, magnesium carbonate, glycerin, alcohol and water. The medicinal virtues of about 4 grains of tar are represented in 1 fluidrachm of the finished glycerite. It is used as an expectorant.

Average dose: 4 Cc. (1 fluidrachm).

Glyceritum Tragacanthæ. N. F.

GLYCERITE OF TRAGACANTH

The formula for this glycerite does not differ from that of the 2d ed. N. F. It is used as an excipient for pills.

Glycerogelatina. N. F.

GLYCEROGELATINS

Glycerogelatins originated with Dr. Unna and are soft masses which melt at the temperature of the body, containing gelatin, glycerin, water and the medicament. They are used in skin diseases. The following were adopted by the 3d ed. N. F.

1. *Glycerogelatinum Acidi Salicylici (10 per cent.).* N. F.—10 per cent. *Salicylic Acid Glycerogelatin.*
2. *Glycerogelatinum Iodoformi (10 per cent.).* N. F.—10 per cent. *Iodoform Glycerogelatin.*
3. *Glycerogelatinum Zinci Durum.* N. F. *Firm Zinc Glycerogelatin.*
4. *Glycerogelatinum Zinci Molle.* N. F.—*Soft Zinc Glycerogelatin.*

Gossypium Stypticum. N. F.

STYPTIC COTTON

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made by impregnating purified cotton with diluted solution of ferric chloride, glycerin and water Used as an antihemorrhagic.

Infusum Gentianæ Compositum Fortius. N. F.

Stronger Compound Infusion of Gentian

The formula for this infusion does not differ from that of the 2d ed. N. F., except a slight increase in the proportions of coriander and bitter orange peel. It is used as a tonic, and in making by dilution, compound infusion of gentian.

Average dose: 4 Cc. (1 fluidrachm).

Infusum Rosæ Compositum. N. F.

Compound Infusion of Rose

The formula for this infusion does not differ from that of the 2d ed. N. F. It is made from red rose, diluted sulphuric acid, sugar and water. It is used as an astringent.

Iodoformum Aromatisatum. N. F.

Aromatized Iodoform

[Deodorized Iodoform]

The formula for this preparation does not differ from that of the 2d ed. N. F. It consists of iodoform containing 4 per cent. of cumarin, and is used as an antiseptic and alterative.

Lac Fermentatum. N. F.

Fermented Milk

[Kumyss]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from fresh cow's milk, yeast and sugar, and is used as a food for invalids.

Lac Humanisatum. N. F.

Humanized Milk

This is a new preparation in the 3d ed. N. F. It is made by adding humanizing milk powder to cow's milk, cream and water. Humanizing milk powder contains pancreatin. The milk is used as a food for invalids.

Linimentum Aconiti et Chloroformi. N. F.

Liniment of Aconite and Chloroform

In the 3d ed. N. F. a smaller proportion of fluidextract of aconite replaces the tincture of aconite of the 2d ed., and alcohol was added to the formula. The quantities of chloroform and soap liniment remain unchanged. It is used externally to relieve pain.

Linimentum Ammonii Iodidi. N. F.

Liniment of Ammonium Iodide

The formula for this liniment does not differ from that of the 2d ed. N. F., except in a slight increase in the proportion of camphor. The liniment is made from iodine, oil of rosemary, oil of lavender, camphor, ammonia water and alcohol. It is used as an external discutient application.

Linimentum Iodi. N. F.

Iodine Liniment

This liniment is nearly identical with that of the British Pharmacopœia. It contains 12½ per cent. of iodine, 5 per cent. of potassium iodide, with glycerin, water and alcohol. It is used as an external discutient application.

Linimentum Opii Compositum. N. F.

Compound Liniment of Opium

[Canada Liniment]

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains 10 per cent. of tincture of opium, with camphor, alcohol, oil of peppermint, ammonia water and oil of turpentine. It is used as a stimulating anodyne application.

Linimentum Saponato-Camphoratum. N. F.

Camphorated Soap Liniment

[Opodeldoc, Solid Opodeldoc]

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains white castile soap, camphor, alcohol, oils of thyme and rosemary and ammonia water. It is a solid preparation used in rheumatism.

Linimentum Terebinthinæ Aceticum. N. F.

Acetic Turpentine Liniment

[Linimentum Album, Stokes' Liniment, St. John Long's Liniment]

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains turpentine, fresh egg, oil of lemon, acetic acid and rose water. It is used as a stimulating external application.

Linimentum Tiglii. N. F.

Liniment of Croton Oil

[Linimentum Crotonis, B. P.]

The proportions in the formula for this liniment have been slightly changed. It now contains 16 parts of croton oil, and 54 parts each of alcohol and oil of cajuput. It is used as a counter-irritant.

Linimentum Tiglii Compositum. N. F.

Compound Croton Oil Liniment

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains 20 per cent. each of croton oil, oil of sassafras, oil of turpentine, with 40 per cent. of olive oil. It is used as a counter-irritant.

Liquor Alumini Acetatis. N. F.

Solution of Aluminum Acetate

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from aluminum sulphate, acetic acid, calcium carbonate and water, and contains from 7.5 to 8 per cent. of basic aluminum acetate. It is used externally as an astringent.

Liquor Alumini Acetico-Tartratis. N. F.

Solution of Aluminum Acetico-Tartrate

The formula for this solution does not differ from that of the 2d ed. N. F.; the solution contains about 50 per cent. of dry so-called aluminum acetico-tartrate. It is made from alum, sodium carbonate, tartaric acid, glacial acetic acid and water, and is used externally as an astringent.

Liquor Ammonii Acetatis Concentratus. N. F.

Concentrated Solution of Ammonium Acetate

The formula for this preparation does not differ from that of the 2d ed. N. F. This solution is about three times stronger than the official solution of ammonium acetate. It is intended to be diluted with carbonic acid water at the time of dispensing.

Liquor Ammonii Citratis Fortior. N. F.

Stronger Solution of Ammonium Citrate

The formula for this solution does not differ from that of the 2d ed. N. F. About 40 grains of ammonium citrate are contained in 1 fluidrachm of the solution. It is intended to be diluted before administration. The Liquor Ammonii Citratis of the British Pharmacopœia may be made by mixing 1 volume of this solution with 4 volumes of water. It is used as a refrigerant and diuretic.

Liquor Antigerminarus. N. F.

"Germicide"

This solution is a new one in the 3d ed. N. F. It contains thymol, oils of eucalyptus and lavender, with alcohol and water. It is used as a germicide.

Liquor Antisepticus Alkalinus. N. F.

"Alkaline Antiseptic"

This is a new solution in the 3d ed. N. F. It is made from potassium bicarbonate, sodium benzoate, sodium borate, thymol, eucalyptol, oils of peppermint and gaultheria, tincture of cudbear, alcohol, glycerin, purified talc and water. It is used as an alkaline detergent and antiseptic.

Liquor Auri et Arseni Bromidi. N. F.

Solution of Bromide of Gold and Arsenic

The formula for this solution does not differ from that of the 2d ed. N. F. About 1-32d of a grain of tribromide of gold and 1-13th of a grain of tribromide of arsenic are contained in 10 minims of this solution. It is used as an alterative.

Average dose: 0.2 Cc. (3 minims).

Liquor Bismuthi. N. F.

Solution of Bismuth

[Liquid Bismuth]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from glycerite of bismuth, alcohol and distilled water. About 1 grain of bismuth and ammonium citrate is represented in 1 fluidrachm of the finished solution. It is used as a sedative in gastric diseases.

Average dose: 4 Cc. (1 fluidrachm).

Liquor Bromi. N. F.

Solution of Bromine

[Smith's Solution of Bromine]

The formula for this solution does not differ from that of the 2d ed. N. F. One hundred Cc. of finished solution contains 25 grains of bromine and 12.5 grains of potassium bromide. It is used as an external application to hospital gangrene and as an antiseptic.

Liquor Calcis Sulphuratæ. N. F.

Solution of Sulphurated Lime

[Solution of Oxysulphuret of Calcium; Vleminck's Solution, or Lotion]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from lime, sublimed sulphur and water. It is used as an external application in skin diseases.

Liquor Carmini. N. F.

Solution of Carmine

The formula for this solution does not differ greatly from that of the 2d ed. N. F. The solution is made from carmine, ammonia water, glycerin and water. It is used as a red coloring solution.

Liquor Coccineus. N. F.

Cochineal Color

This solution does not differ very greatly from that of the 2d ed. N. F. It is made from cochineal, potassium carbonate, alum, potassium bitartrate, alcohol, glycerin, and water. Like the preceding solution it is used as a red coloring solution.

Liquor Electropoeicus. N. F.

Battery Fluid

The formula for battery fluid does not differ from that of the 2d ed. N. F. As indicated by the name, it is used solely in batteries.

Liquor Extracti Glycyrrhizæ. N. F.

Solution of Extract of Glycyrrhiza

[Solution of Extract of Licorice]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from purified extract of glycyrrhiza, alcohol, glycerin and water. About 15 grains of dried extract of glycyrrhiza are represented in 1 fluidrachm of finished solution. It is used as a flavoring and sweetening agent.
Average dose: 4 Cc. (1 fluidrachm).

Liquor Ferri Albuminati. N. F.

Solution of Albuminate of Iron

This is a new preparation in the 3d ed. N. F. It is made from fresh egg-albumen, solution of ferric oxychloride, alcohol, aromatic elixir, solution of sodium hydroxide and water. About 2-5th of a grain of metallic iron in the form of albuminate is contained in 1 fluidrachm of the finished solution. It is used as a chalybeate.
Average dose: 8 Cc. (2 fluidrachms).

Liquor Ferri Hypophosphitis. N. F.

Solution of Hypophosphite of Iron

[Solution of Ferric Hypophosphite]

The formula for this solution does not differ from that of the 2 ed. N. F. It is made from ferric ammonium sulphate, sodium hypophosphite, potassium citrate, glycerin and water. About 10 grains of ferric hypophosphite are represented in 1 fluidrachm of finished solution.
Average dose: 1 Cc. (15 minims).

Liquor Ferri Iodidi. N. F.

Solution of Ferrous Iodide

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from iron wire, iodine, diluted hypophosphorous acid and distilled water. It contains about 81 per cent. of ferrous iodide. This solution was introduced for making syrup of ferrous iodide by mixing 1 volume with 11 volumes of syrup.
Average dose: 0.15 Cc. (2 minims).

Liquor Ferri Oxychloridi. N. F.

Solution of Ferric Oxychloride

This is a new solution taken from the German Pharmacopoeia, and intended to be dispensed when *Liquor Ferri Dialysati* is called for. It is made from solution of ferric chloride, ammonia water, hydrochloric acid and water. It contains about 3.5 per cent. of iron as oxychloride, and is used as a chalybeate.

Liquor Ferri Oxysulphatis. N. F.

Solution of Oxysulphate of Iron

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from ferrous sulphate, nitric acid and distilled water. It is used as a chalybeate.

Liquor Ferri Peptonati. N. F.

Solution of Peptonate of Iron

This is a new preparation of the 3d ed. N. F. It is made from peptone, solution of ferric oxychloride, alcohol, aromatic elixir, solution of sodium hydroxide and distilled water. It contains about 2-5th of a grain of metallic iron in the form of peptonate in 1 fluidrachm of the finished solution. It is used as a chalybeate.
Average dose: 8 Cc. (2 fluidrachms).

Liquor Ferri Peptonati cum Mangano. N. F.

Solution of Peptonate of Iron with Manganese

This is a new solution of the 3d ed. N. F. It is made from ferric peptonate (see Liquor Ferri Peptonati), soluble manganese citrate, ammonia water, aromatic elixir, alcohol and distilled water. It is used as a chalybeate and alterative.
Average dose: 8 Cc. (2 fluidrachms).

Liquor Ferri Protochloridi. N. F.

Solution of Protochloride of Iron

[Solution of Ferrous Chloride]

This formula does not differ from that of the 2d ed. N. F. It is made from iron wire, hydrochloric acid, glycerin, diluted hypophosphorous acid and distilled water. About 20 grains of ferrous chloride are represented by 1 fluidrachm of finished solution. It is used as a chalybeate tonic.
Average dose: 0.65 Cc. (10 minims).

Liquor Hydrargyri et Potassii Iodidi. N. F.

Solution of Iodide of Mercury and Potassium

[Solution of Potassium Iodohydrargyrate, Channing's Solution]

The formula for this solution does not differ from that of the 2d ed. N. F. It represents about 1 per cent. of red iodide of mercury and 0.8 per cent. of potassium iodide in aqueous solution. It is used as an alterative in the treatment of syphilis.
Average dose: 0.2 Cc. (3 minims).

Liquor Hypophosphitum. N. F.

Solution of Hypophosphites

The formula for this solution does not differ from that of the 2d ed. N. F., except that hypophosphorous acid replaces citric acid. About 2 grains of calcium hypophosphite, 1¼ grains of sodium hypophosphite and 1 grain of potassium hypophosphite are contained in 1 fluidrachm of finished solution. It is used as an alterative and tonic.
Average dose: 4 Cc. (1 fluidrachm).

Liquor Hypophosphitum Compositus. N. F.

Compound Solution of Hypophosphites

This is a new solution in the 3d ed. N. F. It is made from calcium, potassium, sodium,

ferric, manganese and quinine hypophosphites, strychnine, potassium citrate, hypophosphorous acid, orange flower water, glycerin and distilled water. It is used as an alterative and tonic.
Average dose: 4 Cc. (1 fluidrachm).

Liquor Iodi Carbolatus. N. F.

CARBOLIZED SOLUTION OF IODINE

[Boulton's Solution, French Mixture]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from compound solution of iodine, phenol, glycerin and water. It is used externally.

Liquor Iodi Causticus. N. F.

CAUSTIC SOLUTION OF IODINE

[Iodine Caustic, Churchill's Iodine Caustic]

The formula for this solution does not differ from that of the 2d ed. N. F. It contains iodine, potassium iodide and water. It is used externally as a caustic and counter-irritant.

Liquor Magnesii Bromidi. N. F.

SOLUTION OF MAGNESIUM BROMIDE

The proportions of the ingredients in this solution do not differ from those in the 2d ed. N. F. The solution is made from magnesium carbonate and diluted hydrobromic acid. About 7½ grains of magnesium bromide are contained in 1 fluidrachm of finished solution. Used as a nervine.
Average dose: 4 Cc. (1 fluidrachm).

Liquor Magnesii Sulphatis Effervescens. N. F.

LIQUOR MAGNESIÆ EFFERVESCENS

[Effervescent Solution of Magnesium Sulphate]

The formula for this solution does not differ from that of the 2d ed. N. F. About 360 grains of magnesium sulphate are contained in 12 fluidounces of the finished solution. It is used as a cathartic, like solution of magnesium citrate.
Average dose: The contents of a bottle (about 12 fl. oz.).

Liquor Morphinæ Citratis. N. F.

SOLUTION OF MORPHINE CITRATE

The quantities of morphine and citric acid were very slightly increased in this solution in the 3d ed. N. F. It is made from morphine, citric acid, cochineal, alcohol and distilled water. About 2 grains of morphine in the form of citrate are contained in 1 fluidrachm of finished solution. It is used as a sedative.
Dose: 0.32 Cc. (5 minims).

Liquor Morphinæ Hypodermicus. N. F.

HYPODERMIC SOLUTION OF MORPHINE

[Magendie's Solution of Morphine]

This solution of morphine should not be confounded with the U. S. Pharm. (1870) solution of morphine, as it is 16 times as strong. Salicylic acid in small quantity is added in the 3d ed. N. F., to promote solubility. Two grains of morphine sulphate are contained in 1 fluidrachm of the finished solution. Used hypodermically as an anodyne.
Average dose: 0.32 Cc. (5 minims).

Liquor Pancreaticus. N. F.

PANCREATIC SOLUTION

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from pancreatin, sodium bicarbonate, glycerin, compound spirit of cardamom, alcohol, purified talc, and water. About 1 grain of pancreatin is represented in 1 fluidrachm of the finished solution. It is used as a digestive
Average dose: 4 Cc. (1 fluidrachm).

Liquor Pepsini. N. F.

LIQUID PEPSIN

The formula for this solution has been changed in the 3d ed. N. F. It is now made from glycerite of pepsin, hydrochloric acid, glycerin and water. It is used as a digestive.
Average dose: 8 Cc. (2 fluidrachms).

Liquor Pepsini Aromaticus. N. F.

AROMATIC SOLUTION OF PEPSIN

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from pepsin, oils of cinnamon, pimenta and cloves, and alcohol, hydrochloric acid, glycerin and water. About 1 grain of pepsin is represented in 1 fluidrachm of finished solution. It is used as a digestive.
Average dose: 8 Cc. (2 fluidrachms).

Liquor Phosphatum Acidus. N. F.

ACID SOLUTION OF PHOSPHATES

[Solution of Acid Phosphates]

The title of this preparation in the 2d ed. N. F. was Liquor Acidi Phosphorici Compositus. No change was made in the formula in the 3d ed. It is a solution of acid phosphates made by adding sulphuric acid and water to bone ash, expressing and filtering. It is used as a tonic.
Average dose: 8 Cc. (2 fluidrachms).

Liquor Phosphori. N. F.

SOLUTION OF PHOSPHORUS

[Thompson's Solution of Phosphorus]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from phosphorus, absolute alcohol, spirit of peppermint and glycerin. About 1-24th of a grain of phosphorus is contained in 1 fluidrachm of finished solution. It is used as a tonic and stimulant in nervous diseases.
Average dose: 0.65 Cc. (10 minims).

Liquor Picis Alkalinus. N. F.

ALKALINE SOLUTION OF TAR

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about 25 per cent. of tar and 12.5 per cent. of potassium hydroxide in water. It is used in skin diseases as an external application.

Liquor Potassæ Chlorinatæ. N. F.

SOLUTION OF CHLORINATED POTASSA

[Liquor Potassæ Chloratæ, Javelle Water]

In the Latin title in the 3d ed. N. F. the word "Chloratæ" was changed to "Chlorinatæ." The formula for this solution does not differ from that of the 2d ed. N. F. It is made from potassium carbonate, chlorinated lime and water. It is used as a disinfectant.

Liquor Potassii Arsenatis et Bromidi. N. F.

SOLUTION OF POTASSIUM ARSENATE AND BROMIDE

[Liquor Arseni Bromidi, Solution of Bromide of Arsenic, Clemens' Solution]

The formula for this solution differs from that of the 2d ed. N. F., the quantity of potassium bicarbonate being increased four-fold. It contains the equivalent of 1 per cent. of arsenic trioxide in the form of potassium arsenate and bromide, in the finished solution. It is used as an alterative and in the treatment of diabetes.

Average dose: 0.2 Cc. (3 minims).

Liquor Saccharini. N. F.

SOLUTION OF SACCHARIN

The formula for this solution does not differ from that of the 2d ed. N. F., except that the quantity of sodium bicarbonate is slightly increased in the 3d ed. It is used as a sweetening solution.

Liquor Seriparus. N. F.

LIQUID RENNET

The formula for this solution does not differ from that of the 2d ed. N. F., except a slight variation in the proportion of alcohol and water. It is used to coagulate milk.

Liquor Sodii Arsenatis, Pearson. N. F.

PEARSON'S SOLUTION OF SODIUM ARSENATE

The formula for this solution does not differ from that of the 2d ed. N. F. This preparation should not be confounded with the Liquor Sodii Arsenatis, U. S. P., which is ten times stronger than Pearson's Solution. It contains about 1-6th per cent. of crystallized sodium arsenate or about 1-10th per cent. of anhydrous sodium arsenate. Whenever it is prescribed or dispensed, the name "Pearson" should be specified, to avoid serious mistakes. It is used as an alterative.

Average dose: 0.2 Cc. (3 minims).

Liquor Sodii Boratis Compositus. N. F.

COMPOUND SOLUTION OF SODIUM BORATE

[Dobell's Solution]

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about 1.5 per cent. each of sodium borate and sodium bicarbonate and 0.3 per cent. of phenol, with glycerin and water. It is an alkaline antiseptic solution, to be used externally.

Liquor Sodii Carbolatis. N. F.

SOLUTION OF SODIUM CARBOLATE

The formula for this solution does not differ from that of the 2d ed. N. F. It contains 50 per cent. of phenol in combination with 3.5 per cent. of sodium hydroxide and water. It is used externally as an antiseptic. It is not to be confounded with the proprietary preparation known as "phénol sodique."

Liquor Sodii Citratis. N. F.

SOLUTION OF SODIUM CITRATE

[Mistura Sodii Citratis, Saturatio, Potio Riveri, G. P.]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made with 2 per cent. of citric acid and 2.5 per cent. of sodium bicarbonate in water. Used in febrile diseases.

Average dose: 8 Cc. (2 fluidrachms).

Liquor Sodii Citro-Tartratis Effervescens. N. F.

EFFERVESCENT SOLUTION OF SODIUM CITRO-TARTRATE

[Tartro-Citric Lemonade]

The formula for this solution does not differ from that of the 2d ed. N. F., except that the proportion of water is slightly increased. It is made from sodium bicarbonate, tartaric acid, citric acid, syrup of citric acid and water. Used as a laxative.

Average dose: The contents of a bottle (containing about 12 fl. oz.).

Liquor Sodii Oleatis. N. F.

SOLUTION OF SODIUM OLEATE

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about 6.25 per cent. of white castile soap dissolved in water. It is used in the preparation of oleates.

Liquor Strychninæ Acetatis. N. F.

SOLUTION OF STRYCHNINE ACETATE

[Hall's Solution of Strychnine]

The formula for this solution does not differ from that of the 2d ed. N. F. This preparation should not be confounded with the Liquor Strychninæ Hydrochloridi of the British Pharmacopœia, which is much stronger. Solution of strychnine acetate is made from strych-

nine acetate, diluted acetic acid, alcohol, compound tincture of cardamom and water. About ⅛ of a grain of strychnine acetate is contained in 1 fluidrachm of the finished solution. It is used as a cardiac stimulant and tonic.
Average dose: 0.6 Cc. (10 minims).

Liquor Zinci et Alumini Compositus. N. F.

Compound Solution of Zinc and Aluminum

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about 20 per cent. of zinc sulphate and aluminum sulphate, with betanaphthol, oil of thyme and water. It is used externally as an astringent and disinfectant.

Liquor Zinci et Ferri Compositus. N. F.

Compound Solution of Zinc and Iron

[Deodorant Solution]

The formula for this solution does not differ from that of the 2d ed. N. F., except in the replacing of diluted hypophosphorous acid by 30 per cent. hypophosphorous acid. It contains 20 per cent. each of zinc sulphate and ferrous sulphate, 6.5 per cent. of copper sulphate, with betanaphthol, oil of thyme, hypophosphorous acid and water. It is used as an antiseptic and astringent solution.

Liquor Zingiberis. N. F.

Solution of Ginger

[Soluble Essence of Ginger]

The formula for this solution does not differ from that of the 2d ed. N. F. It is an aqueous solution of ginger made from 33.5 per cent. of fluidextract of ginger, 10 per cent. of powdered pumice, and water. Intended to mix with water or syrup without precipitation.
Average dose: 3 Cc. (45 minims).

Lotio Adstringens. N. F.

Astringent Lotion [Warren's Styptic]

The formula for this lotion does not differ from that of the 2d ed. N. F. It contains about 38 per cent. of sulphuric acid, 31 per cent. each of oil of turpentine and alcohol. It is used as an astringent and styptic.

Lotio Flava. N. F.

Yellow Lotion

[Yellow Wash, Aqua Phagedænica Flava]

The formula for this lotion does not differ from that of the 2d ed. N. F. It contains about 0.3 per cent. of corrosive mercuric chloride in lime water slightly diluted with water. It is used externally in skin diseases.

Lotio Nigra. N. F.

Black Lotion

[Black Wash, Aqua Phagedænica Nigra]

In this lotion the proportion of mild mercurous chloride was increased in the 3d ed. N. F. It contains now 0.875 per cent. (formerly 0.75 per cent.) of mild mercurous chloride in lime water slightly diluted with water. It is used externally in skin diseases.

Lotio Plumbi et Opii. N. F.

Lotion of Lead and Opium

[Lead and Opium Wash]

The formula for this lotion does not differ from that of the 2d ed. N. F. It contains 1.75 per cent. of lead acetate and 3.5 per cent. of tincture of opium in water. It is used as an astringent and sedative external application.

Magma Magnesiæ. N. F.

Magnesia Magma [Milk of Magnesia]

This is a new preparation in the 3d ed. N. F. It is made from magnesium sulphate, sodium hydroxide and water. About 3 grains of magnesium hydroxide are represented by 1 fluidrachm of the magma. It is used as an antacid.
Average dose: 8 Cc. (2 fluidrachms).

Mistura Acaciæ. N. F.

Mixture of Acacia

[Mixtura Gummosa, G. P.]

The formula for this preparation does not differ from that of the 2d ed. N. F. It contains 7.5 per cent. each of acacia and sugar in water. It is used as a demulcent.

Mistura Adstringens et Escharotica. N. F.

Astringent and Escharotic Mixture

[Villate's Solution]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from solution of lead subacetate, copper sulphate, zinc sulphate and diluted acetic acid. The solution is filtered from the precipitated lead sulphate. It is used externally as an astringent and escharotic.

Mistura Ammonii Chloridi. N. F.

Mixture of Ammonium Chloride

[Mistura (or Mixtura) Solvens Simplex]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 2.5 per cent. each of ammonium chloride and purified extract of glycyrrhiza in water. It is used as an expectorant.
Average dose: 8 Cc. (2 fluidrachms).

Mistura Camphoræ Acida. N. F.

Acid Camphor Mixture

[Mistura Antidysenterica, Hope's Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 1.75 per cent. of nitric acid, 1.2 per cent. of tincture of opium in camphor water. It is used as an antispasmodic and astringent.
Average dose: 8 Cc. (2 fluidrachms).

Mistura Camphoræ Aromatica. N. F.

Aromatic Camphor Mixture

[Parrish's Camphor Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 25 per cent. of compound tincture of lavender, 3.5 per cent. of sugar, and camphor water. It is used in diarrhœa as a carminative.

Average dose: 8 Cc. (2 fluidrachms).

Mistura Carminativa. N. F.

Carminative Mixture

[Dalby's Carminative]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from magnesium carbonate, potassium carbonate, tincture of opium, oils of caraway, fennel and peppermint, with syrup and water. About ⅛ of a grain of opium is represented in 1 fluidrachm of the finished mixture. It is used as a carminative.

Average dose: Infants, 0.5 Cc. (8 minims).

Mistura Chlorali et Potassii Bromidi Composita. N. F.

"Chloral and Bromide Compound"

The formula for this mixture differs from that of the 2d ed. N. F. in the reduction of the quantities of hydrated chloral and potassium bromide, the omission of tincture of quillaja and alcohol, and the introduction of powdered pumice, in order to make a more satisfactory solution. About 12 grains each of hydrated chloral and potassium bromide, and ⅛ grain each of the extracts of Indian cannabis and hyoscyamus are represented in 1 fluidrachm of the finished mixture. It is used as a sedative and hypnotic.

Average dose: 4 Cc. (1 fluidrachm).

Mistura Chloroformi et Cannabis Indicæ Composita. N. F.

Compound Mixture of Chloroform and Cannabis Indica

[Chloroform Anodyne]

The proportions of tinctures of Indian cannabis and capsicum were materially reduced in the 3d ed. N. F., and ether somewhat increased. It contains chloroform, ether, tincture of Indian cannabis, tincture of capsicum, morphine sulphate, oil of peppermint, glycerin, water and alcohol. About 7½ minims of chloroform, 11 minims of tincture of Indian cannabis, 2 minims of tincture of capsicum, 1-7th of a grain of morphine sulphate, are represented in 1 fluidrachm of the finished mixture. It is used in diarrhœa and cholera.

Average dose: 2 Cc. (30 minims).

Misturæ Contra Diarrhœam. N. F.

Diarrhœa Mixtures

1. *Cholera Mixture.* "*Sun Mixture.*"—This mixture contains tincture of opium, tincture of capsicum, tincture of rhubarb, spirit of camphor, spirit of peppermint and alcohol.

Average dose: 2 Cc. (30 minims).

2. *Squibb's Diarrhœa Mixture.*—This mixture contains tinctures of opium and capsicum, spirit of camphor, chloroform and alcohol.

Average dose: 2 Cc. (30 minims).

3. *Loomis' Diarrhœa Mixture.*—This mixture contains tinctures of opium and rhubarb, compound tincture of gambir, oil of sassafras and compound tincture of lavender.

Average dose: 2 Cc. (30 minims).

4. *Thielmann's Diarrhœa Mixture.*—This mixture contains wine of opium, tincture of valerian, ether, oil of peppermint, fluidextract of ipecac and alcohol.

Average dose: 2 Cc. (30 minims).

5. *Velpeau's Diarrhœa Mixture.*—This mixture contains camphor, tincture of opium, and compound tincture of gambir.

Average dose: 2 Cc. (30 minims).

Misturæ Copaibæ. N. F.

Copaiba Mixtures

In the 3d ed. N. F. the word "composita" in the Latin title and the word "compound" in the English name as found in the 2d ed. N. F. does not appear.

1. *Lafayette Mixture.*—The quantities of solution of potassium hydroxide and syrup were slightly decreased in the 3d ed. N. F. in this mixture, and mucilage of acacia substituted for mucilage of dextrin. The mixture contains copaiba, spirit of nitrous ether, compound tincture of lavender, solution of potassium hydroxide, syrup, and mucilage of acacia. It is used in the treatment of gonorrhœa.

Average dose: 8 Cc. (2 fluidrachms).

2. *Chapman's Mixture.*—The quantity of tincture of opium was slightly increased (from 30 to 32 Cc.) in the 3d ed. N. F. This mixture contains copaiba, spirit of nitrous ether, compound tincture of lavender, tincture of opium, mucilage of acacia and water. Used in the treatment of gonorrhœa.

Average dose: 4 Cc. (1 fluidrachm).

Mistura Guaiaci. N. F.

Mixture of Guaiac

The formula for this mixture does not differ from that of the 2d ed. N. F.; it contains 2.5 per cent. each of guaiac and sugar, with acacia and cinnamon water. It is used in the treatment of rheumatism.

Average dose: 16 Cc. (4 fluidrachms)

Mistura Olei Picis. N. F.

Mixture of Oil of Tar

[Mistura Picis Liquidæ, Tar Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains purified extract of glycyrrhiza, oil of tar, sugar, chloroform, oil of peppermint, alcohol, and water. It is used as an expectorant.

Average dose: 8 Cc. (2 fluidrachms).

Mistura Oleo-Balsamica. N. F.

OLEO-BALSAMIC MIXTURE

[Mixtura Oleoso-balsamica, G. P.; Balsamum Vitæ Hoffmanni]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains the oils of lavender, thyme, lemon, nutmeg, orange flowers, cloves and cinnamon, with balsam of Peru and alcohol. It is used as a stimulant and carminative.

Mistura Pectoralis, Stokes. N. F.

STOKES' EXPECTORANT

The name of this mixture was changed in the 3d ed. N. F.; it was formerly Mistura Expectorans, Stokes. Ammonia water has been added to the formula, and the quantity of water decreased. It is made from ammonium carbonate, the fluidextracts of senega and squill, camphorated tincture of opium, ammonia water, water and syrup of tolu. It is used as an expectorant.
Average dose: 4 Cc. (1 fluidrachm).

Mistura Rhei Composita. N. F.

COMPOUND MIXTURE OF RHUBARB

[Squibb's Rhubarb Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of rhubarb and ipecac, sodium bicarbonate, glycerin and peppermint water. It is used as an antacid and laxative.
Averaye dose: 8 Cc. (2 fluidrachms).

Mistura Sassafras et Opii. N. F.

MIXTURE OF SASSAFRAS AND OPIUM

[Mistura Opii Alkalina, Godfrey's Cordial]

The formula for this mixture does not differ from that of the 2d ed. N. F. About 2 minims of tincture of opium are contained in one fluidrachm of the finished mixture. It is used as a carminative.
Average dose: Infants, 0.65 Cc. (10 minims).

Mistura Sodæ et Menthæ. N. F.

MIXTURE OF SODA AND SPEARMINT

[Soda Mint]

The formula for this mixture does not differ from that of the 2d ed. N. F.; it contains 5 per cent. of sodium bicarbonate, with aromatic spirit of ammonia and spearmint water. It is antacid and carminative.
Average dose: 8 Cc. (2 fluidrachms).

Mistura Splenetica. N. F.

SPLENETIC MIXTURE

[Spleen Mixtuse, Gadberry's Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It is made from ferrous sulphate, quinine sulphate, nitric acid, potassium nitrate and water. It is used in malarial fever as an antiperiodic.
Average dose: 4 Cc. (1 fluidrachm).

Mistura Sulphurica Acida. N. F.

SULPHURIC ACID MIXTURE

[Mixtura Sulphurica Acida, G. P.; Haller's Acid Elixir]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 25 per cent. of sulphuric acid in alcohol. It is an antihidrotic and astringent mixture.
Average dose: 0.5 Cc. (8 minims).

Mucilago Chondri. N. F.

MUCILAGE OF IRISH MOSS

The formula for this mucilage does not differ from that of the 2d ed. N. F. It contains 3 per cent. of Irish moss in water. It is used as an emulsifying agent and demulcent.

Mucilago Dextrini. N. F.

MUCILAGE OF DEXTRIN

The formula for this mucilage does not differ from that of the 2d ed. N. F. It consists of 33.5 per cent. of dextrin in water, and is used in preparing emulsions.

Mucilago Salep. N. F.

MUCILAGE OF SALEP

The formula for this mucilage does not differ from that of the 2d ed. N. F. It contains about I per cent. of powdered salep in water. It is used as a demulcent.

Olea Infusa. N. F.

INFUSED OILS

The formula for these is a general one. The infused oils are made from the dried herb, alcohol, ammonia water, lard oil and cotton seed oil.

Oleatum Aconitinæ. N. F.

OLEATE OF ACONITINE

The formula for this oleate does not differ from that of the 2d ed. N. F. It is a solution of 2 per cent. of aconitine in oleic acid. It should be used with care in the external treatment of neuralgia.

Oleatum Zinci. N. F.

ZINC OLEATE

The formula for this oleate does not differ from that of the 2d ed. N. F. It is a powder made from crystallized zinc acetate, solution of sodium oleate and water. Used externally as an astringent.

Oleosacchara. N. F.

OIL SUGARS

[Elæosacchara, G. P.]

The general formula for this class of preparations does not differ from that of the 2d ed. N. F. Oil-sugars are made by triturating volatile oils with sugar, and are used as vehicles.

Oleum Carbolatum. N. F.

CARBOLIZED OIL

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made by dissolving 5 per cent. of phenol in cotton seed oil. Used externally.

Oleum Hyoscyami Compositum. N. F.

COMPOUND OIL OF HYOSCYAMUS

[Balsamum Tranquillans]

The formula for this oil does not differ from that of the 2d ed. N. F. It is made from the oils of absinth, lavender, rosemary, sage and thyme, with infused oil of hyoscyamus. It is used as an anodyne.

Oxymel Scillæ. N. F.

OXYMEL OF SQUILL

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from 1 part of vinegar of squill and two parts of honey. Used as an expectorant.

Average dose: 4 Cc. (1 fluidrachm).

Pastæ Dermatologicæ. N. F.

DERMATOLOGIC PASTES

Under this head are included formulas for seven dermatological pastes, which are new preparations in the 3d ed. N. F. They are as follows:

1. *Pasta Dextrinata. "Dextrinated Paste."* This is made from dextrin, glycerin and distilled water. Used as a vehicle.

2. *Pasta Ichthyoli, Unna. "Unna's Ichthyol Paste."*—This is made from ammonium ichthyolsulphonate and dextrinated paste. Used in skin diseases.

3. *Pasta Naphtholi, Lassar. "Lassar's Naphthol Paste."*—This is made from betanaphthol, precipitated sulphur, petrolatum and soft soap.

4. *Pasta Resorcini Mitis, Lassar. "Lassar's Mild Resorcin Paste."*—This is made from resorcinol, zinc oxide, starch and liquid petrolatum.

5. *Pasta Zinci, Lassar. "Lassar's Zinc-Salicyl Paste."*—This is made from salicylic acid, zinc oxide, starch and white petrolatum.

6. *Pasta Zinci Mollis, Unna. "Unna's Soft Zinc Paste."*—This is made from zinc oxide, calcium carbonate, linseed oil and lime water.

7. *Pasta Zinci Sulfurata, Unna. "Unna's Sulphurated Zinc Paste."*—This is made from zinc oxide, precipitated sulphur, silicic acid benzoinated lard.

Pepsinum Aromaticum. N. F.

AROMATIC PEPSIN

The formula for this preparation does not differ from that of 2d ed. N. F. It is made from saccharated pepsin (U. S. P. 1890), aromatic fluidextract, tartaric acid and sodium chloride. It is used for indigestion.

Average dose: 2 Gm. (30 grains).

Petrolatum Saponatum Liquidum. N. F.

LIQUID SAPONATED PETROLATUM

["Liquid Petrox"]

This is a new preparation in the 3d ed. N. F. It is made from liquid petrolatum, oleic acid and spirit of ammonia, and is used as a vehicle for external application.

Petrolatum Saponatum Spissum. N. F.

SOLID SAPONATED PETROLATUM

["Solid Petrox"]

This is a new preparation in the 3d ed. N. F. It is made from petrolatum, oleic acid and spirit of ammonia, and is used as a vehicle for ointments.

Pilulæ ad Prandium. N. F.

DINNER PILLS

1.—The 3d ed. N. F. recommends that when dinner pills are prescribed, the official pills of aloes and mastic should be dispensed.

Dose of dinner pills, 1 or 2.

2. *Chapman's Dinner Pill.*—The formula for this pill does not differ from that of the 2d ed. N. F. Each pill contains 1½ grains of purified aloes, 1½ grains of mastic, 1 grain of ipecac and about ¼ minim of oil of fennel.

3. *Cole's Dinner Pill.*—The formula for this pill does not differ from that of the 2d ed. N. F. Each pill contains 1 and ⅕ of a grain each of purified aloes, mass of mercury, and jalap and 1-50th of a grain of antimony and potassium tartrate.

4. *Hall's Dinner Pill.*—The formula for this pill does not differ from that of the 2d ed. N. F. Each pill contains 1 grain each of purified aloes, extract of glycyrrhiza, soap, and molasses.

Pilulæ Aloes et Podophylli Compositæ. N. F.

COMPOUND PILLS OF ALOES AND PODOPHYLLUM

[Janeway's Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of purified aloes, ½ grain resin of podophyllum, ¼ grain of extract of belladonna leaves and ¼ of a grain of extract of nux vomica. They are used as a laxative.

Pilulæ Aloini Compositæ. N. F.

COMPOUND PILLS OF ALOIN

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ½ grain of aloin, ⅛ grain of resin of podophyllum, ¼ grain of extract of belladonna leaves. Cathartic.

Pilulæ Aloini, Strychninæ et Belladonnæ. N. F.

PILLS OF ALOIN, STRYCHNINE AND BELLADONNA

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ⅕ grain of aloin, 1-120th grain of strychnine, and ⅛ grain of extract of belladonna leaves. Used as a laxative and tonic.

Pilulæ Aloini, Strychninæ et Belladonnæ Compositæ. N. F.

COMPOUND PILLS OF ALOIN, STRYCHNINE AND BELLADONNA

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ⅕ grain of aloin, 1-120th grain of strychnine, ⅛ grain of extract of belladonna leaves, and ½ grain of extract of cascara sagrada. Used as a tonic and laxative.

Pilulæ Antidyspepticæ. N. F.

ANTIDYSPEPTIC PILLS

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1-40th grain of strychnine, 1-10th grain of ipecac, 1-10th grain of extract of belladonna leaves, 2 grains of mass of mercury, and 2 grains of compound extract of colocynth. Used as a cholagogue and tonic.

Pilulæ Antineuralgicæ. N. F.

ANTINEURALGIC PILLS

1. *Gross' Antineuralgic Pills.*—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 2 grains of quinine sulphate, 1-20th grain of morphine sulphate, 1-30th grain of strychnine, 1-20th grain of arsenic trioxide, and ½ grain of extract of aconite leaves (U. S. P. 1870). Used for neuralgia.

2. *Brown Séquard's Antineuralgic* (or *Neuralgia*) *Pills.*—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ⅔ grain of extract of hyoscyamus, ⅔ grain of extract of conium, ½ grain of extract of ignatia (U. S. P. 1870), ½ grain of extract of opium, ⅓ grain of extract of aconite leaves (U. S. P. 1870), ¼ grain of extract of Indian cannabis, ⅕ grain of extract of stramonium, and 1-6th grain of extract of belladonna leaves. Used in neuralgia.

Pilulæ Antiperiodicæ. N. F.

ANTIPERIODIC PILLS [Warburg's Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of extract of aloes, ½ grain of rhubarb, ½ grain of angelica seed, ¼ grain of elecampane, ¼ grain of saffron, ¼ grain of fennel, ⅛ grain of zedoary root, ⅛ grain of cubebs, ⅛ grain of myrrh, ⅛ grain of white agaric, ⅛ grain of camphor, 1 and 2-5th grains of quinine sulphate, with a sufficient quantity of extract of gentian to form a mass.

Warburg's Pills without aloes have the same composition, except that the extract of aloes is omitted. Used as an antiperiodic.

Dose, 1 to 3 pills one to three times daily.

Pilulæ Colocynthidis Compositæ. N. F.

COMPOUND PILLS OF COLOCYNTH

[Pilulæ Cocciæ, Cochia Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1-6th grain of extract of colocynth, 2 grains of purified aloes, 2 grains of resin of scammony and ¼ minim of oil of cloves. Used as a cathartic.

Pilulæ Colocynthidis et Hyoscyami. N. F.

PILLS OF COLOCYNTH AND HYOSCYAMUS

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1-10th grain of extract of colocynth, 1½ grains of purified aloes, 1½ grains of resin of scammony, 1-6th minim of oil of cloves, and 1½ grains of extract of hyoscyamus. Used as a cathartic.

Pilulæ Colocynthidis et Podophylli. N. F.

PILLS OF COLOCYNTH AND PODOPHYLLUM

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 2½ grains of compound extract of colocynth, and ¼ grain of resin of podophyllum. Used as a cathartic.

Pilulæ Glonoini. N. F.

PILLS OF GLONOIN

[Pills of Nitroglycerin]

The formula for these pills does not differ from that of the 2d ed. N. F. They are made from spirit of glyceryl trinitrate, althæa and confection of rose. Each pill contains 1-100th grain of nitroglycerin. Used as a cardiac stimulant.

Pilulæ Laxativæ Post Partum. N. F.

LAXATIVE PILLS AFTER CONFINEMENT

[Barker's Post Partum Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1⅔ grains of compound extract of colocynth, 5-6th grain of purified aloes, 5-12th grain of extract of nux vomica, 1-12th grain of resin of podophyllum, 1-12th grain of ipecac, and 1¼ grains of extract of hyoscyamus. Used as a cathartic.

Pilulæ Metallorum. N. F.

METALLIC PILLS

[Pilulæ Metallorum Amaræ, Bitter Metallic Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of reduced iron, 1 grain of qui nine sulphate, 1-20th grain of strychnine, and 1-20th grain of arsenic trioxide. Used as a tonic.

Aitken's Tonic Pills are somewhat weaker, each pill containing ⅔ grain of reduced iron, 1 grain of quinine sulphate, 1-50th grain of strychnine, and 1-50th grain of arsenic trioxide. Used as a tonic.

Pilulæ Opii et Camphoræ. N. F.

Pills of Opium and Camphor

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of powdered opium and 2 grains of camphor. Used as an anodyne and astringent.

Pilulæ Opii et Plumbi. N. F.

Pills of Opium and Lead

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of powdered opium and 1 grain of lead acetate. Used as an anodyne and astringent.

Pilulæ Quadruplices. N. F.

Quadruplex Pills

[Quatuor Pills, Pilulæ Ferri et Quininæ Compositæ]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains one grain each of dried ferrous sulphate, quinine sulphate, purified aloes, with ¼ grain of extract of nux vomica, and sufficient extract of gentian to form a mass. Used as a tonic and laxative.

Pilulæ Triplices. N. F.

Triplex Pills

[Pilula Triplex]

1.—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 2 grains of purified aloes, 1 grain of mass of mercury and ¼ grain of resin of podophyllum. Used as a cathartic and cholagogue.

2. *Francis' Triplex Pill.*—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 5-6th grain of purified aloes, 5-6th grain of scammony, 5-6th grain of mass of mercury, 1-20th minim of croton oil, ¼ minim of oil of caraway, and sufficient tincture of aloes and myrrh to form a mass. Used as a cathartic.

Pulvis Acaciæ Compositus. N. F.

Compound Powder of Acacia

[Pulvis Gummosus, G. P.]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 50 per cent. of powdered acacia, 34 per cent. of powdered glycyrrhiza, and 16 per cent. of powdered sugar.

Pulvis Aloes et Canellæ. N. F.

Powder of Aloes and Canella

["Hiera Picra"]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 80 per cent. of purified aloes and 20 per cent. of powdered canella. It is used as an emmenagogue and laxative.

Average dose: 1 Gm. (15 grains).

Pulvis Amygdalæ Compositus. N. F.

Compound Powder of Almond

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 60 per cent. of sweet almond, 30 per cent. of powdered sugar and 10 per cent. of powdered acacia. It is used for extemporaneously preparing emulsion of almond.

Pulvis Anticatarrhalis. N. F.

Catarrh Powder

[Catarrh Snuff]

The formula for this powder does not differ from that of the 2d ed. N. F. It contains 75 grammes of bismuth subnitrate, 25 grammes of powdered acacia and 0.41 grammes of morphine hydrochloride. It is used for catarrh.

Pulvis Antisepticus. N. F.

Soluble Antiseptic Powder

[Pulvis Antisepticus Solubilis]

This is a new preparation in the 3d ed. N. F. It contains salicylic acid, phenol, eucalyptol, menthol, thymol, zinc sulphate and powdered boric acid. It is used as a dusting powder.

Pulvis Catechu Compositus. N. F.

Compound Powder of Catechu

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 40 per cent. of powdered gambir, 20 per cent. of powdered kino, 20 per cent. of powdered krameria, 10 per cent. of powdered cinnamon, and 10 per cent. of powdered nutmeg. It is used in diarrhœa.

Average dose: 1.30 Gm. (20 grains).

Pulvis Cretæ Aromaticus. N. F.

Aromatic Powder of Chalk

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 8 per cent. of cinnamon, 6 per cent. each of saffron and nutmeg, 3 per cent. of cloves, 2 per cent of cardamom, 23 per cent. of prepared chalk and 52 per cent. of sugar. It is used in diarrhœa.

Average dose: 2 Gm. (30 grains).

Pulvis Cretæ Aromaticus cum Opio. N. F.

Aromatic Powder of Chalk with Opium

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. One grain of powdered opium and 39 grains of aromatic powder of chalk are contained in 40 grains of this preparation. It is used as a sedative and astringent.
Average dose: 1 Gm. (15 grains).

Pulvis Ferri et Quininæ Citratis Effervescens. N. F.

Effervescent Powder of Citrate of Iron and Quinine

[Effervescent Citrate of Iron and Quinine]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from soluble citrate of iron and quinine, saccharated sodium bicarbonate and saccharated tartaric acid. About 1 grain of soluble citrate of iron and quinine is represented by 90 grains of the powder. It is used as a chalybeate and tonic.
Average dose: 6 Gm. (90 grains).

Pulvis Ferri Phosphatis Effervescens. N. F.

Effervescent Powder of Ferric Phosphate

[Effervescent Phosphate of Iron]

The formula for this powder does not differ from that of the 2d ed. N. F., except that the word "soluble" is now added to the words ferric phosphate, and in the substitution of parts for grammes. It contains soluble ferric phosphate, saccharated sodium bicarbonate and saccharated tartaric acid. About 2 grains of soluble ferric phosphate are contained in 90 grains of the powder. Used as a chalybeate.
Average dose: 6 Gm. (90 grains).

Pulvis Hydrargyri Chloridi Mitis et Jalapæ. N. F.

Powder of Mild Chloride of Mercury and Jalap

[Calomel and Jalap]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 34 per cent. of mild chloride of mercury and 66 per cent. of jalap. It is cathartic and cholagogue.
Average dose: 0.65 Gm. (10 grains).

Pulvis Iodoformi Compositus. N. F.

Compound Powder of Iodoform

["Naphthalin Iodoform"]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 20 per cent. of powdered iodoform, 30 per cent. of powdered boric acid, 50 per cent. of powdered naphthalene, with a little oil of bergamot. Used as an antiseptic.

Pulvis Kino Compositus. N. F.

Compound Powder of Kino

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 75 per cent. of powdered kino, 5 per cent. of powdered opium and 20 per cent. of powdered cinnamon. Used as an astringent.
Average dose: 1 Gm. (15 grains).

Pulvis Myricæ Compositus. N. F.

Compound Powder of Bayberry

[Composition Powder]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 60 per cent. of bayberry bark, 30 per cent. of ginger, 5 per cent. of capsicum and 5 per cent. of cloves. It is used as a carminative and stimulant.
Average dose: 1 Gm. (15 grains).

Pulvis Pancreaticus Compositus. N. F.

Compound Pancreatic Powder

[Peptonizing Powder]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 20 per cent. of pancreatin and 80 per cent. of sodium bicarbonate. Twenty-five grains of this powder are sufficient to peptonize 1 pint of fresh cow's milk. Used as a digestive.

Pulvis Pepsini Compositus. N. F.

Compound Powder of Pepsin

[Pulvis Digestivus]

The formula for this powder does not differ from that of the 2d ed. N. F. It contains saccharated pepsin, pancreatin, diastase, lactic acid, hydrochloric acid and sugar of milk. Used as a digestive.
Average dose: 1 Gm. (15 grains).

Pulvis Potassii Bromidi Effervescens. N. F.

Effervescent Powder of Potassium Bromide

[Effervescent Potassium Bromide]

The formula for this powder does not differ from that of the 2d ed, N. F., except in the substitution of parts for grammes. It contains potassium bromide, saccharated sodium bicarbonate and saccharated tartaric acid. About 10 grains of potassium bromide are contained in 90 grains of finished powder. It is used as a nerve sedative.
Average dose: 6 Gm. (90 grains).

Pulvis Potassii Bromidi Effervescens cum Caffeina. N. F.

EFFERVESCENT POWDER OF POTASSIUM BROMIDE WITH CAFFEINE

[Effervescent Potassium Bromide with Caffeine]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains potassium bromide, caffeine, saccharated sodium bicarbonate, saccharated tartaric acid. About 10 grains of potassium bromide and 1 grain of caffeine are contained in 90 grains of the finished powder. Used as a nerve sedative.
Average dose: 6 Gm. (90 grains).

Pulvis Pro Lacte Humanisato. N. F.

HUMANIZING MILK POWDER

["Milk Powder"]

This is a new powder in the 3d ed. N. F. It contains 3.5 per cent. of compound pancreatic powder and 96.5 per cent. of powdered sugar of milk. This powder is intended to be used in preparing humanized milk.

Pulvis Rhei et Magnesiæ Anisatus. N. F.

ANISATED POWDER OF RHUBARB AND MAGNESIA

[Compound Anise Powder]

The formula for this powder does not differ from that of the 2d ed. N. F. It contains 35 per cent. of powdered rhubarb and 65 per cent. of heavy magnesia, with oil of anise and alcohol. It is laxative and carminative.
Average dose: Infants, 0.3 Gm. (5 grains).

Pulvis Salis Carolini Factitii Effervescens. N. F.

EFFERVESCENT POWDER OF ARTIFICIAL CARLSBAD SALT

[Effervescent Artificial Carlsbad Salt]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Carlsbad salt, saccharated sodium bicarbonate and saccharated tartaric acid. Ninety grains of this powder dissolved in 6 fluidounces of water represents an equal volume of Carlsbad water (Sprudel). Used as a laxative.
Average dose: 6 Gm. (90 grains).

Pulvis Salis Kissingensis Factitii Effervescens. N. F.

EFFERVESCENT POWDER OF ARTIFICIAL KISSINGEN SALT

[Effervescent Artificial Kissingen Salt]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Kissingen salt, saccharated sodium bicarbonate, and saccharated tartaric acid. Eighty grains of this powder dissolved in 6 fluidounces of water represents an equal volume of Kissingen water (Rakoczi). It is an alterative.
Average dose: 5.5 Gm. (80 grains).

Pulvis Salis Vichyani Factitii Effervescens. N. F.

EFFERVESCENT POWDER OF ARTIFICIAL VICHY SALT

[Effervescent Artificial Vichy Salt]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Vichy salt, saccharated sodium bicarbonate and saccharated tartaric acid. Fifty-seven grains of this powder dissolved in 6 fluidounces of water represents an equal volume of Vichy water (Grande Grille). It is an antacid.
Average dose: 3.75 Gm. (57 grains).

Pulvis Salis Vichyani Factitii Effervescens cum Lithio. N. F.

EFFERVESCENT POWDER OF ARTIFICIAL VICHY SALT WITH LITHIUM

[Effervescent Artificial Vichy Salt with Lithium]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Vichy salt, lithium citrate, saccharated sodium bicarbonate and saccharated tartaric acid. Ninety grains of this powder represent about 14 grains of artificial Vichy salt and 5 grains of lithium citrate. It is antacid and antilithic.
Average dose: 6 Gm. (90 grains).

Pulvis Talci Salicylicus. N. F.

SALICYLATED POWDER OF TALCUM

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 3 per cent. of salicylic acid, 10 per cent. of boric acid and 87 per cent. of talc, all in very fine powder. Used as an antiseptic dusting powder.

Sal Carolinum Factitium. N. F.

ARTIFICIAL CARLSBAD SALT

1. *In a dry, amorphous form* (*G. P.*)—The formula for this salt does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 2 per cent. of potassium sulphate, 18 per cent. of sodium chloride, 36 per cent. of sodium bicarbonate, and 44 per cent. of dried sodium sulphate. Sixteen grains of this salt when dissolved in 6 fluidounces of water represent an equal volume of Carlsbad water (Sprudel). Used as a laxative.

2. *In a crystalline form.*—The formula for this variety of artificial Carlsbad salt does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from 2 parts of potassium sulphate, 18

parts of sodium chloride, 61 parts of sodium carbonate in clear crystals, 88 parts of crystallized sodium sulphate and 50 parts of distilled water. Twenty-seven grains of this salt dissolved in 6 fluidounces of water represent an equal volume of Carlsbad water (Sprudel). It is a laxative.

Sal Kissingense Factitium. N. F.

Artificial Kissingen Salt

The formula for this salt does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from 1.7 parts of potassium chloride, 35.7 parts of sodium chloride, 5.9 parts of magnesium sulphate (anhydrous), and 10.7 parts of sodium bicarbonate. Twenty-four grains of this salt dissolved in 6 fluidounces of water represents an equal volume of Kissingen water (Rakoczi). It is an antacid.

Sal Vichyanum Factitium. N. F.

Artificial Vichy Salt

The formula for this preparation does not differ from that of the 2d ed. N. F., except in substitution of parts for grammes. It contains sodium bicarbonate, potassium carbonate, magnesium sulphate (anhydrous) and sodium chloride. Fourteen grains dissolved in 6 fluidounces of water represents an equal volume of Vichy water (Grande Grille). It is antacid.

Soda cum Calce. N. F.

Soda with Lime

[London Paste]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from equal parts of sodium hydroxide and lime. Used as a caustic externally.

Sodii Bicarbonas Saccharatus. N. F.

Saccharated Sodium Bicarbonate

The formula of this preparation does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from 3 parts of sodium bicarbonate and 1 part of sugar. Used for making effervescent powders.

Sodii Boro-Benzoas. N. F.

Sodium Boro-Benzoate

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from 3 parts of sodium borate and 4 parts of sodium benzoate. Used as an antiseptic, and in urinary affections.

Species Emollientes. N. F.

Emollient Species [Emollient Cataplasm, G. P.]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from equal parts of althæa leaves, mallow leaves, melilot tops, matricaria and flaxseed. Emollient; used for making an emollient poultice.

Species Laxantes. N. F.

Laxative Species [St. Germain Tea, G. P.]

The formula for this preparation does not differ from that of the 2d ed. N. F. It contains 16 parts of cut senna, 10 parts of elder flowers, 5 parts of bruised fennel, 5 parts of bruised anise and 4 parts of potassium bitartrate. Used as a laxative.

Species Pectorales. N. F.

Pectoral Species [Species ad Infusum Pectorale, Breast Tea, G. P.]

The formula for this preparation does not differ from that of the 2d ed. N. F. It contains 8 parts of althæa, peeled, 4 parts of coltsfoot leaves, 3 parts of Russian glycyrrhiza, peeled, 2 parts of anise, 2 parts of mullen flowers, and 1 part of orris root. Used as a pectoral.

Spiritus Acidi Formici. N. F.

Spirit of Formic Acid [Spiritus Formicarum, G. P.; Spirit of Ants]

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 3.5 per cent. of formic acid in alcohol and distilled water. Used externally as a counter irritant.

Spiritus Aromaticus. N. F.

Aromatic Spirit

The formula for this spirit does not differ from that given in the 2d ed. N. F. This preparation contains 6.5 per cent. of compound spirit of orange in alcohol. It is used only for flavoring purposes.

Spiritus Cardamomi Compositus. N. F.

Compound Spirit of Cardamom

The formula for this spirit does not differ from that of the 2d ed. N. F. It is made from the oils of cardamom, caraway and cinnamon dissolved in alcohol, glycerin and water. Used for flavoring, being equivalent to compound tincture of cardamom, without the coloring matter.

Spiritus Curassao. N. F.

Spirit of Curaçao

The formula for this spirit does not differ from that of the 2d ed. N. F. It is made from oils of Curaçao orange, fennel and bitter almond with alcohol. Used for flavoring.

Spiritus Ophthalmicus. N. F.

Ophthalmic Spirit [Alcoholic Eye-Wash]

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 2 per cent. of oil of lavender, 6 per cent. of oil of rosemary, and 92 per cent. of alcohol. Used as an eyewash.

Spiritus Phosphori. N. F.

Spirit of Phosphorus [Tincture of Phosphorus]

This spirit is identical with the Spirit of Phosphorus of the U. S. Pharmacopœia (1890). There is a slight change, however, in the form of the apparatus.
Average dose: 0.5 Cc. (8 minims).

Spiritus Saponatus. N. F.

Spirit of Soap

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 17.5 per cent. of Castile soap in shavings, with alcohol and water. Used as a detergent.

Spiritus Sinapis. N. F.

Spirit of Mustard

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 2 per cent. of volatile oil of mustard in alcohol. Used as a counter-irritant.

Spongia Compressa. N. F.

Compressed Sponge [Sponge Tent]

The formula for this does not differ from that of the 2d ed. N. F. It consists of sponge treated with diluted mucilage of acacia and dried. Used for surgical purposes.

Spongia Decolorata. N. F.

Decolorized Sponge

[Bleached Sponge]

The formula for this does not differ from that of the 2d ed. N. F. It consists of sponge bleached by treatment with potassium permanganate, sodium thiosulphate, hydrochloric acid and water. Used for surgical purposes.

Succus Limettæ cum Pepsino. N. F.

Lime Juice and Pepsin

In the Latin title for this preparation the word " Limettæ " replaces the word "Limonis" of the 2d ed. N. F. The formula was also changed in the 3d ed. It is now made from 40 per cent. of glycerite of pepsin and 60 per cent. of lime juice. Used in dyspepsia.
Average dose: 8 Cc. (2 fluidrachms).

Suppositoria Boroglycerini. N. F.

Suppositories of Boroglycerin

This is a new preparation in the 3d ed N. F. The suppositories contain glycerinated gelatin, boric acid, glycerin and water.

Stili Dilubiles. N. F.

Paste Pencils

[" Unna Pencils "]

This is a new class of preparations introduced into the 3d ed. N. F., and consists of pencils suggested by Dr. Unna. They are used in dermatological practice.

1. *Stilus Acidi Salicylici Dilubilis, 10 per cent.—Salicylic Acid Pencil* (*10 per cent.*). These pencils contain 10 per cent. of salicylic acid, with tragacanth, starch, dextrin, sugar and distilled water.

2. *Stilus Cocainæ Dilubilis, 5 per cent. Cocaine Pencil* (*5 per cent.*).—These pencils contain 5 per cent. of cocaine hydrochloride, with tragacanth, starch, dextrin, sugar and distilled water.

Syrupus Actææ Compositus. N. F.

Compound Syrup of Actæa

[Compound Syrup of Cimicifuga, or Black Cohosh]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of cimicifuga, glycyrrhiza, senega and ipecac, with wild cherry, purified talc, sugar and water. It is used as an antispasmodic.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Asari Compositus. N. F.

Compound Syrup of Asarum

[Compound Syrup of Canada Snake-Root]

The formula for this syrup was slightly changed in the 3d ed. N. F., the quantities of asarum, alcohol and sugar having been reduced. It is made from asarum root, alcohol, cochineal, potassium carbonate, wine of ipecac, sugar and water. About 3.5 grains of asarum are represented by 1 fluidrachm of finished syrup. Used as a stimulant and expectorant.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Bromidorum. N. F.

Syrup of the Bromides

This is a new preparation in the 3d ed. N. F. It is made from potassium, sodium, ammonium, calcium and lithium bromides, tincture of vanilla, compound tincture of cudbear, compound syrup of sarsaparilla and syrup. About 15 grains of the mixed bromides are contained in 1 fluidrachm of the finished syrup. Used as a nervous sedative.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Calcii Chlorhydrophosphatis. N. F.

Syrup of Calcium Chlorhydrophosphate

[Syrup of Chlorhydrophosphate of Lime]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from precipitated calcium phosphate, tincture of lemon peel, hydrochloric acid, water and syrup. About 1 grain of calcium phosphate is contained in 1 fluidrachm of the finished syrup. Used as an alterative.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Calcii et Sodii Hypophosphitum. N. F.

Syrup of Calcium and Sodium Hypophosphites

[Syrup of Hypophosphite of Lime and Soda]

The formula for this syrup does not differ from that of the 2d ed. N. F., except in the replacing of citric acid with hypophosphorous acid. About 2 grains each of calcium and sodium hypophosphites, with hypophosphorous acid, sugar and water, are contained in 1 fluidrachm of the finished syrup. Used as an alterative.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Calcii Hypophosphitis. N. F.

Syrup of Calcium Hypophosphite

[Syrup of Hypophosphite of Lime]

The formula for this syrup does not differ from that of the 2d ed. N. F., except in the substitution of hypophosphorous acid for citric acid. It is made from calcium hypophosphite, hypophosphorous acid, sugar and water. About 2 grains of calcium hypophosphite are contained in 1 fluidrachm of the finished syrup. Used as an alterative.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Calcii Iodidi. N. F.

Syrup of Calcium Iodide

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from iodine, iron wire, precipitated calcium carbonate, sugar, distilled water and syrup. About 5 grains of calcium iodide are contained in 1 fluidrachm of the finished syrup.
Average dose: 2 Cc (30 minims).

Syrupus Calcii Lactophosphatis cum Ferro. N. F.

Syrup of Calcium Lactophosphate with Iron

[Syrup of Lactophosphate of Lime with Iron]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from ferrous lactate, potassium citrate, water and syrup of calcium lactophosphate. About ½ grain of ferrous lactate, and ¼ grain of calcium lactate are contained in 1 fluidrachm of the finished syrup. Used as an alterative and tonic.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Chondri Compositus. N. F.

Compound Syrup of Chondrus

[Compound Syrup of Irish Moss]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from Irish moss, the fluidextracts of ipecac, squill and senega, camphorated tincture of opium, purified talc, sugar and water. Used as an expectorant.
Average dose: 8 Cc. (2 fluidrachms).

Syrupus Cinnamomi. N. F.

Syrup of Cinnamon

In the formula for this syrup in the 3d ed. N. F. the quantity of sugar has been increased and Saigon cinnamon replaces the Cassia of the 2d ed. It is made from Saigon cinnamon, alcohol, sugar and cinnamon water. It is used for flavoring.
Average dose: 4 Cc. (1 fluidrachm).

Syrupus Codeinæ. N. F.

Syrup of Codeine

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from codeine sulphate and syrup. About ⅛ grain of codeine sulphate is contained in 1 fluidrachm of the finished syrup. Used as a sedative.
Average dose: 2 Cc. (30 minims).

Syrupus Coffeæ. N. F.

Syrup of Coffee

The formula for this syrup was slightly changed in the 3d ed. N. F., by increasing the quantity of sugar. It is made from roasted coffee, sugar and water. About 25 per cent. of coffee is represented in this syrup. Used as a stimulant.
Average dose: 8 Cc. (2 fluidrachms).

Syrupus Eriodictyi Aromaticus. N. F.

Aromatic Syrup of Eriodictyon

[Aromatic Syrup of Yerba Santa, Syrupus Corrigens]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from fluidextract of eriodictyon, solution of potassium hydroxide, compound tincture of cardamom, the oils of sassafras, lemon and cloves, alcohol, sugar and water. Used as a vehicle and as an alterative.
Average dose: 8 Cc. (2 fluidrachms).

Syrupus Ferri Arsenatis. N. F.

Syrup of Arsenate of Iron

A slight change was made in the formula for this preparation. It is now made from dried sodium arsenate, ferric citrate, water and syrup. About 1–40th grain of ferric arsenate is contained in 1 fluidrachm of the finished syrup. Used as an alterative and tonic.
Average dose: 0.5 Cc. (8 minims).

Syrupus Ferri Citro-Iodidi. N. F.

Syrup of Citro-Iodide of Iron

[Tasteless Syrup of Iodide of Iron]

The English name of the syrup was changed from Syrup of Ferric Citro-Iodide to Syrup of Citro-Iodide of Iron in the 3d ed. N. F. The quantities of the ingredients were also slightly changed. It is made from iodine, iron wire, potassium citrate, sugar and distilled water. An amount of iron corresponding to about 4 grains of ferric iodide is contained in 1 fluidrachm of the finished syrup. It is alterative and tonic.

Average dose: 2 Cc. (30 minims).

Syrupus Ferri et Mangani Iodidi. N. F.

SYRUP OF IODIDE OF IRON AND MANGANESE

The formula of this syrup was slightly changed. It is made from iodine, iron wire, manganese sulphate, potassium iodide, sugar and water. About 6 grains of ferrous iodide and 2¼ grains of manganese iodide are contained in 1 fluidrachm of finished syrup. Used as an alterative.

Average dose: 1 Cc. (15 minims).

Syrupus Ferri Hypophosphitis. N. F.

SYRUP OF FERRIC HYPOPHOSPHITE

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from ferric hypophosphite, potassium citrate, orange flower water and syrup. About 1 grain of ferric hypophosphite is contained in 1 fluidrachm of the finished syrup. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Ferri Lactophosphatis. N. F.

SYRUP OF LACTOPHOSPHATE OF IRON

The quantity of water was very slightly increased in the 3d ed. N. F. The syrup is made from ferrous lactate, phosphoric acid, water and syrup. About 1 grain of ferrous lactate or about 1½ grains of so-called lactophosphate of iron is represented in 1 fluidrachm of the finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Ferri Protochloridi. N. F.

SYRUP OF PROTOCHLORIDE OF IRON

[Syrup of Ferrous Chloride]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from solution of ferrous chloride, glycerin, orange flower water and syrup. About 1 grain of ferrous chloride is contained in 1 fluidrachm of the finished syrup. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Ferri Saccharati Solubilis. N. F.

SYRUP OF SOLUBLE SACCHARATED IRON

[Syrupus Ferri Oxydati Solubilis, G. P.; Syrup of Saccharated Oxide of Iron, Syrup of Soluble Oxide of Iron]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from solution of ferric chloride, sodium hydroxide, solution of sodium hydroxide, sugar, distilled water and syrup. About 1 grain of metallic iron is represented in 75 minims of this syrup. Used as a tonic and chalybeate.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Glycyrrhizæ. N. F.

SYRUP OF GLYCYRRHIZA

[Syrup of Licorice]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from pure extract of glycyrrhiza, glycerin, sugar and water. About 30 grains of glycyrrhiza root are represented in 1 fluidrachm of the finished syrup. It is used as a vehicle.

Average dose: 8 Cc. (2 fluidrachms).

Syrupus Hydrochlorophosphatum. N. F.

COMPOUND SYRUP OF PHOSPHATES WITH QUININE AND STRYCHNINE

[" Compound Syrup of Hydrochlorophosphates"]

This is a new preparation of the 3d ed. N. F., and is made from potassium bicarbonate, magnesium carbonate, calcium carbonate, soluble ferric phosphate, quinine hydrochloride, strychnine sulphate, phosphoric acid, citric acid, orange flower water, glycerin, sugar and distilled water. It contains 1–128th grain of strychnine sulphate and ¼ grain of quinine hydrochloride in 1 fluidrachm of finished syrup. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Ipecacuanhæ et Opii. N. F.

SYRUP OF IPECAC AND OPIUM

[Syrup of Dover's Powder]

This syrup is of the same relative strength as that of the 2d ed. N. F. Instead of being made as it was formerly, with fluidextract of ipecac and tincture of deodorized opium, it is now made with the official tincture of ipecac and opium, with spirit of cinnamon, cinnamon water and syrup. Five grains of Dover's powder are represented by 1 fluidrachm of finished syrup. Used as a diaphoretic and sedative.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Mannæ. N. F.

SYRUP OF MANNA

The formula for this syrup does not differ from that of the 2d ed. N. F. It contains about 12.5 per cent. of manna, with sugar, alcohol and water. Used as a laxative.

Average dose: 8 Cc. (2 fluidrachms).

Syrupus Morphinæ Compositus. N. F.

COMPOUND SYRUP OF MORPHINE

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of ipecac, senega and rhubarb, morphine sulphate, oil of sassafras and syrup. About 1–32d grain of morphine sulphate is contained in 1 fluidrachm of the finished syrup. Used as a sedative and expectorant.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Morphinæ Sulphatis. N. F.

SYRUP OF MORPHINE SULPHATE

[Syrupus Morphinæ, Syrup of Morphine]

This preparation does not differ from that of the 2d ed. N. F. It is made from morphine sulphate, water and syrup. About ⅛ grain of morphine sulphate is contained in 1 fluidrachm of the finished syrup.

Care should be used in dispensing this syrup, as the Sirop de Morphine of the French Codex is a weaker preparation and contains about 1–25th grain of morphine hydrochloride in 1 fluidrachm of syrup. Used as a sedative.

Average dose: 2 Cc. (30 minims).

Syrupus Papaveris. N. F.

SYRUP OF POPPY

The formula for this syrup does not differ from that of the 2d ed. N. F. It contains 87.5 per cent. of tincture of poppy, with sugar and water. It is a mild anodyne.

Average dose: 2 Cc. (30 minims.)

Syrupus Pectoralis. N. F.

PECTORAL SYRUP

[Jackson's Pectoral (or Cough) Syrup]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from morphine hydrochloride, oil of sassafras and syrup of acacia. About 1–32d grain of morphine hydrochloride is contained in 1 fluidrachm of the finished syrup. It is pectoral and sedative.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Phosphatum Compositus. N. F.

COMPOUND SYRUP OF PHOSPHATES

["Chemical Food"]

Several changes were made in the formula for this syrup. The quantity of citric acid was considerably increased, and that of glycerin has been increased five times; the quantity of phosphoric acid was slightly increased. The syrup is made from precipitated calcium carbonate, soluble ferric phosphate, ammonium phosphate, potassium bicarbonate, sodium bicarbonate, citric acid, glycerin, phosphoric acid, orange flower water, tincture of cudbear, sugar and water. About 2 grains of calcium phosphate, 1 grain each of the phosphates of iron and ammonium and smaller quantities of potassium and sodium phosphates are contained in 1 fluidrachm of the finished syrup. It is used as a tonic and nutrient.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Pini Strobi Compositus. N. F.

COMPOUND SYRUP OF WHITE PINE

The formula for this syrup does not differ from that of the 2d ed. N. F., except that the quantities of white pine bark and wild cherry bark have been slightly increased. It is made from white pine bark, wild cherry bark, spikenard root, balm of gilead buds, sanguinaria root, sassafras bark, morphine sulphate, chloroform, sugar, alcohol, water and syrup. About 1–32d grain of morphine sulphate is contained in 1 fluidrachm of the finished syrup. Used as an expectorant and sedative.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Quinidinæ. N. F.

SYRUP OF QUINIDINE

[Bitterless Syrup of Quinidine]

This is a new preparation of the 3d ed. N. F. It is made from quinidine, mucilage of acacia, solution of saccharin, and syrup of orange flowers. About ½ grain of quinidine is contained in 1 fluidrachm of finished syrup. Used as a tonic and antiperiodic.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Rhamni Catharticæ. N. F.

SYRUP OF RHAMNUS CATHARTICA

[Syrup of Buckthorn Berries, Syrupus Spinæ Cervinæ]

The formula for this syrup does not differ from that of the 2d ed. N. F. It contains 20 per cent. of fermented juice of buckthorn berries with sugar. Used as a cathartic.

Average dose: 8 Cc. (2 fluidrachms).

Syrupus Rhei et Potassi Compositus. N. F.

COMPOUND SYRUP OF RHUBARB AND POTASSA

[Neutralizing Cordial]

The proportions of the ingredients of this syrup have been slightly changed. It is made from the fluidextracts of rhubarb and hydrastis, potassium carbonate, tincture of cinnamon, spirit of peppermint, syrup and diluted alcohol. Used as a cathartic.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Rubi Aromaticus. N. F.

AROMATIC SYRUP OF BLACKBERRY

The formula for this syrup was slightly changed in the 3d. ed. N. F. It is made from rubus, cinnamon, nutmeg, cloves, allspice, sugar, diluted alcohol and fresh blackberry juice. It is used in diarrhœa.

Average dose: 8 Cc. (2 fluidrachms).

Syrupus Sanguinariæ. N. F.

SYRUP OF SANGUINARIA

[Syrup of Bloodroot]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from powdered sanguinaria, acetic acid, sugar and water. Used as an expectorant.

Average dose: 2 Cc. (30 minims).

Syrupus Sennæ Aromaticus. N. F.

Aromatic Syrup of Senna

The formula for this syrup does not differ from that of the 2d ed. N. F., except a slight increase in the quantity of sugar. It is made from fluidextract of senna, with jalap, rhubarb, cinnamon, cloves, nutmeg, oil of lemon, sugar, and diluted alcohol. About 7½ grains of deodorized senna, 3 grains of jalap, and 1 grain of rhubarb are contained in 1 fluidrachm of finished syrup. Used as a purgative.

Average dose: 8 Cc. (2 fluidrachms).

Syrupus Sennæ Compositus. N. F.

Compound Syrup of Senna

The formula for this syrup does not differ from that of the 2d ed. N. F., except that the quantity of alcohol is slightly increased. It is made from the fluidextracts of senna, rhubarb and frangula, oil of gaultheria, alcohol and syrup. About 8 grains of senna and 2 grains each of rhubarb and frangula are represented in 1 fluidrachm of the finished syrup. Used as a purgative.

Average dose: 8 Cc. (2 fluidrachms).

Syrupus Sodii Hypophosphitis. N. F.

Syrup of Sodium Hypophosphite

The formula for this syrup does not differ from that of the 2d ed. N. F., except that hypophosphorous acid replaces citric acid. It is made from sodium hypophosphite, hypophosphorous acid, sugar and water. Two grains of sodium hypophosphite are represented by 1 fluidrachm of finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

Syrupus Stillingiæ Compositus. N. F.

Compound Syrup of Stillingia

The formula for this syrup does not differ from that of the 2d ed. N. F., except a slight increase in the quantity of sugar. It is made from compound fluidextract of stillingia, purified talc, sugar and water. About 15 minims of compound fluidextract of stillingia are represented by 1 fluidrachm of the finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

Tinctura Aconiti, Fleming. N. F.

Fleming's Tincture of Aconite

The formula for this tincture does not differ from that of the 2d ed. N. F. Made from aconite root and alcohol. This is a preparation which should no longer be prescribed or dispensed, as it will be likely to produce confusion and possibly serious consequences. It is 7 times stronger than the official tincture of aconite. Seventy grammes of aconite root are represented in 100 Cc. of finished tincture. It is a heart sedative.

Average dose: 0.06 Cc. (1 minim).

Tinctura Amara. N. F.

Bitter Tincture

[Stomachic Tincture, Bitter Stomachic Drops, Stomach Drops]

The formula for this tincture was very slightly changed in the 3d ed. N. F., the quantities of orange berries and zedoary being increased. It is made from gentian, centaury herb, bitter orange peel, orange berries, zedoary root, alcohol and water. It is a bitter tonic.

Average dose: 2 Cc. (30 minims).

Tinctura Antacrida. N. F.

Antacrid Tincture

[Dysmenorrhœa Mixture, Fenner's Guaiac Mixture]

The quantities of guaiac, Canada turpentine and oil of sassafras were slightly increased in the 3d ed. N. F. in this tincture. It is made from corrosive mercuric chloride, guaiac, Canada turpentine, oil of sassafras and alcohol. About ⅓ grain of corrosive mercuric chloride is contained in 1 fluidrachm of finished tincture. Used in dysmenorrhœa.

Average dose: 1 Cc. (15 minims).

Tinctura Antiperiodica. N. F.

Antiperiodic Tincture

["Warburg's Tincture"]

The formula for this tincture has been considerably changed, prepared chalk, opium, black pepper, cinnamon and ginger having been added in the 3d ed. N. F., to the long list of other ingredients. The proportions have also been slightly changed. It is made from rhubarb, angelica seed, elecampane, saffron, fennel, prepared chalk, gentian, zedoary, cubeb, myrrh, camphor, white agaric, opium, black pepper, cinnamon, ginger, quinine sulphate, alcohol and distilled water. About 9 gr. of quinine sulphate are contained in 1 fl. oz. of finished tincture.

The above tincture without aloes is intended to be used as a stock tincture, Warburg's tincture with aloes being made by adding 8 grains of extract of aloes to each fluidounce of Warburg's tincture. For prescription and dispensing purposes, Warburg's tincture with aloes is to be dispensed when Warburg's tincture, without specification, is ordered.

Dosage.—The dosage of Warburg's Tincture depends on the kind used—whether with aloes or without—and the intended purpose, and varies from 4 Cc. (1 fluidrachm) to 16 Cc. (4 fluidrachms). The larger quantity is given when Dr. Warburg's original directions are followed for administering the remedy in remittent fevers, which were as follows: "One-half ounce to be given alone without dilution, after the bowels have been evacuated by any convenient purgative, all drink being withheld. After three hours, another half ounce is to be given." It is an antiperiodic.

Tinctura Aromatica. N. F.

AROMATIC TINCTURE

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from cinnamon, ginger, galangal, cloves, cardamom, alcohol and water. Used as a stimulant and aromatic.
Average Dose: 2 Cc. (30 minims).

Tinctura Capsici et Myrrhæ. N. F.

TINCTURE OF CAPSICUM AND MYRRH

[Hot Drops]

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from capsicum, myrrh, alcohol and water. It is a powerful stimulant and carminative.
Average dose: 2 Cc. (30 minims).

Tinctura Cinchonæ Detannata. N. F.

DETANNATED TINCTURE OF CINCHONA

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from fluidextract of cinchona, alcohol, solution of ferric sulphate, ammonia water, water and diluted alcohol. It is to be used in place of the official tincture of cinchona when iron preparations are directed.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Coto. N. F.

TINCTURE OF COTO

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from coto bark and alcohol. Used as an astringent.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Cresoli Saponata. N. F.

SAPONATED TINCTURE OF CRESOL

This is a new tincture made from 35 per cent. of cresol and 45 per cent. of soft soap with alcohol. Used as an antiseptic.

Tinctura Ferri Chloridi Ætherea. N. F.

ETHEREAL TINCTURE OF FERRIC CHLORIDE

[Bestucheff's Tincture, Lamotte's Drops]

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from solution of ferric chloride, ether and alcohol. It should be remembered that the official solution of ferric chloride has been reduced in strength. About ½ grain of metallic iron is represented in 1 fluidrachm of finished tincture. Used as a chalybeate.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Ferri Citro-Chloridi. N. F.

TINCTURE OF CITRO-CHLORIDE OF IRON

[Tasteless Tincture of Ferric Chloride, Tasteless Tincture of Iron]

The proportions of solution of ferric chloride and sodium citrate have been changed to conform to the alteration in strength of the official solution of ferric chloride. About 7½ grains of dry ferric chloride are represented in 1 fluidrachm of finished tincture. Used as a chalybeate.
Average dose: 0.65 Cc. (10 minims).

Tinctura Ferri Pomata. N. F.

TINCTURE OF FERRATED EXTRACT OF APPLES

[Tinctura Ferri Malatis Crudi, Tincture of Crude Malate of Iron]

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from ferrated extract of apples, alcohol and cinnamon water. About 1-8 grain of metallic iron is represented in 1 fluidrachm of finished tincture. Used as a chalybeate.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Guaiaci Composita. N. F.

COMPOUND TINCTURE OF GUAIAC

[Dewees' Tincture of Guaiac]

The formula for this tincture does not differ from that of the 2d ed. N. F., except a slight increase in the quantities of pimenta and pumice. It is made from guaiac, potassium carbonate, pimenta, pumice, alcohol, water and diluted alcohol. About 7½ grains of guaiac are represented in 1 fluidrachm of finished tincture. Used for rheumatism, and as an emmenagogue.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Iodi, Churchill. N. F.

CHURCHILL'S TINCTURE OF IODINE

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from iodine, potassium iodide, water and alcohol. About 16.5 per cent. of iodine and 3.3 per cent. of potassium iodide are represented in the finished tincture. Used as a discutient and counter-irritant.

Tinctura Iodi Decolorata. N. F.

DECOLORIZED TINCTURE OF IODINE

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from iodine, sodium thiosulphate, water, stronger ammonia water and alcohol. Used as a discutient.

Tinctura Jalapæ. N. F.

TINCTURE OF JALAP.

The formula for this tincture does not differ from that of the 2d ed. N. F. It contains 20 per cent. of jalap, with alcohol and water. Used as a cathartic.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Japalæ Composita. N. F.

COMPOUND TINCTURE OF JALAP

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from 12.5 per cent. of jalap and 3.2 per cent. of scammony, with alcohol and water. Used as a purgative.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Kino Composita. N. F.

Compound Tincture of Kino

The quantity of tincture of kino has been doubled to conform to the reduced strength of the official tincture of kino; the quantity of cochineal has been slightly decreased. The tincture is made from the tinctures of kino and opium, spirit of camphor, oil of cloves, cochineal, aromatic spirit of ammonia and diluted alcohol. About ½ grain each of kino and powdered opium are contained in 1 fluidrachm of finished tincture. Used as an astringent and anodyne.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Papaveris. N. F.

Tincture of Poppy

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from poppy capsules, glycerin, alcohol and water. About 30 grains of poppy capsules, freed from seeds, are represented in 1 fluidrachm of finished tincture. Used as a sedative.
Average dose: 2 Cc. (30 minims).

Tinctura Pectoralis. N. F.

Pectoral Tincture

[Guttæ Pectorales, Pectoral Drops, Bateman's Pectoral Drops]

The formula for this tincture does not differ materially from that of the 2d ed. N. F. It is made from tincture of opium, compound tincture of gambir, spirit of camphor, oil of anise, caramel and diluted alcohol. About 2.5 minims of tincture of opium are represented in 1 fluidrachm of finished tincture. Used as an expectorant.
Average dose: Infants, 0.65 Cc. (10 minims).

Tinctura Persionis. N. F.

Tincture of Cudbear

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from cudbear, alcohol and water. Used as a bright red coloring agent.

Tinctura Persionis Composita. N. F.

Compound Tincture of Cudbear

The formula for this tincture does not differ from that of the 2d ed. N. F., except that the quantity of cudbear was slightly reduced. It is made from cudbear, caramel, alcohol and water. Used as a brownish-red coloring agent.

Tinctura Pimpinellæ. N. F.

Tincture of Pimpinella

The formula for this tincture does not differ from that of the 2d ed. N. F. It contains 16.5 per cent. of pimpinella, with alcohol and water. Used as a diuretic and tonic.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Rhei Aquosa. N. F.

Aqueous Tincture of Rhubarb

The formula for this tincture was very slightly changed in the 3d ed. N. F. It is made from rhubarb, sodium borate, potassium carbonate, cinnamon water, alcohol and water. About 5⅔ grains of rhubarb are represented in 1 fluidrachm of finished tincture. Used as a cathartic.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Rhei et Gentianæ. N. F.

Tincture of Rhubarb and Gentian

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from rhubarb, gentian and diluted alcohol. About 4 grains of rhubarb and 1 grain of gentian are represented by 1 fluidrachm of finished tincture. Used as a tonic and laxative.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Rhei Vinosa. N. F.

Vinous Tincture of Rhubarb

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of rhubarb and bitter orange peel, tincture of cardamom, sugar and sherry wine. Used as a laxative and stomachic.
Average dose: 4 Cc. (1 fluidrachm).

Tinctura Saponis Viridis Composita. N. F.

Compound Tincture of Green Soap

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from soft soap, oil of cade and alcohol. It is a detergent used in skin diseases.

Tinctura Tolutana Ætherea. N. F.

Ethereal Tincture of Tolu

This is a new preparation in the 3d ed. N. F. It contains 16.5 per cent. of balsam of tolu in alcohol and ether. It is used for coating pills.

Tinctura Tolutana Solubilis. N. F.

Soluble Tincture of Tolu

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from balsam of tolu, magnesium carbonate, glycerin, water and alcohol. Used for producing a transparent mixture with water or syrup.
Average dose: 2 Cc. (30 minims).

Tinctura Vanillini Composita. N. F.

Compound Tincture of Vanillin

[Compound Essence of Vanillin]

The formula for this tincture does not differ from that of the 3d ed. N. F. It is made from vanillin, cumarin, alcohol, glycerin, syrup, compound tincture of cudbear and water. Used for flavoring.

Tinctura Viburni Opuli Composita. N. F.

COMPOUND TINCTURE OF VIBURNUM

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from viburnum opulus, dioscorea, scullcap, cloves, cinnamon, glycerin, alcohol and water. Used as an antispasmodic.
Average dose : 4 Cc. (1 fluidrachm).

Tinctura Zedoariæ Amara. N. F.

BITTER TINCTURE OF ZEDOARY

[Compound Tincture of Zedoary]

The formula for this tincture does not differ from that of the 2d ed. N. F. About 15 grains of zedoary, 7.5 grains of aloes, 3.75 grains each of rhubarb, gentian, white agaric and saffron, with glycerin, alcohol and water, are contained in 1 fluidrachm of finished tincture. It is used as a tonic and laxative.
Average dose : 4 Cc. (1 fluidrachm).

Tincturæ Æthereæ. N. F.

ETHEREAL TINCTURES

In the general formula for ethereal tinctures the quantity of drug has been reduced from 12.5 per cent. to 10 per cent.

Unguenta Extensa. N. F.

"SALVE MULLS"

[Steatina, Steatins]

These are new preparations for external use introduced into the 3d ed. N. F., consisting of mulls or gauze upon which certain ointments are spread uniformly. The following ointments are used :

1. *Unguentum Zinci Extensum, 10 per cent. Zinc Salve Mull (10 per cent.).*—This contains 10 per cent. of zinc oxide, with benzoinated suet and benzoinated lard.
2. *Unguentum Salicylatum Extensum, 10 per cent.—Salicylic Acid Salve Mull (10 per cent.).* This contains 10 per cent. of salicylic acid with benzoinated suet and benzoinated lard.
3. *Unguentum Hydrargyri Chloridi Corrosivi Extensum, 0.2 per. cent.—Corrosive Mercuric Chloride Salve Mull (0.2 per cent.).*—This contains 0.2 per cent. of corrosive mercuric chloride with alcohol, benzoinated suet and benzoinated lard.
4. *Unguentum Creosoti Salicylatum Extensum, 20 : 10 per cent.—Creosote-Salicylic Acid Salve Mull (20:10 per cent.).*—This contains 20 per cent. of creosote, 10 per cent. of salicylic acid, with yellow wax and benzoinated suet.

Unguentum Calaminæ. N. F.

CALAMINE OINTMENT

[Unguentum Zinci Carbonatis (Impuri), Unguentum Calaminare, Turner's Cerate]

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 1 part of calamine, with five parts of ointment. Used as an antiseptic.

Unguentum Camphoræ. N. F.

CAMPHOR OINTMENT

[Unguentum Camphoratum]

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 22 per cent. of camphor, with white wax and lard. Used as an anodyne.

Unguentum Fuscum. N. F.

BROWN OINTMENT

[Unguentum Matris, Mother's Salve]

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 50 per cent. of camphorated brown plaster, with olive oil and suet. Used as a discutient.

Unguentum Picis Compositum. N. F.

COMPOUND TAR OINTMENT

The formula for this ointment differs very little from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from the oil of tar, tincture of benzoin, zinc oxide, yellow wax, lard and cotton seed oil. It is used against parasites and in skin diseases.

Unguentum Resorcini Compositum. N. F.

COMPOUND RESORCIN OINTMENT

["Soothing Ointment"]

This is a new preparation in the 3d ed. N. F. It contains 6 per cent. each of resorcinol, zinc oxide and bismuth subnitrate, 12 per cent. of oil of cade, with paraffin, petrolatum and hydrous wool fat. It is used as an antiseptic and astringent in skin diseases.

Unguentum Sulphuris Compositum. N. F.

COMPOUND SULPHUR OINTMENT

[Wilkinson's Ointment, Hebra's Itch Ointment]

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 10 per cent. of precipitated calcium carbonate, 15 per cent. of sublimed sulphur, 15 per cent. of oil of cade, with soft soap and lard. Used in the treatment of itch.

Vinum Aurantii. N. F.

WINE OF ORANGE

The formula for this wine does not differ from that of the 2d ed. N. F. It is made from oil of bitter orange, alcohol, purified talc and sherry wine. Used as a flavor.

Vinum Aurantii Compositum. N. F.

COMPOUND WINE OF ORANGE

[Elixir Aurantiorum Compositum, Compound Elixir of Orange]

The formula for this wine was very slightly changed in the 3d ed. N. F. The quantities of cinnamon and gentian were increased. It is made from bitter orange peel, absinthium, menyanthes leaves, cascarilla, cinnamon, gentian, potassium carbonate and sherry wine. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

Vinum Carnis. N. F.

Wine of Beef

["Beef and Wine"]

The quantity of extract of beef has been slightly reduced in the 3d ed. N. F. and the quantity of hot water slightly increased. Syrup, alcohol and compound spirit of orange have been added, which, with sherry wine, completes the list of ingredients. Two grains of extract of beef are represented in 1 fluidrachm of the finished wine. Used as a nutrient tonic.

Average dose: 8 Cc. (2 fluidrachms).

Vinum Carnis et Ferri. N. F.

Wine of Beef and Iron

["Beef, Wine and Iron"]

Compound spirit of orange, alcohol and syrup have been added to the formula for this wine, and there has also been a slight decrease in strength. Two grains of extract of beef, and 2 minims of tincture of citro-chloride of iron are represented in 1 fluidrachm of the finished wine. Used as a nutrient and tonic.

Average dose: 8 Cc. (2 fluidrachms).

Vinum Carnis, Ferri et Cinchonæ. N. F.

Wine of Beef, Iron and Cinchona

["Beef, Wine, Iron and Cinchona"]

The formula for this wine has been changed. It is now made from quinine sulphate, cinchonidine sulphate, citric acid and wine of beef, and iron. Two grains of extract of beef, 2 minims of tincture of citro-chloride of iron, and small quantities of cinchona alkaloids are represented in 1 fluidrachm of finished wine. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

Vinum Cocæ Aromaticum. N. F.

Aromatic Wine of Coca

[Vinum Erythroxyli Aromaticum, Aromatic Wine of Erythroxylon]

The formula for this wine does not differ from that of the 2d ed. N. F. It is made from fluidextract of coca, compound elixir of taraxacum, syrup of coffee, port wine, aromatic elixir and sherry wine. About 30 grains of coca are represented in 1 fluidounce of finished wine. Used as a nerve stimulant.

Average dose: 8 Cc. (2 fluidrachms).

Vinum Fraxini Americanæ. N. F.

Wine of White Ash

The formula for this wine does not differ from that of the 2d ed. N. F. About 30 grains of white ash bark are represented in 1 fluidrachm of the finished wine. Used as a stimulant and emmenagogue.

Average dose: 4 Cc. (1 fluidrachm).

Vinum Pepsini. N. F.

Wine of Pepsin

["Pepsin Wine"]

The formula for this wine was changed in the 3d ed. N. F. It is now made of glycerite of pepsin, alcohol and sherry wine. One grain of pepsin is represented in 1 fluidrachm of the finished wine. Used as a digestive.

Average dose: 8 Cc. (2 fluidrachms).

Vinum Picis. N. F.

Wine of Tar

The formula for this wine does not differ from that of the 2d ed. N. F. It is made from tar, water, pumice and stronger white wine (U. S. P. 1880). Used as a stimulant and expectorant.

Average dose: 8 Cc. (2 fluidrachms).

Vinum Pruni Virginianæ. N. F.

Wine of Wild Cherry

The formula for this wine does not differ from that of the 2d ed. N. F., except that the quantity of alcohol was increased 25 per cent. About 15 grains of wild cherry are represented in 1 fluidrachm of the finished wine. Used as a tonic and pectoral.

Average dose: 4 Cc. (1 fluidrachm).

Vinum Pruni Virginianæ Ferratum. N. F.

Ferrated Wine of Wild Cherry

The formula for this wine does not differ from that of the 2d ed. N. F., except that the quantity of tincture of citro-chloride of iron was slightly decreased. About 5 minims of tincture of citro-chloride of iron and 13¾ grains of wild cherry are represented by 1 fluidrachm of finished wine. Used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

Zinci Oleo-Stearas. N. F.

Oleo-Stearate of Zinc

This is a new preparation in the 3d ed. N. F. It is made from zinc acetate, stearic acid, oleic acid, potassium hydroxide, alcohol and distilled water. It is a white powder, used as an antiseptic application.

ANSWERS TO PRACTICAL PROBLEMS AND EXERCISES

(See page 91)

[The answers to these questions have been worked out from the data given in the problems or chapters, but may vary slightly from other results on account of the use of metric or other equivalents not given in this book, or because in the answer or in some of the results leading to it, the decimals have not been carried out far enough or perhaps too far.]

1. *Ans.* 700 grains each of powdered ipecac and opium and 5600 grains of powdered sugar of milk. **2.** Ten percent. each of powdered ipecac and opium and 80 percent. of powdered sugar of milk. **3.** 3195 grains. **4.** 3775 grains. **5.** 34 cents. **6.** 128. **7.** 7680. **8.** 9600. **9.** 1750. **10.** 1822.8. **11.** 1920. **12.** 48+ (1 pint = 7291.2 grains). **13.** 41.66+. **14.** 80. **15.** Linseed oil, f ℥ii; lime water, f ℥iv. **16.** Six. **17.** Place 4.55 grains (1 percent. of 455 grains) of cocaine hydrochlorate in a graduate, and dissolve it in enough distilled water to make a fluidounce; or, more conveniently, dissolve 5 grains in 1 fl. oz. 40 minims of water and use 1 fl. oz. of the solution. **18.** Strychnine, 2 grains; quinine, 128 grains; ferric phosphate, 256 grains. **19.** $1.20. **20.** He would lose $1. **21.** 7500 mm. **22.** 8.0623 M. **23.** 6.30 M. **24.** 12.543 M. **25.** 12.543 M. **26.** 1.001 M. **27.** Twenty-five dekameters. **28.** Twenty-five decimeters. **29.** Yes. **30.** One meter and twenty centimeters. **31.** $1.2 is an unusual way of expressing one dollar and two-tenths; one dollar and two dimes is also unusual; but one dollar and twenty cents is common. **32.** Four thousand two hundred and sixty-three meters and six hundred and seventy-eight millimeters. **33.** 81.396 M. (Place each row in position, beginning at the right-hand column, and add in the usual manner; if 816 cm. is to be placed, beginning with 6 in the centimeter place, and 8 would be in the meter place, thus 8.16; 732 dm. would be 73.2, while 36 mm. would be 0.036) —

$$\begin{array}{r} 8.16 \\ 73.2 \\ 0.036 \\ \hline 81.396 \end{array}$$

34. 0.015 M. **35.** 473.016 M. **36.** 500. **37.** 8.36 sq. M. **38.** 8.3608 sq. M. **39.** 3.030303 sq. M. **40.** 20.202020 sq. M. **41.** 505.0005 sq. M. **42.** 1,000,000. **43.** 63.063063063 cu. M. **44.** 1000. **45.** A liter. **46.** 50. **47.** 174.625 L., or 174 L. 625 Cc. **48.** Oil of juniper, 2 Gm.; oil of caraway, oil of fennel, each 0.20 Gm.; alcohol, 600 Gm.; water, 397.60 Gm. **49.** Oil of juniper, 14 grains; oil of caraway, oil of fennel, each 1.4 grains; alcohol, 4200 grains; water, 2783.2 grains. **50.** 82.28+. **51.** 61.69+ fl. oz. (7291.2 × 1.387, the sp. gr. of solution of ferric chloride (see page 93) = 10112.894, the weight of one pint of solution of ferric chloride; 10112.894 × 37.8 = 3822.6740832, the number of grains of anhydrous salt in one pint of solution of ferric chloride; 10 times this amount (10 × 3822.6740832) equals the weight in grains of a solution containing 10 percent. of anhydrous salt, 38226.740 grains; now if the weight of one pint of solution of ferric chloride be subtracted from it, the remainder must be the number of grains of water to be added to make the whole 10 percent., 38226.740 — 10112.894 = 28113.846; then 28113.846 ÷ 455.7 (the number of grains in a fluidounce of water) = 61.69+ fl. oz.). **52.** 7.161+ fl. oz. solution, 8.839+ fl. oz. water. **53.** 15 percent. **54.** 5.5 grains. **55.** 377 grains. **56.** 16 minims. **57.** 480. **58.** 630 grains. **59.** 604.83+ grains. **60.** 497.6+ grains. **61.** $\frac{37}{64}$. **62.** 3235.47 grains. **63.** 25.277+ grains. **64.** 28.709+ grains. **65.** 3059 grains. **66.** 4932.32 grains. **67.** 38.53+ grains. **68.** 15.6 minims. **69.** 3758.75+. **70.** 103.78+ minims. **71.** 1800. **72.** 61.025+ (gallon = 231 cu. in.). **73.** 0.4731+. **74.** 28314.87+. **75.** 946.32+. **76.** 2113.4+. **77.** 270.52+. **78.** 453.59+. **79.** 1370.17+. **80.** 373250.38+. **81.** 91.44+. **82.** 189. **83.** 1021.2. ***83a.*** 1.0212. ***83b.*** 1021200. **84.** 1609.329+. **85.** 721.65+. **86.** 187.2. **87.** 5 oz., 262.5 grains. **88.** 20. **89.** 3.47+ grains. **90.** 0.324 Gm., 5 grains nearly. **91.** 5248 grains. **92.** 10 lbs. troy, or 8 lbs. 3 oz. 287.5 gr. av. **93.** 30 lbs. troy, or 24 lbs. 10 oz. 425 gr. av. **94.** 8 lbs. 9 oz. troy weight, or 7 lbs. 3 oz. 87.5 gr. av. **95.** 4.4. **96.** 4.2. **97.** 11.45. **98.** 6.49. **99.** 1 ÷ 6.49 = 0.154+. **100.** 4.680 kilogrammes. **101.** 625 centimeters. **102.** 21.84 kilogrammes. **103.** 11.5.

104. 4.2. **105.** 0.960+. **106.** 1.476+ chloroform. **107.** 1.246 glycerin. **108.** 589.58+. **109.** 36.848. **110.** 698.41+. **111.** 43.65+ Gm. **112.** 0.4731+. **113.** $\frac{1}{1024}$. **114.** $\frac{1}{1920}$. **115.** $\frac{3}{35}$ (Oi = 473.11 Cc.). **116.** 0.845.

$$\begin{array}{r} 68.25 \\ \underline{35.7} \\ 32.55 \end{array} \qquad\qquad \begin{array}{r} 177.45 \\ \underline{32.55} \\ 210.00 \end{array} \qquad\qquad \begin{array}{r|l} 210\,) & 177.45\,(0.845 \\ & \underline{1680} \\ & 945 \\ & \underline{840} \\ & 1050 \\ & 1050 \end{array}$$

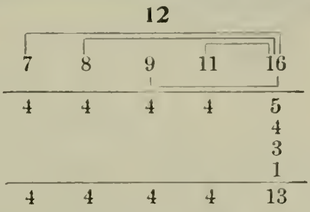
117. 400 grains. **118.** 16 oz. av. Weight of bottle 15 oz. av. **119.** 454.21+ (Oi = 473.11 Cc.). **120.** 56 lbs. 4 oz. 164.04 gr. av. **121.** 726.74+ (Oi = 473.11 Cc.). **122.** 11.45+. **123.** 7.69+. **124.** 9. **125.** 10.6+. **126.** 5 pints phenol cost $2.21+, 5 pints glycerin cost $2.08+ ; the druggist therefore loses 13+ cents. **127.** 1.31. 1560 : 7.8 : : 262 : 1.31. **128.** 0.820 alcohol. **129.** 11220 lbs. 399.360 gr. av. (1 cu. in. 252.509 grains) = 180 cubic feet ; volume = 192 cubic feet. **130.** 11 gallons 3 pints 10.18 fl. oz., or 95 lbs. 7 oz. 76.314 gr. av. **131.** 0.0738+. **132.** 0.9372+. **133.** 0.8025. **134.** 0.25. **135.** 15.28 fl. oz. **136.** 9.3 Cc. **137.** 36.456 grains (see answer to No. 17). **138.** 25.56 oz. av. **139.** Weight of the bottle, 7436.94 grains ; weight of the syrup, 8598.06 grains ; weight of the oil, 5907.06 grains. **140.** Weight of the bottle, 6125 grains ; weight of the water, 7000 grains. **141.** Weight of the water, 16.5 oz. av. ; weight of acid, 19.14 oz. av. ; sp. gr. 1.16 ; hydrochloric acid. **142.** Lard, 28.57 percent. ; wax, 57.14 percent. ; spermaceti, 14.29 percent. **143.** 285.71 Gm. lard ; 571.43 Gm. wax ; 142.86 Gm. spermaceti. **144.** 296+ percent. profit.

500 Gm. ether = 7716.2 grains
4 fl. oz. water = 1822.8 grains
1822.8 × 0.716 = 1305.1, weight of 4 fl. oz. ether
7716.2 : 75 : : 1305.1 : X = 12.6+ cents, cost of ether
50 — 12.6 = 37.4 cents profit
12.6 : 100 : : 37.4 : X = 296+

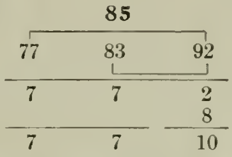
145. 0.928 percent. **146.** 32.47. **147.** 6 fl. oz. **148.** Morphine sulphate, 0.9 Gm. ; camphor, 19.2 Gm. ; glycyrrhiza, 19.8 Gm. ; prec. calc. phosph. 20.1 Gm. **149.** $1.56+. **150.** 13 oz. $72\frac{1}{2}$ grains (13.166 oz.). **151.** 14 oz. 280 grains (14.58 oz.). **152.** 8.3328 lbs. av. **153.** 10.126 lbs. troy. **154.** 11.415 lbs. av. **155.** 0.2286 percent. **156.** 0.0143 percent. **157.** 1.0416. **158.** 0.9600615. **159.** 7.14 percent. **160.** 3998.5+ grains. **161.** 4.227. **162.** About $3\frac{1}{5}$ by $4\frac{4}{5}$ inches. **163.** 5 inches = 12.7 cm. The funnel is 0.7 cm. or about $\frac{1}{3}$ inch too small. **164.** 3.3831 grains. **165.** 231.5 grains. **166.** 252+ percent. **167.** 51.54+ percent. **168.** 15.4+ cents. **169.** 2083+ Cc. **170.** 3 fl. oz. 157 minims. **171.** 1358.125 Cc. **172.** 5 percent. **173.** 12 oz. av. salt, $14\frac{1}{4}$ lbs. water. **174.** 27 + 3 = 30 Gm. of total solution. 3 ÷ 30 = 0.10 or 10 percent. **175.** 437.5 ÷ 8 = 54.7 grains ; this added to 455.7 grains = 510.4 grains total solution ; 54.7 ÷ 510.4 = 0.107+ or 10.7 percent. **176.** 480 ÷ 8 = 60 grains + 455.7 grains = 515.7 grains total solution. 60 ÷ 515.7 = 0.116 or 11.6 percent. **177.** 3.64+ grains. **178.** 0.333 Gm. **179.** 6.17+ percent. (480 + 7291.2 = 7771.2 ; 480 ÷ 7771.2 = 0.0617). **180.** 18 + 1 = 19 parts total. 1 ÷ 19 = 0.05263 = 5.26 percent. **181.** 48.98 percent. 7291.2 + 7000 = 14291.2 ; 7000 ÷ 14291.2 = .4898 or 48.98 percent. **182.** 5760 + 7291.2 = 13051.2 ; 5760 ÷ 13051.2 = 0.4413 or 44.13 percent. **183.** 9.1 grains. **184.** 57.14 percent. **185.** 5 Gm. **186.** 46.65 Gm. **187.** 93+ cents. **188.** Oil of turpentine heavier by 45.57 grains. **189.** $2.34. **190.** 63+ cents a gallon. **191.** 173.97 Cc. **192.** 39.9 troy oz. **193.** 22 fl. oz. **194.** 12 fl. oz. **195.** 14 fl. oz. **196.** 6 fl. oz. **197.** 2 fl. oz. (actual measure 1.14 fl. oz.). **198.** Salicylic acid, 207 grains ; monohydrated sodium carbonate, 93 grains. **199.** 86.2 Gm. salicylic acid, 38.7 Gm. monohydrated sodium carbonate. **200.** 58.9+ cents.

ALLIGATION

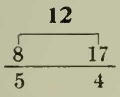
1. 2 parts of 7 percent. and 9 parts of 18 percent. **2.** 6 parts of 7 percent. and 5 parts of 18 percent. **3.** 6 parts of 7 percent., 7 parts of 16 percent., and 7 parts of 18 percent. **4.** 4 parts of 7 percent., 2 parts of 8 percent., 6 parts of 16 percent., 7 parts of 18 percent., or 2 parts of 7 percent., 4 parts of 8 percent., 7 parts of 16 percent., 6 parts of 18 percent. **5.** 7 parts of 9 percent., 5 parts each of 15, 16, and 18 percent. **6.** 4 parts of 7 percent., 4 parts of 8 percent., 4 parts of 9 percent., 4 parts of 11 percent., and 13 parts of 16 percent.



7. 7 parts of 77 percent. 539
7 parts of 83 percent. 581
10 parts of 92 percent. 920
24 24)2040
85



8. 10 oz. **9.** 184 parts of glycerin and 246 parts of alcohol. **10.** 36 parts of glycerin and 125 parts of diluted alcohol. **11.** 58.82 ounces of 94 percent. and 41.18 ounces of 60 percent. **12.** 148.7 Cc. of alcohol, 77.3 Cc. of glycerin, and 24 Cc. of syrup. **13.** 26 pints of 0.820, 3 pints each of sp. gr. 0.935 and sp. gr. 0.865. **14.** 12½ troy ounces.

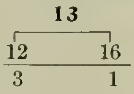


4 : 5 : : 10 : 12½

$10 \times 17 = 170$
$12\frac{1}{2} \times 8 = 100$
$22\frac{1}{2}$ 270

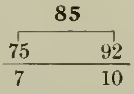
$270 \div 22\frac{1}{2} = 12$ percent.

15. 160 grains.



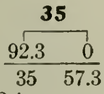
3 : 480 : : 1 : 160

16. $685\frac{5}{7}$ grains.



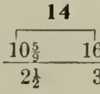
7 : 480 : : 10 : $685\frac{5}{7}$

17. 72.16 oz. av. ($7291.2 \times 2 \times 0.816 = 11899.238$ grains in a quart of U. S. P. alcohol; and $11899.238 \times 0.923 = 10982.997$ grains of absolute alcohol (92.3 percent. absolute alcohol in U. S. P. alcohol).



35 parts of alcohol (92.3 percent.) require 57.3 parts of water to make the mixture 35 percent.; then as 35 : 57.3 : : 11899.238 : 19680.466 and $19680.466 + 11899.238 \div 437.5 = 72.16$ oz. av.

18. 12.4 oz.



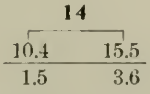
4 oz. 10 percent. = 40
5 oz. 11 percent. = 55
9 95

$95 \div 9 = 10\frac{5}{9}$ percent.

$2\frac{1}{2} : 9 : : 3\frac{4}{9} : 12.4$

19. 24 oz.

3 oz. 9 percent. = 27
3½ oz. 10 percent. = 35
3½ oz. 12 percent. = 42
10 104



$104 \div 10 = 10.4$ percent.

1.5 : 10 : : 3.6 : 24

20. 1280 grains 8 percent., 1920 grains 11 percent., 1280 grains 16 percent. and 320 grains 18 percent. **21.** 18.5 parts to every 32.3 parts. **22.** 5 oz. 362+ grains. 50.8 : 18.5 : : 7000 grains : 2550 grains.

23. 6 ℥ 192 grains.

$$\begin{array}{cc} \multicolumn{2}{c}{\mathbf{14}} \\ 16 & 13\frac{1}{2} \\ \hline \frac{1}{2} & 2 \end{array}$$

For one part of 16 percent. he must use 4 parts of 13½ percent., or $\frac{4}{5}$ of the whole amount of 13½ percent. $\frac{4}{5}$ of 8 oz. = 6 oz. 192 grains.

24.

$$\begin{array}{cc} \multicolumn{2}{c}{\mathbf{2}} \\ 1.6 & 3\frac{7}{8} \\ \hline 1\frac{7}{8} & .4 \end{array}$$

$1\frac{7}{8}$ oz. = 900 grains
$\frac{4}{10}$ oz. = 192 grains
or in the proportion of 75 to 16.

25. 20 parts of $\frac{15}{16}$ths of 1 percent. and 17 parts of 3¼ percent. **26.** 23 parts of 1.235 percent. and 51 parts of 2.345 percent. **27.** 11 parts of 1.676 percent. and 3 parts of 3.188 percent. **28.** 43 parts of 0.840 percent., 43 parts of 1.848 percent., and 82 parts of 2.688 percent. **29.** 19 oz. 256¾ grains. If 43 parts are equal to 5 oz., then by proportion 82 parts are equal to 19 oz. 256¾ grains. **30.** 5 oz. of 0.840 percent., 11.7905 oz. of 2.688 percent., and 15.2095 oz. of 1.848 percent. **31.** 43.2 oz. of solution, 22 oz. of water. **32.** 2 pints 8 fl. oz. 353 min. **33.** 16 fl. oz. of 1.412, 20 fl. oz. of 1.448. **34.** 57.6 fl. oz. water. **35.** $20\frac{4}{7}$ oz. 28 : 18 : : 32 : $20\frac{4}{7}$. If in 28 oz. there are 18 oz. water, then 32 oz. will require $20\frac{4}{7}$ oz. **36.** 11.5+ fl. oz.

$$\begin{array}{cc} \multicolumn{2}{c}{\mathbf{81}} \\ 94.9 & 76 \\ \hline 5 & 13.9 \end{array}$$

13.9 : 5 : : 32 : 11.5

37. 80 fl. oz. 76.8 min. **38.** 3 parts of 1.03 percent., 7 parts of 1.10 percent., 15 parts of 1.32 percent., and 22 parts of 1.28 percent. **39.** 63.8 Gm. of 1.03 percent., 148.9 Gm. of 1.10 percent., 319.2 Gm. of 1.32 percent., and 468.1 Gm. of 1.28 percent. **40.** 1506.4 Gm. **41.** 832.5 Gm. **42.** 115.35 Gm. **43.** 80 Cc. **44.** 2.77+ pints. **45.** 3.08+ pints. **46.** 7.14 Gm. **47.** 349.2 Gm. **48.** 21.5+ fl. oz. **49.** 1088.6+ Gm. **50.** 84 parts of 3.52 to 48 parts of 4.84.

GLOSSARY

OF

UNCOMMON NAMES, TERMS, OR SUBSTANCES

A.

Acetum Acerrimum. Concentrated acetic acid.
Bezoardicum. Aromatic vinegar.
Saturni. Solution of lead subacetate.
Theriacale. Aromatic vinegar.
Acetylphenylamine. Acetanilid, *U. S. P.*
Acid, Anticyclic. Mixture of antipyrin and salicylic acid.
Boroboracic (Acid Boroboric). Mixture of equal parts of borax and boric acid.
Borussic. Prussic. Hydrocyanic.
Carbazotic (Picronitric acid). Picric acid.
Coalic. Obtained by treating coal with 34 per cent. nitric acid.
Cresylic. Cresol.
Nancic. Lactic acid.
Phenic. Carbolic acid.
Sozoiodolic. Diiodoparaphenolsulphonic acid. (Antiseptic.)
Sozolic. Orthophenolsulphonic acid.
Sulphhydric. Hydrogen sulphide. Sulphuretted hydrogen. Hydrosulphuric acid.
Thiolinic. Sulphurated and sulphonated linseed oil.
Tumenolsulphonic. Obtained by treating the distillate of a mineral oil with sulphuric acid.
Acidum Asepticum (Acidum Aseptinicum). Mixture of solution of hydrogen peroxide with boric and salicylic acids.
Chloronitrosum. Nitrohydrochloric acid.
Cœruleum (Blue acid). Hydrocyanic acid.
Muriaticum Oxygenatum. Chlorine.
Nitrico-Nitrosum. Fuming nitric acid.
Ossium. Glacial phosphoric acid.
Scytodepsicum. Tannic acid.
Actina. Contains menthol, oil of mustard, and ether.
Adeps Anserinus. Goose-grease.
Gadi. Cod-liver oil.
Lanæ. Lanolin (purified wool-fat).
Ovillus. Mutton-suet.
Adipatum. Substitute for lard; a mixture of lanolin, vaselin, and ceresin.
Adragante. Tragacanth.
Aer Fixus. Carbonic acid gas.
Aerosus Lapis. Lapis calaminaris.
Aerozol. Ozonized volatile oils. (Ozone Co., New York.)
Ærugo. Crude copper acetate.
Æs. Copper.
Æs Aratum. Copperas.
Æther Vegetabilis. Acetic ether.
Ætheroleum. Volatile (essential) oil.
Æthiops Antimonialis. Chiefly a mixture of black antimony and mercury.
Martialis. A black iron oxide; formed by keeping iron filings covered with water for a long time.
Mineralis. Mixture of mercury and sulphur.
per se. Mercury oxide.
Vegetabilis. Charcoal of sea-weed.
Affium. Extract of poppy-heads (opium).
Agathin. Salicylalphamethylphenylhydrazone. (Anodyne.)
Agnine. Lanolin without the water. (Metcalf & Co., Boston.)
Agopyrin. Said to be a mixture of salipyrin, ammonium chloride, and cinchonine sulphate. (Influenza remedy.)
Alabastine. An improved kalsomine.
Alanin-Mercury. Mercury amidopropionate.
Alboline. A purified petroleum product, similar to white vaselin. (McKesson & Robbins.)
Album Græcum. Excrement of dogs.
Nigrum. Excrement of mice or rats.
Alcohol Sulphuris. Carbon disulphide.
Alcolene. A mixture of ethyl and methyl alcohols.
Alcoolat (French). A distilled spirit.
Alcoolature (French). An alcoholic tincture of a fresh plant. ("Green tinctures.")

Alcoolė (French). An alcoholic solution of a substance entirely soluble in the alcohol.

Alegar. Ale vinegar. (Made by fermenting ale upon raisins or vine cuttings.)

Alexine. A generic name for protective albuminous preparations used for inoculations.

Algaroth. Antimony oxychloride.

Alkali, Vegetable. Potassium carbonate.

Volatile. Ammonium carbonate.

Alkalithia. Contains caffeine, sodium, and potassium bicarbonates, and lithium carbonate. (Specialty of Keasbey & Mattison.)

Alkathrepta. A homœopathic preparation of cacao.

Almond Bran. A cosmetic powder for washing, consisting of perfumed powdered almonds and borax.

Alum, Rock (Alumen Rupeum). Lump alum as it occurs with the earth attached.

Roman. See Rock Alum.

Alumen Plumosum. Asbestos.

Alumnol. Aluminum salt of oxymethylsulphonic acid. Aluminum naphtol sulfonate. (Astringent antiseptic.)

Amadou. Punk; tinder.

Ambretta Seeds. Musk seeds.

Amianthus. Asbestos.

Amidol. Diamidophenol (for photographic purposes).

Amidum. Starch.

Ammonium Carbonicum Pyro-Oleosum. A mixture of ammonium carbonate with "animal oil."

Sulpho-Ichthyolate. Ichthyol.

Amphion. Opium.

Amplosia. An unfermented juice of the grape.

Amylopsin. Starch-converting ferment of the pancreatic juice.

Analgene. An antineuralgic and anodyne. Orthoexethylalphamonoacetylamidochinoline. Orthoöxyethylanamonobenzoylamidoquinoline.

Analgesine. Antipyrin.

Anaphromeli. Clarified honey (Mel despumatum).

Anaspalin. Ointment base, similar to lanolin.

Angioneurosin. Nitroglycerin.

Anima Articulorum (Life of the Limbs). A name given to colchicum.

Rhei. Aqueous tincture of rhubarb.

Annidalin. Aristol. (Antiseptic.)

Anodynin. Antipyrin.

Antacidines. Lime-water tablets. (Metcalf & Co., Boston.)

Anthos (**Flores or Herba**). Rosemary (flowers or herb).

Anthrakokali. Coal treated with caustic potassa.

Anthrarobine. Dioxyanthranol. Leucoalizarin. (Antiseptic dermic.)

Antibacteride. A mixture of borax, boric acid, and glucose.

Anticholerine. A product of cholera bacteria, according to Klebs.

Antidiphtherine. Potassium chlorate with a trace of iron chloride.

Antidotum Fuchsi. Fluid ferric hydrate. (Arsenic antidote.)

Antifebrin. Acetanilid, *U. S. P.* Acetylphenylamine. Phenylacetamide.

Antifungin. Antiseptic. Contains magnesium biborate and free boric acid.

Antikamnia. An anodyne. Said to be a mixture of antifebrin, sodium bicarbonate (with or without caffeine), and tartaric acid. (Anodyne, antipyretic.)

Antikol. Mixture of acetanilid, sodium bicarbonate, and tartaric acid.

Antimonium Album. Bismuth.

Antimony, Diaphoretic. Potassium antimonate.

Antinervine. Salicyl-bromanilid. Said to be a mixture of acetanilid, ammonium bromide, and salicylic acid. (Sedative.)

Antinonnine. Potassium orthodinitrocresol with soap and glycerin. (Parasiticide.)

Antipyrin. Analgesine. Anodynine. Dimethyloxychinozin. Parodyn. Metosin. Phenazon. Phenylon. Phenyldimethylpyrazolon. Pyracin. Phenyldimethylisopyrazolon. Pyrazolon. Oxydimethyl-chinizin. Sedatin. Oxydiëthylquinizine.

Antisepsin. Monobromacetanilid. Paramonobromphenylacetamide.

Antiseptin. Mixture of zinc iodide and sulphate with boric acid and thymol.

Antiseptol. Cinchonine iodosulphate. (Antiseptic.)

Antithermal. A new antipyretic of unknown composition.

Antithermin. Phenylhydrazine-lævulinic acid. (Antipyretic.)

Antlia Gastrica. Stomach-pump.

Apioline. Chapoteau's specialty; active principle of parsley.

Apone. Liniment. (Capsicum, ammonia, chloral.)

Apyonin. French designation for yellow pyoktanin. (Antiseptic.)

Apyrothium. Sulphur.

Aqua Binelli. Creosote water.

Bullientis (Aquæ). Boiling water.

Cerasorum. Diluted bitter almond water.

Crotonis. Water from Croton Lake, New York (that is, hydrant water).

Flava. Yellow wash.

Fœtida Antihysterica. A distillate from asafetida, galbanum, myrrh, valerian, etc.

Fortis. Nitric acid.

Aqua Gummosa. Diluted mucilage of gum arabic (about 1 part of gum in 64 of water).

Hydrothionica. Sulphuretted hydrogen water.

Laxativa Viennensis. Compound infusion of senna. (Modified black draught.)

Metallorum. Mercury.

Naphæ. Orange flower water.

Nigra. Black wash.

Phagedænica. Yellow wash.

Regis. Nitrohydrochloric acid.

Saturnina. Lead water.

Vitæ. Brandy or whiskey.

Aquila Alba. Calomel.

Aquozon. Ozonized water. (Ozone Co., New York.)

Argentum Fugitivum. Quicksilver.

Musivum. Mosaic gold.

Vivum. Quicksilver.

Argilla. Clay. (In pharmacy it means alumina.)

Sulphurica Alcalisata. Alum.

Argols. Crude potassium bitartrate.

Aristol. Dithymoldiiodide. Di-iodo-dithymol. (Antiseptic.)

Arquebusade. An agreeably smelling vulnerary water, which might be called "compound sage water."

Asa Dulcis. Benzoin.

Asaprol. Calcium salt of betanaphtol-alphamonosulphonic acid. (Antiseptic.)

Asbolin. An alcoholic distillate of soot. (Antitubercular.)

Asepsin. Antisepsin.

Aseptin. Mixture of boric acid, borax, and alum.

Aseptol. Sozolic acid. Orthophenyl-sulphonic acid (33 per cent. aqueous solution).

Asparoline. Contains guaiacum, asparagin, parsley seed, black haw, and hyoscyamus. (According to Wampole & Co., Philadelphia.)

Ater (Atra). Black (Niger).

Atramentum. Black ink.

Indicum (Sinense). India ink.

Auramin. Yellow pyoktanin. (Antiseptic.)

Aureoline. Hair bleach. (A more or less diluted solution of hydrogen peroxide.)

Aurum Musivum (Mosaic Gold). Tin bisulphide.

Axungia. Adeps. (Fat.)

B.

Baker's Salt. Ammonium subcarbonate.

Balata. Gum chicle.

Balsam, Friar's. Compound tincture of benzoin.

Balsam, Hungarian. Exudation from Pinus pumilio.

Persian. Compound tincture of benzoin.

Riga. By distillation from the leaves of Pinus cembra; generally an artificial aromatic spirit.

Sulphur. Sulphurated linseed oil.

Traumatic. Compound tincture of benzoin.

Balsamum Arcæi. An ointment of elemi.

Gileadense. Balm of Gilead.

Judaicum. Balm of Gilead.

Nucistæ. An ointment containing the volatile and fixed oils of nutmeg.

Ophthalmicum Rubrum. Ointment of red precipitate.

Saponaceum. Opodeldoc.

St. Yves. Ointment of red precipitate.

Universale. Ointment of lead subacetate, made with yellow wax and rape-seed oil.

Verum. Balm of Gilead.

Vitæ Hoffmanni. Alcoholic solution of sundry balsamic oils.

Bang. Cannabis Indica.

Barbotine. See Semen Contra.

Barilla. Impure sodium carbonate.

Barm. Yeast.

Baudruche. Goldbeaters' skin.

Baume de Vie. Compound decoction of aloes.

Tranquille. Compound infused oil of hyoscyamus.

Belle Dame. Atropa belladonna.

Benedictum Vinum. Antimonial wine.

Benzene. Of English chemists, means benzol (coal-tar benzin), and not the American benzin (from petroleum).

Benzoic Ether. Ethyl benzoate.

Benzonaphtol. Betanaphthylbenzoate. Betanaphtol-benzoate. (Intestinal antiseptic.)

Benzophenoneid. Apyonin (yellow pyoktanin).

Benzosol. Benzoyl-guaiacol. Guaiacol benzoate (Antitubercular.)

Betel Nut. Areca nut.

Betol. Betanaphthyl salicylate. Betanaphtol salicylate. (Intestinal antiseptic.)

Big "G." Injection. Contains borax and berberine.

Bilis Bovinum. Ox's gall.

Bi-Palatinoid. Gelatin capsule divided by a partition, to keep two powders separate until swallowed.

Bitumen Judaicum. Asphaltum.

Black Draught. A compound infusion of senna; must not be confounded with "Black Drop."

Black Drop. Vinegar of opium.

Black Flux. A mixture of charcoal and potassium carbonate.

Blanc Fixe. Artificial barium carbonate or sulphate.

Blue, Berlin. Prussian blue.

Black. A name for ivory-black.

Chinese. Prussian blue.

Bolus Armena. Bole Armenian.

Borofax. Trade-mark applied to an emollient by Burroughs, Wellcome & Co.

Boroglycerin. A concentrated solution of boric acid in glycerin.

Borol. Fused mixture of boric acid and sodium bisulphate.

Borussic. Prussian. Hydrocyanic.

Bovinine. Meat juice preserved by glycerin and boric acid.

Bovox. An essence of beef. (Boston.)

Bovril. Extract of beef, peptone, albumen, and fibrin. (London.)

Brain Salt, Effervescent. Contains chiefly ammonium bromide and caffeine.

Brasium. Malt.

British Gum. Dextrin.

Brofeine. Specialty of Wohlfarth, New York (?).

Bromo-Febrin. Said to be potassium or ammonium bromide and antifebrin. (Specialty of Weiller & Co., Baltimore.)

Bromo-Caffeine. Specialty of Keasbey & Mattison, Ambler, Pa.

Bromo-Pyrene. Specialty of Wampole, Philadelphia.

Bromo-Soda. Specialty of Warner & Co., Philadelphia.

Bromol. Tribromophenol. (Antiseptic.)

Brotipyrine. Specialty of Stearns & Co., Detroit.

Burning Fluid. Three measures of alcohol and one of purified oil of turpentine.

Butter of Antimony. Solution of antimony chloride.

Butylhypnal. Butylchloral-antipyrin.

Butyrum Majoranæ. Ointment of sweet marjoram.

Nucistæ. Expressed oil of nutmeg.

Byne (Bynin). Apparently a favorite name in England for malt and malted preparations.

Bynol. Malt and cod-liver oil. (Allen & Hanbury, London.)

C.

C. See also K.

Cactina. A preparation of Cactus grandiflorus. (Sultan Co., St. Louis.)

Caffa. Camphor.

Caffeoresorcin. Combination of caffeine with resorcin.

Cail-Cedra. Bark of Swietenia senegalensis.

Calamine. Impure zinc carbonate.

Calcithos. Copper subacetate.

Calisaya. Cinchona (Yellow).

Camphine. Rectified oil of turpentine.

Camphoid. Gun-cotton dissolved in an alcoholic solution of camphor. 1 : 20 solution of pyroxylin in Rubini's camphor solution. (Vehicle for dermics.)

Camphol. A mixture of camphor and salol. (Antiseptic.)

Camphor Julep. Camphor mixture.

Camphorline. A trade name for naphtalin.

Cancroin. Extract of cancerous tumors, according to Adamkiewicz. (Alexine of cancer.)

Cancrorum Lapilli. Crabs' stones.

Chelæ. Crabs' claws.

Candelæ Fumales. Fumigating pastilles.

Canthos. A special cantharidal plaster of Johnson & Johnson. London.

Capita Papaveris. Poppy-heads.

Capsulæ Amylaceæ. Wafer capsules.

Carbasus. Gauze.

Carboline. A hair preparation. Perfumed liquid vaselin.

Carbon Black. The soot of natural gas.

Carnine Syrup, Niemann's. Beef juice preserved by cane sugar.

Cassius's Purple. A compound of tin with gold oxide.

Castoria. A laxative. Said to be a modified compound infusion of senna.

Celerina. Said to be a combination of celery, black haw, coca, and probably kola.

Cera Sigillata. Sealing-wax.

Cerate, Compound Camphor. Camphor ice.

Ceratum Citrini (P. L. 1745). Resin cerate.

Epuloticum (P. L. 1745). Ceratum calaminaris. Turner's cerate.

Labiale. Lip salve.

Lithargyri Acetati Compositum. Goulard's cerate. (P. L. 1787)

Cerate, Turner's. Cerate of calamine.

Ceresin. Earth-wax. An impure paraffin.

Cetraria. Iceland Moss.

Chalcanthum. Copperas.

Charpie. Lint.

Chelen (Kelene). Ethyl chloride. (Local anæsthetic.)

Chemical Food. Compound syrup of phosphates.

Chinium. Quinine.

Chionia. A preparation of Chionanthus. (Peacock Co., St. Louis.)

Chloral Caffeine. Molecular combination (1 : 1) of chloral and caffeine. (Anodyne, antispasmodic.)

Camphor. A mixture of chloral and camphor.

Chloral Carmine. Staining fluid prepared by heating together on a water-bath for half an hour .05 Gm. carmine, 20 C.c. absolute alcohol, and 30 drops hydrochloric acid (sp. gr. 1.124), adding 25 Gm. chloral hydrate, and filtering when cool.

Chloralamide. Chloral formamide.

Chloralimide. Trichlorethylidenimide.

Chlorobrom. Solution of potassium bromide and chloralamide in water.

Chlorol. Solution of corrosive sublimate, sodium chloride, hydrochloric acid, and copper sulphate in water. (Antiseptic.)

Chlorophenol. Antiseptic.

Christia. Manilla paper made waterproof with chrome gelatin.

Chymosin. Pepsin.

Cibus Deorum. Asafetida.

Cineres Clavellati. Crude potassium carbonate.

Cinnabar (Vermilion). Mercuric sulphide.

Coal-Tar Naphtha. Benzol.

Cognac. Brandy.

Colcothar. Crude ferric oxide.

Colla Piscium. Isinglass.

Conchinine (of the German chemists). Quinidine

Confectio Cardiaca. Aromatic confection.

Damocratis. Damocrates' confection. An aromatic astringent confection containing opium, which originally had 64 ingredients.

Connecticut Lead. Barytes.

Cornu Cervi. Hart's horn. Ammonium carbonate.

Cervi Ustum Nigrum. Boneblack.

Cream of Tartar, Soluble. Potassium and sodium borotartrate.

Cremor Antisepticus. Chiefly vaselin and thymol. (London.)

Creolin. Mixture of coal-tar hydrocarbons with resin soap (Pearson's), or with cresolsulphonic acid (Artmann's creolin).

Creosotal. Creosote carbonate.

Creosote Carbonate. Chiefly an impure guaiacol carbonate.

Cresalol. Paracresol salicylate. Paracresylic ether of salicylic acid. (Intestinal antiseptic.)

Cresol. Cresylic acid.

Cresolin. A preparation similar to creolin.

Cresylol. Cresol. Cresylic acid. Metacresol. (Antiseptic.)

Crocus Martis. Ferric oxide.

Metallorum (Antimonii). Brown antimony oxide.

Saturni. Red lead.

Croton-Chloral. Butyl-chloral.

Cryst Alba. Refined naphtalene. (Disinfectant.)

Crystalli Tartari. Cream of tartar.

Cuca. Coca.

Cullet. Broken glass for remelting.

Cuprum Scoriatum. Crude copper acetate. (Verdigris.)

Curaçao. Elixir of orange peel.

Cutch. Dark (black) gum catechu.

Cynosbatæ. See Hips.

D.

Dactyli. Dates.

Dagutt. See Daggett, Oil of.

Dasjespis. Inspissated urine of the South African badger (Hyrax).

Decoctum Album. A kind of chalk mixture.

Diaphoreticum. Compound decoction of guaiacum.

Lignorum. Compound decoction of guaiacum wood.

Zitmanni. Compound decoction of sarsaparilla.

Dermatol. Bismuth subgallate. (Astringent antiseptic.)

Derosne's Salt. Narcotine.

Diabolus Metallorum. Tin.

Diacodium. Poppy-heads. (Old name for syrup of poppies.)

Diagrydium. Scammony.

Diana. Silver.

Diapente. A tonic powder, or electuary, composed of 5 ingredients.

Diaphtherin. Oxychinaseptol. (Oxychinolin and orthosulphonic acid.) Orthophenol sulphonate. (Antiseptic.)

Diascordium. An aromatic electuary of tormentil root and scordium (water germander) with opium.

Dilapsus. As an adjective to several salts means effloresced.

Dimethyl-oxy-chinizin. Antipyrin.

Disinfectant, Jeye's. Mixture of coal-tar hydrocarbons with resin soap.

Ledoyen's. Solution of lead nitrate.

Disinfectol. A product similar to creolin.

Dithione. Mixture of the sodium salts of the isomers of dithiosalicylic acid. (Antirheumatic.)

Diuretin ("I. & II."). Theobromine sodium salicylate. (Diuretic.)

Draco Mitigatus. Calomel.

Dulcin. A new sweetening agent. Paraphenetolcarbamid. (Sucrol.)

Dutch Drops. Haarlem oil.

Liquid. } The chloride of olefiant
Oil. } gas.

Tea. A variety of St. Germain tea. (Laurent.)

E.

Earth, Japan. Catechu.

Nut. Peanut.

Eau de Rabel. See Elixir, Haller's.

Sédative de Raspail. Contains ammonia, salt, camphor, alcohol, and water.

Ebur Ustum. Boneblack.

Eikonogen. Sodium salt of the amidobetanaphtolbetamonosulphonic acid. (For photographic purposes.)

Elæosaccharum. Oil sugar. (Sugar flavored with volatile oil.)

Electuarium. Confection. (Soft.)

Dentifricium. Tooth paste.

Elephant Louse. The nut of cashew.

Eliteine. Specialty of Ingram, Detroit, Mich. (Skin lotion.)

Elixir Adjuvans. A kind of simple elixir.

Anisi. Aniseed cordial.

Aperitivum. Compound tincture of aloes.

Aurantiorum Compositum. A compound elixir of orange peel and gentian.

of the Three Chlorides. Contains iron, mercury, and arsenic, with elixir cinchona. (Renz & Henry, St. Louis.)

Corrigens. Aromatic elixir of yerba santa.

Daffy's. Compound tincture of senna.

Garus. Mixture of syrup with an alcoholic distillate of aloes and spices.

Haller's. 3 parts alcohol and 1 part sulphuric acid, mixed slowly.

of Long Life. A modification of the well-known Swedish Bitters.

ad Longam Vitam. Elixir of Long Life.

Nutrans. Tonic. (Allaire, Woodward & Co., Peoria, Illinois.)

Pectorale. Compound ammoniated elixir of liquorice with oils of fennel and anise.

Proprietatis (Paracelsi). Compound tincture of aloes and myrrh.

Purgans. Compound tincture of jalap.

Rhei Darelii. Tinctura rhei dulcis.

Roborans Whyttii. Compound tincture of cinchona (containing saffron).

Salutis. Compound tincture of senna.

Stomachic. }
Stoughton's. } Compound tincture of gentian.

Viscerale. Compound tincture of orange peel and gentian.

Vitrioli Mynsichti. Aromatic sulphuric acid.

Emplastrum Cantharidum Perpetuum. A mild cantharidal plaster.

Fuscum. Mother plaster. Universal plaster. Brown salve.

Gummosum. Compound plaster of galbanum.

Ens Martis. Ammoniated iron.

Enule. Trade-mark suppositories, Burroughs, Wellcome & Co.

Epidermine. Ointment basis, consisting of white wax, water, gum, and glycerin, equal parts.

Ergotole. Specialty of Sharp & Dohme, Baltimore.

Eserine. Physostigmine.

Essence (French). Volatile oil.

of Mirbane. Nitrobenzol. (Artificial oil of bitter almonds.)

Éthérolat, Éthérolaturé, Éthérolé (French). Correspond to the alcoholic terms. (See Alcoolat, etc.)

Ethyl Bromide. Monobrom-ethane. Must not be confounded with ethylene bromide.

Ethylene Bromide. Dibrom-ethane. Different from ethyl bromide.

Eucalypteol. Eucalyptene bichloride (according to Lafarge). (Antiseptic.)

Eucalyptoresorcin. Combination of eucalyptol and resorcin.

Eulyptol. A mixture of salicylic acid, carbolic acid, and oil of eucalyptus. (Antiseptic.)

Euphorin. Phenyl-urethane. Phenylethylic urethane. Ethyl and phenyl carbamate.

Europhen. Diisobutylorthocresoliodide. Substitute for iodoform.

Exalgin. Methylacetanilid. Methylphenylacetamide. (Anodyne.)

Exodine. Mixture of acetanilid, sodium salicylate, and sodium bicarbonate. Exodyne. (Antipyretic.)

Expectorant, Stokes's. Senega and squill cough mixture with ammonium carbonate.

Extract of Apple, Ferrated. Crude iron malate.

Extractum Catholicum. Compound extract of rhubarb.

Martis Pomatum. Crude iron malate in the form of extract.

Panchymagogum Crollii. Compound extract of rhubarb. (Rhubarb, aloes, jalap, soap.)

Eyesolene. Eye-salve of Spitler & Drexler, Paterson, N.J.

Eyestones. Crabs' eyes.

F.

Faba Porcina. }
Suilla. } The fruit of Hyoscyamus niger.

Purgatrix. Castor oil bean.

Fæcula. Starch. (Amylum.)

Fairoline. Ointment of unknown composition.

Farina Hordei Præparata. Barley flour heated in a steam bath for about thirty hours.

Ferri Iodidum Saccharatum. Contains 20 per cent. pure ferrous iodide. U. S. P. 1890.

Ferri Scobs. Iron filings.

Ferro Pagliari. Solution of ferrous chloride.

Ferrugo. Iron rust.

Ferrum Alcoholisatum. Finely powdered iron, which is not the same as reduced iron.

Limatum. Iron filings.

Pomatum (extract, tincture, etc.). Iron malate.

Firwein. Contains bromine, iodine, and phosphorus with balsams. (Tilden & Co., New Lebanon, N Y.)

Flake White. Carbonate of lead.

Flea Seeds. Seeds of Nigella.

Flores Antimonii. Antimony sesquioxide.

Benzoes. Benzoic acid.

Bismuthi. Bismuth oxide.

Zinci. Zinc oxide.

Flos Æruginis. Copper acetate.

Flos Salis. Sodium subcarbonate.

Fluor Spar. Calcium fluoride.

Flowers of Antimony. Oxide of antimony.

of Benjamin. Benzoic acid.

of Zinc. Oxide of zinc.

Fo-di-ta. A pepsin tablet. (New York & Chicago Chemical Co.)

Formalin. 40 per cent. solution. Formaldehyde. (Antiseptic.)

Formol. Formaldehyde.

Formylum Chloratum. Chloroform.

Fossiline. Similar to petrolatum, vaselin, etc. Vaselin.

Frankincense. Olibanum.

French Polish. An alcoholic solution of shellac.

White. Pulverized talc.

Friar's Balsam. Compound tincture of benzoin.

Fromentin. The embryo of wheat.

Fuligokali. An alkaline solution of soot evaporated to dryness.

Fuller's Earth. A species of clay.

Furfur. Bran.

Fustic, Old. The wood of Morus tinctoria.

Young. The wood of Rhus cotinus.

G.

Galactic. Lactic.

Galena. Lead sulphide.

Gallacetophenone. Methylketotrioxybenzol. Methylketotrioxybenzene. Trioxyacetophenone. Alizarin-yellow "C."

Gallein. Coal-tar color. Used as an indicator.

Gallobromol. Dibromogallic acid.

Gambir. Pale gum catechu.

Gannal's Solution. Solution of aluminum acetate.

Gelatol. Ointment basis, consisting of oil, glycerin, gelatin, and water.

Gentian, White. A German rural domestic medicine, which is dried white dog-dung.

Glacialin. Mixture of borax, boric acid, and sugar (or glycerin).

Glacies. Ice.

Mariæ. Isinglass-stone; Muscovy glass. (A variety of calcium sulphate.)

Glandes Quercus (Tostæ). Acorns. (Acorn coffee.)

Glass Gall. The scum forming on the surface of melting glass.

of Antimony. Vitrified antimony oxide.

Globuli Martiales. A crude iron tartrate in the form of balls or marbles.

Glonoin. Nitroglycerin. Trinitrin.

Glusidum. The official name for saccharin in the Brit. Ph.

Gluten. Glue.

Glycéré (Glycérat) (French). Soft or solid glycerin preparations.

Glycerinum Pepticum. One of Fairchild's pepsin preparations.

Glycerolé (French). Liquid glycerin preparations.

Glyceryl Borate. Boroglyceride.

Glyconin. A mixture of yolk of egg and glycerin.

Glycozone. Probably a solution of hydrogen peroxide in glycerin. (Marchand, New York.)

Gommeline. Crude dextrin.

Grains d'Avignon. French berries (Rhamnus infectorius).

Graphite. Black lead.

Green Vitriol. Ferrous sulphate.

Guaiacolsalol. Guaiacol salicylate. (Intestinal antiseptic.)

Gum Dragon. Tragacanth.

Gummi Elasticum. India rubber.

Guttæ (Gutti). Gamboge.

Rubrum Gambiense. Kino.

Scorpionis. } Gum arabic.
Thebaicum.

Gunjah. Cannabis Indica.

Gypsum. Plaster of Paris.

H.

Hæmatites. Bloodstone.

Hæmatogen. Iron albuminate, as found in eggs.

Hæmogallol. Produced by the action of pyrogallol upon the coloring matter of blood. Reduction product of hæmatin. Blood-producer.

Hæmol. Produced by the action of zinc-dust upon the coloring matter of the blood. Blood-producer.

Hamburg Drops. A kind of "Swedish Bitters."

Tea. Identical with St. Germain tea, differently flavored.

Hazeline. Trade-mark for a hamamelis preparation, Burroughs, Wellcome & Co.

Hazeline Snow. Trade-mark for a toilet preparation, Burroughs, Wellcome & Co., London.

Hemisine. Trade-mark for an active principle of suprarenal gland by Burroughs, Wellcome & Co., London.

Hepar. Liver (of sulphur, antimony, lime, etc.).

Antimonii. An impure antimonium and potassium sulphide.

Sulphuris. Potassa sulphurata. "Liver of sulphur."

Herba Corta. Specialty of Griswold, Hartford, Conn.

Hiera Picra. (Incorrectly, but commonly, called Hiera Piera.) Pulvis aloes et canellæ.

Hill's Balsam of Honey. A tincture of tolu, honey, etc.

Hips. The fruit of dog-rose.

Homberg's Phosphorus. Calcium chloride.

Pyrophorus. A mixture of alum and brown sugar, or of potassium sulphide, alumina, and charcoal.

Huxham's Tincture of Bark. Compound tincture of cinchona.

Hydracetine. Acetophenylhydrazine. Pyrodine. Acetylphenylhydrazine.

Hydrargyri Oxymurias. Corrosive chloride of mercury.

Hydrargyrus Muriatus. Corrosive chloride of mercury.

Hydrastis, Colorless. Solution of hydrastine in glycerin and water. (Keith & Co.)

Hydrochrite. Barley water.

Hydrolat (French). A distilled water.

Hydrolé (French). An aqueous solution.

Hydroleine. A kind of pancreatic emulsion of cod-liver oil. (Crittenden, New York.)

Hydronaphtol. Antiseptic. Said to be different from betanaphtol. (Rigney & Wolff, New York.)

Hydropege. Spring or hydrant water.

Hydrophilous (Hygrophilous) Cotton. Absorbent cotton.

Hygrine. One of the alkaloids of coca.

Hypnal. Chloral-antipyrin. Trichloraldehydphenyldimethylpyrazolone. (Hypnotic.)

Hypnone. Acetophenone. (Hypnotic.)

Hypoderms. Tablets for hypodermic injections. (Allen & Hanbury, London.)

I.

Ichthyocolla. Isinglass.

Ichthyol. Ammonium ichthyol-sulphonate from a peculiar bituminous shale.

Indian Pink. Spigelia marilandica.

Tobacco. Lobelia inflata.

Indicum. Indigo.

Inflammable Air. Hydrogen.

Ingluvin. Pepsin obtained from the crop of chicken.

Injection Brou. A French specialty for gonorrhœa.

Iodol. Pyrrol tetraiodide. Tetraiodopyrrole. (Antiseptic, alterative.)

Iodophenine. Combination of phenacetin with iodine. (Antiseptic.)

Iodophenochloral. Mixture of tincture of iodine, carbolic acid, and chloral hydrate.

Iodopyrine. Iodoantipyrine. Antipyrine monoiodide.

Iron, Alcoholized. Finely powdered iron. It is not the same as iron by hydrogen.

by Hydrogen. Reduced iron.

Nitrogenized. Syrup of iron and sodium albuminates.

Issue Peas. Small orange berries, or round pills turned from orris root.

Izal. By-product obtained in coke-formation. "Thorncliffe disinfectant."

J.

Japan Earth. Catechu.

Jap-Menthol. Menthol from Japanese oil of peppermint.

Jesuits' Bark. Cinchona.

Drops. Contain guaiacum, sarsaparilla, and Peruvian balsam.

Jews' Pitch. Asphaltum.

Judas's Ear. A fungus of elder-tree. (Exidia.)

Jupiter. An ancient name for tin.

Jusculum. Broth (of beef, veal, turtle, etc.).

K.

K. See also C.

Kairine. Oxychinolinethyl hydrochlorate. (Antipyretic.)

"A." Oxyquinolinethylhydride. (Antipyretic.)

Kali Aeratum. Potassium carbonate.

Kalicum Hydras. Fused potassa.

Kalium, Kali. Potassium, potassa.

Kaolin. China clay. A hydrated silicate of alumina.

Kefir. A kind of kumyss.

Kelene. Chelen. Ethyl chloride.

Kepler. Trade-mark applied to malt and other preparations, Burroughs, Wellcome & Co., London.

King's Yellow. Yellow arsenic sulphide.

Kochine. Tuberculin.

Kodozonol Ozonized cod-liver oil. (Ozone Co., New York.)

Kreozonol. Ozonized oil of tar. (Ozone Co., New York.)

Kresin. A solution of cresol in a solution of sodium cresoxyl-acetate. (A 25-per-cent. solution.)

Kresylol. See Cresylol.

Kumysgen. Kumyss in a dry form. (Reed & Carnrick, New York.)

L.

Lac Magnesiæ. Milk of magnesia.

Virginis. See Virgin's Milk.

Lacca Cœrulea. Litmus.

Musica (Lakmus). Litmus.

Lactin. Sugar of milk.

Lacto Preparata. A kind of malted milk with cereals, etc. (Reed & Carnrick, New York.)

Lakmoid. Substitute for litmus; a coal-tar color.

Lamium Album. Blind nettle.

Lamotte's Drops. Ethereal tincture of ferric chloride.

Lanadeps. A purified lanolin. (Lloyd & Co., Leicester, England.)

Lanain. Adeps lanæ. Lanolin.

Lana Philosophica. Zinc oxide.

Lanesin. Similar to lanolin.

Lanolin. Purified wool fat emulsified with water. Adeps lanæ. Lanain.

Lapides Cancrorum. Eyestones.

Lapilli Cancrorum. Crab's eyes, crab-stones; concretions found in the stomach of the European crawfish.

Lapis Baptista. Ancient name for talcum.

Calaminaris. Impure zinc carbonate.

Causticus. Potassa. (In sticks.)

Cœruleus. Copper sulphate.

Divinus. Copper aluminate.

Hæmatites. Bloodstone.

Infernalis. Lunar caustic. (Fused silver nitrate.)

Lazuli. Ultramarine.

Ophthalmicus. Eyestones.

Smiridis. Emery.

Latrol. A substitute for iodoform. By the action of iodine upon one of the anilines. (Clinton Pharm. Co.)

Ledoyen's Disinfecting Liquid. Solution of nitrate of lead.

Lenitive Electuary. Confection of senna.

Leucœnus. White wine.

Leucogene. Sodium bisulphite.

Levant Nut. Cocculus Indicus. (Fish berries.)

Lichen Islandicus. Iceland moss.

Life-Everlasting. Gnaphalium polycephalum.

Lignia Nitrica. Gun-cotton.

Lignum Sanctum. Guaiacum wood (Lignum vitæ.)

Vitæ. Guaiacum wood.

Limatura Ferri. Iron filings.

Linonine. Compound emulsion of linseed oil. (Danbury Pharm. Ass., Conn.)

Lintine. Absorbent cotton in thin sheets. (Johnson & Johnson, New York.

Lipanin. An olive oil containing 6 per cent. of free oleic acid. (Alterative.)

Liquor Anodynus (Hoffmanni). Hoffmann's anodyne.

Cornu Cervi (Liquor C.C.). Solution of ammonium carbonate, containing empyreumatic oil.

Cornu Cervi Succinatus (Liquor C. C. Succinatus). Solution of ammonium succinate.

Ferri Oxychlorati. Dialyzed iron.

Fumans Boylii. Ammonium hydrosulphide.

Salicylicus, Sellers's. Contains sodium and quinine salicylates and salicin.

Seriparus. Liquid rennet.

Stypticus Loofii. Solution of ferric chloride.

Tongæ Salicylatus. See Tongaline.

Listerine. Antiseptic. Contains borax, thymol, eucalyptol, oils of wintergreen and peppermint.

Lithiated Hydrangea. Kidney remedy. Contains hydrangea and lithium benzo-salicylate. (Lambert Co., St. Louis.)

Lithines. Lithia water tablets. (Metcalf & Co., Boston.)

London Paste. Soda with lime.

Looch Album. An emulsion of almonds and oil of almonds.

Loofah. "Vegetable sponge;" the skeleton of a gourd.

Losophan. Triiodometacresol. Triiodometacresylic acid. (Antiseptic dermic.)

Love-Apple. Tomato.

Luna. Silver.

Lysol. Mixture of cresols with soap. (Antiseptic.)

M.

Magisterium Bismuthi. Bismuth subnitrate.

Coccionellæ. Carmine.

Sulphuris. Washed sulphur.

Magnesia Alba. Magnesium carbonate.

Nigra. Black manganese oxide.

Mala. Poma (apple).

Mallein. A product of the "epizootic" bacilli, prepared by Adamkiewicz. Alexine of glanders, according to Adamkiewicz.

Marcasita. Metallic bismuth.

Marine Acid. Hydrochloric acid.

Salt. Sodium chloride.

Mars, or Martis. Iron (Tinctura Martis is tincture of iron).

Massicot. Lead protoxide.

Mater Metallorum. Mercury.

Matta. The cortical portion from a variety of millet-seed, used for adulterating pepper.

Maw-Seed. Poppy-seed.

Meadow Saffron. Colchicum.

Meconium. The juice of the poppy.

Medulla Bovis. Ox-marrow.

Lactis. Butter.

Sassafras. Sassafras pith.

Mel Ægyptiacum. Liniment of copper.

Melanosmegma. Soft (green) soap.

Meleguette Pepper. Grains of Paradise.

Mellite (French). A honey.

Mephite of Soda. Impure sodium carbonate.

Mercure Précipité Blanc (French). White precipitate.

Mercurius Dulcis. Calomel.

Præcipitatus Albus. A name for calomel.

Mortis. } Antimony oxide.
Vitæ. }

Mercury Alanin. Mercury amidopropionate.

Hahnemann's Soluble. Black mercury oxide.

Methacetine. Paraacetanisidine. Paraoxymethylacetanilid. Acetylmethylparamidophenol. (Antipyretic.)

Methanilid. Exalgin.

Metheglin. Honey wine. Mead.

Methonal. Dimethylsulphonedimethylmethane.

Methozin. Antipyrin.

Methylal. Methylenedimethylic ether. (Anæsthetic.)

Metol. Salt of monomethylparaamidometacresol (for photographic uses).

Metopium. Expressed oil of almonds.

Metozin. Antipyrin.

Metrenchyta. Vaginal injection; sometimes a vaginal syringe.

Mica Panis. Bread crumb.

Microcidin. Sodium betanaphtol. Sodium betanaphtolate (75 per cent.). (Antiseptic.)

Microcosmic Salt. A mixture of sodium and ammonium phosphates.

Mikozone. Hypnotic and sedative. (A variety of chlorodyne).

Milk of Sulphur. Precipitated sulphur. (Strictly only that precipitated by sulphuric acid.)

Virgin's. Rose-water rendered milky by the addition of tincture of benzoin.

Mineral Gum. Soluble glass; sodium or potassium silicate.

Minium. Red lead.

Græcorum, Minium Purum. Red mercuric sulphide.

Miraculum Chemicum. Magnesium carbonate.

Mithridate. See Confectio Damocratis.

Mistura Acaciæ. Mucilage of gum arabic of variable strength.

Oleoso-Balsamica. An alcoholic solution of Peru balsam, oil of amber, and sundry volatile oils.

Mixtura Alba. Compound chalk mixture.

Salina. Potio Riveri. (Effervescent mixture of potassium citrate.)

Solvens. Solution of ammonium chloride with liquorice.

Solvens Stibiata. Solution of ammonium chloride with liquorice and tartar emetic.

Mixture, Antidysenteric. Acid camphor mixture.

Dysmenorrhœa. Guaiac mixture with corrosive sublimate.

French. Carbolized solution of iodine.

Gadberry's. Acid mixture of quinine and iron.

Griffith's. Compound mixture of iron.

Hope's. Acid camphor mixture.

Mollin. Ointment basis, consisting of a glycerin soap containing an excess of fat or oil.

Mollisin. Ointment basis of 4 parts of paraffin oil and 1 part of yellow wax.

Molybdos. Lead.

Morrhuol. Alcoholic extract of cod-liver oil.

Mosaic Gold. Tin bisulphide.

Mosquera Preparations. Contain meat digested by pine-apple juice. (Parke, Davis & Co., Detroit, Mich.)

Mountain Fat. Paraffin.

Muride. } Bromine.
Murina. }

Muscus. Moss. (Iceland, Irish, etc.)

Myrrholin. Solution of myrrh in castor oil, equal parts. (Alterative.)

N.

Naphæ Flores (Aqua). Orange flowers (water, etc.).

Naphtha. Prescribed by English physicians, means pyroxylic and pyroacetic spirits. In German prescriptions it means ether; often written naphtha vitrioli.

Vitrioli. Ether.

Naphthalol. Betol.

Naphthopyrin. Combination of betanaphtol with antipyrin.

Naphthosalol. Betol.

Naphthyl. Naphtol.

Natrium, Natron. Sodium, soda.

Natro-Kali Tartaricum. Rochelle salt.

Neapolitan Ointment. Mercurial ointment.

Neogale. Fresh milk.

Nepenthe. A preparation of opium. (Ferris & Co., Bristol, England.)

Nico. Nickel carbonmonoxide.

Nigramentum. Black ink.

Nihil Album. Crude zinc oxide.

Griseum. Zinc oxide.

Nitratine. Sodium nitrate.

Nitre, Rough. Magnesium chloride.

Nitrobenzin. }
Nitrobenzol. } Artificial oil of bitter almonds.

Nitrum Flammans. Ammonium nitrate.

Saturninum. Lead nitrate.

Nix Zinci. Zinc oxide.

Norwood's Tincture. A tincture of Veratrum viride, U.S.P. 1890 strength.

Number Six. Tincture of capsicum and myrrh. (Hot drops.)

Nux Aromatica. Nutmeg.

Metella. Seed of Strychnos nux vomica.

Moschata. Nutmeg.

O.

Œnanthic Ether. Artificial oil of cognac.

Œsipus. Suint. Impure wool fat.

Oil, "American." Scandinavian for castor oil.

of Bay. Oil of laurel berries. (Generally is understood to mean oil of bay rum.)

of Ben (or Behen). Comes from a Moringa, and is not the same as oil of benne, which comes from a Sesamum.

of Cassia, Artificial. Probably camphor oil, or neutral oil perfumed with oil of cassia.

Colza. Oil of rapeseed.

Dagget. Empyreumatic oil of birch. (Oil of Russia leather.)

Dippel's. Rectified oil of hartshorn.

of Eggs. By expression from hard-boiled yolks.

Leaurelle. A preparation for the complexion. (Proprietary.)

Lucca. A brand of good olive oil.

of Niobe. Methyl benzoate.

St. Jacob's. A liniment. (Specialty of Vogeler, Baltimore.)

Seneka. Crude petroleum.

of Smoke. Creosote.

Swallow. Infused oil of elder flowers.

of Tartar. Solution of potassium carbonate.

of Vitriol. Sulphuric acid.

Ointment, Black Basilicon. Basilicon ointment with pitch.

Maury's. A compound rhubarb ointment.

Volatile. Volatile liniment.

Oleite. Sodium sulphoricinoleate.

Oleosa. A special brand of eucalyptus oil. (Drysdale & Co., London.)

Oleum Animale Fœtidum. Crude oil of hartshorn.

Anthos. Oil of rosemary.

Betulinum. Empyreumatic oil of birch. (Oil of Russia leather.)

Bubulum. Neatsfoot oil.

Cadinum. Empyreumatic oil of juniper.

Camphoratum. Liniment of camphor.

Castoris. Castor oil. (Has nothing to do with castoreum.)

Cedræ (de Cedro). Oil of lemon.

Chaberti. Rectified animal oil.

Chamomillæ Citratum. Oil of lemon, distilled over German chamomile.

Cocois. Oil of cocoanut.

Coctum. Fixed oil (olive oil) infused with the respective herb, etc.

Cornu Cervi (Fœtidum). Crude animal oil.

Fermentationis. Fusel oil.

Juniperi Oxycedri (Empyreumaticum). Oil of cade.

Laurinum. Expressed oil of laurel berries.

Lumbricorum. Infused oil of earthworms.

Napi. Rapeseed oil.

Nucis Moschatæ. Besides the two kinds of oils (volatile and fixed) see also Balsam Nucistæ.

Nucistæ. Expressed or volatile oils of numeg.

Palmæ Christi. Castor oil.

Petræ. Crude petroleum. (Seneka oil.)

Philosophorum. Olive oil distilled over hot bricks.

Portugallicum. Oil of bergamot.

Rusci. Empyreumatic oil of birch. (Oil of Russia leather.)

Tartari per Deliquium. Concentrated solution of potassium carbonate.

Templinum. Oil of pine cones and small branches of Pinus pumilio.

Onguent (French). Ointment which contains resin.

Opodeldoc, Steers's. Solid opodeldoc.

Orellana. Arnotta.

Orexin. Phenyldihydrochinazoline hydrochloride. Phenyldihydroquinazoline. (Appetizer.)

Orleana. Annotta.

Orthine. Orthohydrazineparaoxybenzoic acid. (Antiseptic, antipyretic.)

Oryza. Rice.

Os Sepiæ. Cuttlefish bone.

Oxalium. Potassium binoxalate.

Oxychinaseptol. Orthophenolsulphonate of oxychinoline.

Oxy-di-methyl-chinizin. Antipyrin.

Oxygen Powder. Sodium peroxide containing 20 per cent. active oxygen. (Bleacher.)

Oxymel. Honey boiled with vinegar.

Æruginis. Honey with copper acetate.

Oxymellite (French). Honey with vinegar.

Ozokerite. Earth-wax; an impure paraffin.

P.

Palacetyrus. Old cheese.

Palatinoid. Gelatin capsule with dry powder.

Panacea Mercurialis. Calomel.

Panchymagogum Minerale (P. Quercitani). Calomel.

Pancro-Bilin. Ox-gall and pancreatin (Reed & Carnrick, New York.)

Pan-Peptic Preparations. Specialty of Sharp & Dohme, Baltimore.

Papine. A preparation of opium. (Battle & Co., St. Louis.)

Papoid. Digestive principle of the fruit of Carica papaia.

Paraffinum Molle. Petrolatum.

Paroleine. Trade-mark for a preparation of tasteless petroleum oil, Burroughs, Wellcome & Co., London.

Passulæ. Raisins.

Minores. Corinthian raisins. (Grocers' "currants.")

Pasta Cerata. Ointment basis, consisting of yellow wax, water, and potassium carbonate.

Peacock's Bromides. Contains potassium, sodium, calcium, ammonium, and lithium bromides. (St. Louis.)

☛ **Pearl White.** Bismuth subnitrate.

Pelletierine. Alkaloid of pomegranate bark.

Pental. Trimethylethylene. Betaisoamylene. (Anæsthetic.)

Pepperette. Olive pits. (For adulterating pepper.)

Pepsalia. A peptic salt (probably pepsin and salt) for table use. (Stern, London.)

Perloids. A style of capsules. (Proprietary.)

Persio. Cudbear.

Phenacetine. Paraacetophenetidine. Phenin. Oxyethylacetanilid. (Antipyretic, anodyne.)

Phenates. Carbolates.

Phenazone. Antipyrin.

Phenetidin. Phenacetin.

Phenetol. Ethyl phenate.

Phenic Acid. Carbolic acid.

Phenin. Paraacetophenetidine. Phenacetin.

Phenocoll. Amidoacetoparaphenetidine. Glycocoll-paraphenetidine. (Antipyretic.)

Phenofax. Trade-mark applied to an antiseptic surgical dressing, Burroughs, Wellcome & Co., London.

Phenolin. Mixture of soap with cresols.

Phenolphthalein. A coal-tar color. Indicator in analysis.

Phenolsulphonate. Sulphocarbolate.

Phenopyrin. Combination of carbolic acid with antipyrin.

Phenosalyl. Mixture of carbolic acid, salicylic acid, lactic acid, menthol, and eucalyptus oil. (Antiseptic.)

Phenyl. Phenol.

Phenylacetamide. Acetanilid, *U. S. P.*

Phenyl-di-methyl-iso-pyrazolon. Antipyrin.

Phenyl-di-methyl-pyrazolon. Antipyrin.

Phenylic Acid. Carbolic acid.

Phenylone. Antipyrin.

Phosphin. A coal-tar color. Chrysanilin nitrate.

Photoxylin. Similar to gun-cotton, but made from wood-pulp.

Phyllis Amara. Bitter almond bran.

Physostigmine. Eserine.

Phytoline. Antifat. From poke berries by a peculiar process. (Walker Pharm. Co., St. Louis.)

Pichi. Fabiana imbricata.

Picrol. Diiodoresorcinmonosulphonic acid.

Picropyrin. Combination of picric acid with antipyrin.

Pills, Eternal. Pills of metallic antimony, about 15 grains each, which, after use, were recovered from the stools and washed.

Lapactic. Sharp & Dohme's specialty. (Baltimore.)

Perpetual. See Pills, Eternal.

Pinguedo. Lard.

Pinguoleum. Fixed oil.

Pink Powders. Contain calomel and sugar, colored with a little carmine.

Saucer. The coloring matter is derived from safflower.

Pinus Canadensis, Kennedy's. Dark: compound fluid extract of Pinus canadensis. White: compound solution of zinc sulphate.

Piperazidin. Piperazin.

Piperazin. Diethylendiamine. Ethylenimine. (Uric acid solvent.)

Pip-Menthol. Menthol from American and European oil of peppermint.

Pisselæum Indicum. Petroleum.

Plasma. Glycerite of starch.

Plasment. Basis for urethral injections. A slimy solution of Irish and Iceland moss with admixture of glycerin and benzoin.

Plaster, Diachylon. Lead plaster.
  Nuremberg. Brown plaster. Mother plaster.

Platt's Chlorides. Contains aluminum, sodium, zinc, and calcium chlorides.

Plumbago. Black lead. Also a genus of herbs.

Plumbum Album. Tin.
  Scytodepsicum. Moist lead tannate.

Plutonium. Barium.

Poivrette. Olive pits; adulterant of pepper.

Polysolve. Alkaline salts of sulpholeic acid.

Poma Aurantii (-iorum). Orange buds.

Pommade (French). Ointment which does not contain resin.

Pompholix. Zinc oxide.

Pond's Extract. A private make of "distilled extract of witch-hazel" (hamamelis).

Potash for Gargling. Potassium chlorate.

Potassium Chromate (neutral). Yellow potassium chromate.
  Hydriodate. Potassium iodide. (Kalium hydro-iodicum of German prescriptions.)
  Rhodanate. Potassium sulphocyanide (-cyanate).

Pot-Pourri. Fumigating species, chiefly flowers, generally preserved with salt.

Powder, Digestive. Compound powder of pepsin. (Proprietary.)
  of Algaroth. Antimony oxide.

Précipité Blanc (French). This, in French prescriptions, for internal use, is calomel (by the wet process), and for external use it generally means white precipitate.

Primuline. Sodium thioparatoluidinesulphonate.

Prussian Blue. Iron ferrocyanide.

Pulvis Ærophorus. Effervescing powder. (Soda, Seidlitz.)
  Diatragacanthæ. Starch, liquorice root, gum arabic, and sugar.
  Digestivus. Rhubarb, saltpetre, and cream of tartar.
  Gummosus. See Pulvis Diatragacanthæ.
  Infantum. When for internal use: magnesia and rhubarb, with oil of fennel. When for external use: baby dusting-powder.
  Jacobi. Antimonial powder.
  Puerorum. See Pulvis Infantum (internal use).

Pumiline. A distillate from Pinus pumilio, in a variety of forms. (Stern, London.)

Punicine. Pelletierine; alkaloid of pomegranate bark.

Purple of Cassius. Gold precipitated from solution by tin chloride.

Putty Powder. Polishing substance. Tin oxide.

Putz Pomade. A polishing ointment, containing ferric oxide, and probably pumice-stone.

Pyoktanin, Blue. Methylviolet.
  Yellow. Auramine.

Pyracine. Antipyrin.

Pyrazolone. Antipyrin.

Pyretin. A new antipyretic of, as yet, unknown composition.

Pyrodine. Acetophenylhydrazine. Hydracetin. Acetylphenylhydrazine.

Pyrœnus. Alcohol.

Pyrogallopyrin. Combination of pyrogallol with antipyrin.

Pyrolignine. A "ligneous" (*sic*) product from wood tar. (Borst, Montreal, Canada). (Antipyretic.)

Pyrophorus. A mixture of certain substances which ignite spontaneously when exposed to the air.

Pyroxylin. Gun-cotton.

Pyrozole. One of the coal-tar chemicals. (Pyrozole Chem. Co., St. Louis.) (Antipyretic.)

Pyrozone. Hydrogen peroxide rendered permanent in ether. (Specialty, McKesson & Robbins, New York.)

Q.

Quaker Button. Nux vomica.

Quaker's Black Drop. Vinegar of opium.

Quassation. In pharmacy, the act of reducing roots and tough barks to morsels.

Quévenne's Iron. Iron reduced by hydrogen.

Quickine. A solution of 1 part of carbolic acid and 0.02 part of mercuric chloride in 100 parts of dilute alcohol.

Quickwater. Solution of mercuric nitrate.

Quinine, Amorphous. The ether soluble part of quinoidine.

Quinole. Hydroquinone (for photographic purposes).

R.

Radical Vinegar. Glacial acetic acid.

Raisins, Corinthian. Grocers' currants.

Ramenti Ferri. Iron filings.

Realgar. Red arsenic sulphide.

Reddle. Red chalk.

Regulus (Antimonii, etc.). The pure metals, when separated by fusion.

Resina Elastica. India rubber.
Empyreumatica Liquida. Tar.
Empyreumatica Solida. Pitch.
Flava. Rosin. (Colophony.)
Pini. Turpentine (solid, hard).

Resopyrin. Compound of resorcin and antipyrin.

Resorcinol, Resorcin. This name has also been given to the fused product of resorcin and iodoform. (Bielaiew.)

Resorcinopyrin. Combination of resorcin and antipyrin.

Retinol. Rosin oil. Rosinol. Resinol. (Antiseptic, astringent.)

"Rex." Extract of beef of Cudahy, Omaha, Neb.
Metallorum. Gold.

"Rham. Cat." Abbreviation of Rhamnus catharticus. (Buckthorn berries.)

Rixoline. Artificial oil of turpentine.

Rizine. Rice, partially acted upon by superheated steam.

Rob (Roob). Inspissated juice (of elderberries, carrot, juniper berries, etc.).

Rodinal. Paraamidophenol. (For photographic purposes.) Solution of paraamidophenol hydrochlorate, sodium sulphite, and potassa in water.

Rose Pink. Whiting colored with decoction of Brazil wood and pearl ash.

Rosinol. Rosin oil.

Rotterin. Antiseptic solution, containing zinc chloride and sulphocarbolate, salicylic acid, boric acid, citric acid, thymol, and sodium chloride. Also in pastilles.

Rotulæ. Lozenges.

Rouge. Red ferric oxide.
Card. Sodium carthamate, from safflower.

Rubigo Ferri. Iron-rust.

Rubramentum. Red ink.

Ruddle. A kind of red chalk.

Rufus's Pills. Pills of aloes and myrrh.

Rusot. Extract of Berberis lycium.

S.

Saccharated Pepsin. (U. S. P. 1890.) Pepsin 10 percent. Powdered sugar of milk, 90 percent.

Sacchari Fœx. Molasses.

Saccharolé (French). Any moist liquid preparation (except syrup) which contains sugar in large proportions.

Saccharum Acernum. } Maple sugar.
Canadense. }
Candum (Candisatum). Rock candy.
Saturni. Sugar of lead.

Saccharure (French). Dry saccharolé; medicated sugars.

Saffranin. A coal-tar color.

Saffrol. A concentrated oil of sassafras; now mostly obtained from oil of camphor.

Saffron, American. Safflower.

Saim. Adeps.

Sal Absinthii. Potassium carbonate.
Acetosellæ. Potassium oxalate. (Generally oxalic acid is expected.)
Æratus. Potassium carbonate.
Alembroth. A mixture of mercuric and ammonium chlorides.
Amarum. Magnesium sulphate.
Ammoniacum Martiale. Iron ammonio-chloride.
Ammoniacum Secretum Glauberi. Ferrous sulphate.
Ammoniacum Volatile. Ammonium carbonate.
Anglicum. Magnesium sulphate.
Argenti. Silver nitrate.
Armeniacum. Ammonium chloride.
Artis. A mixture of mercuric and ammonium chlorides.
Benjamin. } Benzoic acid.
Benzoin. }
Catharticus Amarus. Magnesium sulphate.
Catharticus Anglicanus. Magnesium sulphate.
Catharticus Glauberi. Sodium sulphate.
Chalybis. Iron sulphate.
Cornu Cervi. Ammonium subcarbonate.
de Duobus. Potassium sulphate.
Diureticus. Potassium acetate.
Enixum. Potassium bisulphate.
Essentiale Tartari. Tartaric acid.
Fossilis. Sodium chloride.
Fuliginis. Ammonium carbonate.
Gemmæ. Sodium chloride.
Lactis. Milk sugar.
Marinum. Sea salt.
Martis. Ferrous sulphate.
Microcosmicum. Salts of urine.
Mirabile Glauberi. Sodium sulphate.
Mirabile Perlatum. Sodium phosphate.
Nitrum. Potassium nitrate.
Ossium. Ammonium carbonate.
Panchrestum. Potassium tartrate.
Petræ. Potassium nitrate.
Polychrestum Seignetti. Sodium tartrate.
Polychrestus. Potassium sulphate.
Polychrestus Glaseri. Potassæ sulphas cum sulphure.
Prunelle. Potassium nitrate.
Rupellensis. Rochelle salt.
Sapientiæ. Sal alembroth.
Saturni. Lead acetate.
Scientiæ. Sal alembroth.
Sedativus Hombergi. Boracic acid.

Sal Sedlicensis. Magnesium sulphate.
  Sennerti. Potassium acetate.
  Seydschutzense. Magnesium sulphate.
  Succini. Succinic acid.
  Tartari. Potassium carbonate.
  Tartari Essentiale. Tartaric acid.
  Thermarum (Carolinarum). Carlsbad salt.
  Urinæ. Sodium phosphate.
  Vegetabile. Potassium tartrate.
  Vitæ. Sal alembroth.
  Vitrioli. Zinc sulphate.
  Vitrioli Narcoticum. Boracic acid.
  Volatile. Ammonium carbonate.
  Volatile Liquid. Ammonia water
  Vomitorium Vitrioli. Zinc sulphate.

Salacetol. Salicylacetol. (Antirheumatic.)

Salamander's Blood. Fuming nitric acid.

Salbromalide. Antinervine.

Salicyl-Bromanilide. Antinervine.

Salinaphtol. Betol.

Saliphene. Salicylphenetidine.

Salipyrin. Antipyrin salicylate.

Salitonia. A saline tonic. (Phenique Chem. Co., St. Louis.)

Salmiac. Ammonium chloride.

Salol. Phenyl salicylate. Phenol salicylate. Phenylic ether of salicylic acid.

Salophene. Acetylparaamidosalol. (Antirheumatic.)

Salt, Fruit. A variety of Seidlitz (or Seltzer) aperient.
  Herapath's. Quinine iodosulphate.
  Microcosmic. Sodium and ammonium phosphate.
  Seignette. Rochelle salt.
  Sore-Throat. Sal prunellæ.
  of Tartar. Pure potassium carbonate.
  of Tin. Tin chloride.

Salve Pencil. Ointment in the shape of a pencil or stick.

Sandiver. See Glass Gall.

Sandyx. Red lead oxide.

Sanmetto. A combination of santal oil and saw-palmetto. For bladder-complaints. (Od. Chem. Co., New York.)

Santal Midy. Gonorrhœa capsules of Grimault & Co., in Paris.

Santoninoxim. Derivative of santonin.

Sapo Medicatus. A good quality of neutral white Castile soap.

Sapocarbol. Mixture of cresols with soap. (Antiseptic.)

Saponiment. A kind of compound soap liniment.

Saprol. Mixture of crude cresols with hydrocarbons. (Antiseptic.)

Sarco-Peptones. Specialty of Rudish. (Meat peptone.)

Saturatio. Solution of sodium citrate.

Saturnus (Saturni). Lead.

Schweinfurth's Green. Copper arsenite.

Sea-Onion. Squill.

Sebum (Sevum). Suet. Tallow.

Sedatine. Antipyrin. Also applied to paravalerylamidophenetol. (A new sedative.)

Sedox. A new dressing for wounds, etc., similar to cotton.

Seignette's Salt. Rochelle salt.

Semen Contra. Wormseed from Barbary.

Semen Cynæ. Santonica. Levant wormseed.
  Sanitum. The seed of Artemisia santonica.

Semencina. Levant wormseed. (Santonica.)

Semina Strychni. Nux vomica.

Serosine. Bromo-anilid. (Antipyretic.) (Serosine Chem. Co., St. Louis.)

Serum (Lactis, etc.). Whey (milk, etc.).

Sideros. Iron.

Siliqua Dulcis. St. John's bread.

Soloid. Trade-mark for compressed and other chemicals for making lotions, etc. Burroughs, Wellcome & Co., London.

Sol. Gold.

Solution, Goadby's. A preserving solution for animal substances, containing salt, corrosive sublimate, and arsenic.

Solutol. A solution of sodium cresolate in excess of cresol. Solution of cresols in sodium cresylate. (Disinfectant.)

Solveol. A solution of cresolene in sodium salicylate. Solution of cresols in sodium cresotate. (Surgical antiseptic.)

Solvin. See Polysolve.

Somnal. Solution of chloral hydrate and urethane in alcohol.

Sozal. Aluminum salt of paraphenolsulphonic acid.

Sozoiodol (difficultly soluble). Potassium salt of diiodoparaphenolsulphonic acid.
  Mercury, Zinc, etc. The respective salts of diiodoparaphenolsulphonic acid.

Sozoiodol (easily soluble). Sodium salt of diiodoparaphenolsulphonic acid.

Spanish White. Bismuth subnitrate.

Sparadrap. Spread adhesive plaster.

Spathum Fluoricum. Fluor-spar.

Species Pectorales. Pectoral species. ("Breast tea.")

Spelter. Zinc.

Speltrum. Zinc.

Sperma Mercurii. Mercury acetate.

Spermine. An aqueous infusion obtained from the prostate gland and testicles of animals. (Nerve tonic.)

Spina Cervina (Baccæ, etc.). Buckthorn berries, etc.

Spirit of Nitre. Crude nitric acid.

Pyro-Acetic. Acetone.

of Salt. Crude muriatic acid.

of Turpentine. Oil of turpentine.

Spiritus. See also Liquor.

Inflammabilis. Alcohol (sometimes whiskey).

Juniperi. Generally gin.

Lethalis. Carbonic acid.

Mindereri. Solution of ammonium acetate.

Muriatico-Æthereus. Spirit of chloric ether. (Not that containing chloroform.)

Muriatico-Æthereus Martiatus. Tinctura ferri chloridi ætherea.

Nitri Dulcis. Sweet spirit of nitre.

Nitri Duplex.
Nitri Fumans. Nitric acid.
Nitri Glauberi.

Nitrico-Æthereus. Sweet spirit of nitre.

Odoratus. Cologne.

Pyroxylicus. Methylic alcohol.

Sacchari. Rum.

Salis Dulcis. Spirit of chloric ether. (Not that containing chloroform.)

Salis Fumans. Muriatic acid.

Sulphurico-Æthereus. Spirit of ether. (Hoffmann's drops.)

Veneris. Acetic acid.

Vitrioli. Diluted sulphuric acid.

Vitrioli Dulcis. Hoffmann's anodyne.

Spodium. Crude bone charcoal. (Ivory-black.)

Spritz. A laboratory wash-bottle.

St. Germain Tea. Contains senna, manna, elder-flowers, and fennel or anise.

Stannum Cinereum.
Glaciale. Bismuth.

Indicum. Zinc.

Steapsin. Emulsifying ferment of the pancreatic juice.

Stearin. Stearic acid.

Steel Mixture. Mistura ferri composita.

Stibio-Kali Tartaricum. Tartar emetic.

Stibium. Antimony.

Stilus (Stylus). Ointment in the shape of pencil or stick.

Stipites Dulcamaræ. Dulcamara.

Storax Calamita. Solid storax. (Generally sawdust or residue of cinchona preparations mixed with liquid storax.)

Stoughton's Elixir. Compound tincture of gentian.

Stypteria. Alum.

Styracol. Guaiacol cinnamate. Cinnamylguaiacol. (Antiseptic.)

Styrone. Cinnamyl alcohol.

Succata. "Citron" of the grocers.

Succinum (Oleum, etc.). Amber (Oil, etc.)

Succolata. Chocolate.

Sucrate (French). A saccharate.

Sucrol. Paraphenetolcarbamide. (Sweetener.)

Suffitus. Fumigation.

Sugar Sand. Crude milk sugar.

Suint. Œsipus. Impure wool fat. (Antiseptic.)

Sulphaminol. Thio-oxydiphenylamine.

Sulphas Americanus Australis. Quinine sulphate.

Sulphonal. Diethylsulphonedimethylmethane. (Hypnotic.)

Sulphur Antimoniatum Fuscum. Precipitated sulphuret of antimony.

Auratum. Golden sulphur. (Antimony sulphide.)

Nigrum. Impure native sulphur.

Stibiatum Rubrum (Rubeum). Kermes mineral, antimony, sulphide and oxide.

Vivum. Impure native sulphur.

Sydenham's Laudanum. Wine of opium.

Syrup, Cuisinier. Compound syrup of sarsaparilla.

of Figs. A kind of compound syrup of senna. (California Fig Syrup Co., San Francisco.)

Syrupus Communis. Molasses.

Diacodii. Syrup of poppy-heads.

Domesticus. Syrup of buckthorn berries. (Generally molasses.)

Empyreumaticus. Molasses.

Fuscus. Molasses.

Hollandicus. Molasses.

T.

Tabloids. Trade-mark applied to compressed and other goods, etc. Burroughs, Welcome & Co., London.

Taffetas. Plaster spread on silk.

Tartarus. Crude potassium bitartrate (argols). Then, several potassium salts.

Boraxatus. Potassium and sodium borotartrate.

Natronatus. Rochelle salt.

Tartarisatus. Potassium tartrate.

Vitriolatus. Potassium sulphate.

Terebinthina Cocta. Turpentine (hard, solid).

Terra Cariosa. Rotten-stone.

Foliata. Sulphur.

Foliata Mineralis. Impure sodium carbonate.

Foliata Tartari. Potassium acetate.

Fullonica.
Fullonum. Fuller's earth.

Japonica. Catechu.

Ponderosa. Natural barium sulphate.

Sigillata (Alba, Rubra). White and red bole.

Terraline. A preparation from petroleum products, for internal use. (Terraline Co., Washington, D.C.)

Tetraiodpyrrol. Iodol.

Tetronal. Diethylsulphonediethylmethane. (Hypnotic.)

Thebaicum. Containing opium.

Therapol. Ozonized vegetable oils. (Ozone Co., New York.)

Theriaca. Molasses.

Theriaca Andromachi. An aromatic astringent confection containing opium, which originally had more than 70 ingredients.

Thermine. Tetrahydrobetanaphthylamine. Tetrahydrobetanaphtholamine. (Heat producer.)

Thilanin. Compound of sulphur with lanolin. (Dermic.)

Thioform. Basic bismuth dithiosalicylate. (Antiseptic.)

Thiolin. Salts of thiosulphonic acid. Salt of thiolinic acid. Sulphonated and sulphurated linseed oil.

Thiolo. Ammonium salt of thiosulphonic acid. Thiol. Artificial ichthyol.

Thiosinamine. Allylsulphocarbamide; by the action of ammonia upon volatile oil of mustard. (Thorncliffe disinfectant.) See Izal.

Thymacetin. Oxethylacetamidothymol. (Analgetic.)

Thymolol. Aristol.

Tincal. Native borax.

Tinctura Hiera. Wine of aloes.

Japonica. Tincture of catechu.

Melampodii. Tincture of black hellebore.

Thebaica. Tincture of opium.

Tincture, Antacrid. Guaiac mixture with corrosive sublimate.

Antiperiodic. A kind of Swedish bitters with quinine.

Bestucheff's. Ethereal tincture of ferric chloride.

Huxham's. Compound tincture of cinchona with saffron.

Simulo. Tincture of the seeds of Capparis coriacea. (Nervine.)

Tolphite. A dusting-powder containing talcum. (England.)

Tolypyrin. A new antipyretic. Paratolyldimethylpyrazolone.

Tolysal. A compound of tolypyrin with salicylic acid.

Tongaline. Contains tonga, cimicifuga, colchicine salicylate, pilocarpine salicylate, according to Mellier Co., St. Louis.

Tonquinol. Trinitroisobutyltoluol. Substitute for musk.

Tous-les-mois. Canna starch.

Traumaticine. Solution of gutta-percha.

Treacle. Originally "Theriac." In English prescriptions it means "molasses."

Treacle, Venice. See Theriaca Andromachi.

Trefusia. A natural iron albuminate.

Tribromhydrine. Allyl tribromide.

Trifolium Fibrinum. Menyanthes (Buckbean. Bogbean.)

Tri-Iodides, Henry's. For rheumatism. (Renz & Henry, St. Louis.)

Trimethylamine. Is not exactly the same as propylamine, though often prescribed thus.

Trional. Triethylsulphonmethylethylmethane. Diethylsulphonomethylethylmethane (Hypnotic.)

Trip. Iron subcarbonate.

Tritica. A kidney remedy. Probably a preparation of Triticum repens. (Searles & Hereth, Chicago.)

Trypsin. Peptonizing ferment of the pancreatic juice.

Tuberculin. A product of the tubercle-bacilli, according to Koch.

Tuberculocidin (shortened "T. C.," or Alexine "T. C."). Purified tuberculin, according to Klebs.

"E." Mixture of tuberculin (Koch) and tuberculocidin (Klebs), according to Spengler.

Tumenol. A preparation of tumenol-sulphonic acid.

Powder. Also a preparation.

Turbeth Mineral. Yellow mercuric sulphate.

Turionis Pini. Pine cones.

"Turps." Oil of turpentine

Tusche. India ink.

Tushy-stone. A gray zinc oxide.

Tutia. Impure zinc carbonate or oxide.

Tutty. Impure zinc oxide.

U.

Ultramarine. German blue.

Unction. Mild mercurial ointment.

Unguentum Ægyptiacum. Honey with acetate of copper

Cerussæ Acetatæ (P. L. 1787). Cerate of lead acetate.

Diapompholygos. Ointment of impure zinc oxide.

Myrrhæ. Ointment basis: 1 part of myrrh and 10 parts of wax melted together with oil.

Nervinum. Compound ointment of rosemary.

Ophthalmicum. A mild ointment of mercuric oxide.

Quercinum. Soft (moist) lead tannate.

Scytodepsicum. Moist lead tannate.

Uralin. Uralium.

Uralium. Chloral-urethan. Uralin.

Urethane. Ethyl-carbamate.

Uricedin-Stroschein. Compound, containing in 100 parts 27.5 sodium sulphate, 1.6 sodium chloride, 67 sodium citrate, and 1.9 lithium citrate.

Uropherin. Theobromine, lithium, and sodium salicylate. (Diuretic.)

V.

Valoid. Trade-mark for liquid extracts, etc. Burroughs, Wellcome & Co.

Valule. Trade-mark applied usually to capsules enclosing divided doses of substances. Burroughs, Wellcome & Co.

Vaporole. Trade-mark applied usually to capsules containing medicaments for inhalation, etc. Burroughs, Wellcome & Co., London.

Venus. Copper.

  Crystals of. Copper acetate.

Vervain's Balsam. Compound tincture of benzoin.

Vienna Powder. Potassa with lime.

Vigoral. A mixture of beef extract and powdered beef. (Armour & Co., Chicago.)

Vin Mariani. Compound wine of coca. French specialty.

Vinegar of the Four Thieves. An aromatic vinegar of the French Pharmacopœia.

Vinolia Preparations. Contain zinc oxide and borax.

Vinum Adustum. Alcohol. (Sometimes brandy.)

  Crematum. Brandy.

Virgin's Milk. A mixture of tincture of benzoin and water.

Viride Æris. Verdigris. (Crude copper acetate.)

Viscum Album. Mistletoe.

Vitriolum Cupri. Blue vitriol.

W.

Wade's Drops. Compound tincture of benzoin.

Wash Rag. Luffa ægyptiaca.

  Goulard's. Lead water.

Waterglass. Sodium or potassium silicate.

White Copperas. Sulphate of zinc.

  Flake. Lead carbonate.

  Liquor. Southern negro term for alcohol.

  "Nix." Crude zinc oxide.

  Pearl. Bismuth subnitrate or chloride.

  Permanent. Artificial barium carbonate or sulphate.

Wolfram. Tungsten.

Wolframate. Tungstate.

Wound Balsam. Compound tincture of benzoin.

Y.

Yellow Arsenic. Yellow arsenic sulphide.

Z.

Zea. Maize. Indian corn.

Zinc Flowers. Zinc oxide.

Zinchæmol. The same as hæmol.

Zootic Acid. Prussic acid.

Zooticum. As adjective to several salts Hydrocyanate.

Zymine. English name for pure pancreatin.

Z. Z. Anciently myrrh, now zingiber Ginger.

QUESTIONS

Note.—In the fourth edition of this book, questions which had appeared in former editions were omitted to save space. these are now inserted in a revised form and are placed at the end of the book. These questions are intended to aid students in reviewing their work and as suggestive to Boards of Pharmacy in preparing examination questions.

QUESTIONS ON INTRODUCTORY CHAPTER.

Define Pharmacy. (See page 25.)
In what respects is Pharmacy an art as well as a science, and what does it comprehend?
Is the word Pharmacy ever applied to any particular place? If so, how?
Into what two classes is Pharmacy divided?
Name and define the sciences which form the basis of Theoretical Pharmacy.
Define Materia Medica.
What is the name of the science which treats of crude drugs?
In what respect does this science differ from Pharmacy in its specific sense?
What is Toxicology?
Of what does Microscopy treat?
Name and define additional collateral branches taught in association with Theoretical Pharmacy.
Define Practical Pharmacy.
What is a Pharmacopœia?
Give the titles and last dates of issue of four of the most important Pharmacopœias.
Why is the present Pharmacopœia called "Eighth Revision" and not "1900"?
Are all Pharmacopœias issued under authority of government?
If not, name an exception.
What would be the advantages of an International Pharmacopœia?
By what practical plan have the chief advantages of such a book been secured?
When was the present U. S. Pharmacopœia prepared?
Describe the way in which the U. S. Pharmacopœia is revised and how the committees are appointed.
How many members constituted the final committee of revision?
How many substances having separate titles are contained in the Pharmacopœia?
What classification or arrangement of the various drugs and medicines has been accepted?
In the nomenclature of the Pharmacopœia, how are the titles of the various substances indicated?
What is the official Latin title of Caraway?
What is the botanical name of Caraway?
What is the official English title of Cantharis?
What is the synonym of Cantharis?
What is the symbolic formula of Potassium Chlorate?
What is the official definition of Caraway?
What is the object of having an official Latin title, and what use is made of it?
Why is the Latin language selected for this title?
Under what circumstances is it allowable to abbreviate official Latin titles?
When are abbreviations improper?
What does the official definition indicate?

In choosing the official name, what part of the botanical name of a plant is preferred?
What exceptions are there to this rule?
When several parts of the same plant are used, how are they distinguished?
When two or more plants of the same genus are official, how are they distinguished?
Are the Latin names of drugs usually in the singular or the plural number?
What reason is assigned for this?
In the case of compound medicines, how have the names been selected?
Where medicines have too many important ingredients to admit of selection, how have they been named?
What is meant by the official English title of a Pharmacopœial substance?
Under what circumstances should the official English title be used?
The common or popular names having been discarded and other names substituted, what, for example, are the present names of the drugs formerly known as Irish Moss, Pipsissewa, Male Fern, Yellow Jasmine?
Why has this change been made?
Have all the common names been changed? If not, give an example and the reason why it was not changed.
What important change in the English names of chemical substances was made in the U. S. Pharmacopœia of 1890? Why was this done?
How are the higher and lower forms of the salts of iron and mercury differentiated? Give an example.
How are the compounds of mercury further distinguished?
Why is the term "iron" retained for the scale salts of iron?
Do the pharmacopœial names of chemical substances always represent their chemical composition? If not, give an example of one that does not, and the reason for not using the systematic name.
Were the proprietary or trade names for synthetic remedies introduced into the U. S. P. (8th Rev.)?
Give an illustration of the rule followed.
What is meant by a synonym?
Is it desirable to increase the use of synonyms?
Why are they used?
Where were synonyms placed in the present Pharmacopœia? Why?
What is meant by the botanical name of a plant?
How is it usually derived?
Why is it important to know the botanical names of plants?
What is the meaning of the official abbreviation "Fam." used after the botanical name?
What abbreviation was used in the U. S. P. 1890 in place of the present "Fam."?
What are symbolic formulas?
What are the objects of their employment?
What do the figures following a symbolic formula indicate?
What is meant by molecular weight?
What is an atom?
Describe what is meant by the official definition of a drug or chemical.
What was the purpose in introducing the "purity rubric"?
How will it prevent unjust prosecutions?
What is meant by the official description of a drug?
What are the objects of having official descriptions?
What is an assay process? How are alkaloidal drugs usually assayed?
What is meant by "gravimetric" assay?
By "volumetric" assay?
Why was an average dose introduced into the U. S. P.? What was the need for doses in the Pharmacopœia?
Describe the principle of weight and measure adopted by the U. S. Pharmacopœia of 1890.
How are the quantities expressed in the late Pharmacopœia? Which system is preferable?
What is a Dispensatory?
Name the two principle Dispensatories published in the United States.

PART I

QUESTIONS ON CHAPTER I

METROLOGY

Define Metrology. (See page 37.)
What does its present and less strict definition include?
What is weight ?
What is measure .
What is specific gravity ?
In the history of Metrology, how many distinctly-marked periods may be traced ?
Describe the peculiarities of each period.
What was the original weight of the English silver penny ?
What is the origin of the avoirdupois pound ?
How did the custom originate of druggists using one system of weights for buying drugs and another for compounding them ?
When were the Imperial measures and standards adopted in Great Britian ?
What relation does the yard bear to the length of a pendulum beating seconds ?
What is the weight in grains of the pound troy ?
What is the weight in grains of the pound avoirdupois ?
What is the weight in grains of a cubic inch of distilled water ?
What is the weight of an Imperial gallon of distilled water ?
What is the weight of a wine gallon of distilled water ?
How many cubic inches does a wine gallon contain ?
How is the pound troy divided ?
How is the pound avoirdupois divided ?
What is the difference in grains between the troy ounce and the avoirdupois ounce.
What is the difference in grains between the troy pound and the avoirdupois pound ?
How is the U. S. wine gallon divided?
How is the Br. Imperial gallon divided?
What is the weight in grains of a pint of distilled water (U. S.)?
What is the weight in grains of a fluidounce of distilled water (U. S.)?
What is the weight in grains of a troy ounce of distilled water (U. S.)?
What is the weight in grains of an avoirdupois ounce of distilled water?
What is the weight in grains of an Imperial fluidounce of distilled water (Br.)?
What is the estimated capacity of a tumblerful?
What is the estimated capacity of a teacupful?
What is the estimated capacity of a wineglassful?
What is the estimated capacity of a tablespoonful?
What is the estimated capacity of a dessertspoonful?
What is the estimated capacity of a teaspoonful?
Can ordinary household teaspoons, tablespoons, etc., be relied upon for accurate dosage? What is recommended for use in measuring such doses?
What is the standard or unit of measurement in the metric or decimal system?
How is it derived?
Why is the system called the metric system?
Why is the system called the decimal system?
How is the unit of capacity derived?
How is the unit of weight derived?
How are the multiples of the various units expressed?
How are the divisions of the various units expressed?
What word has been suggested as a useful mnemonic?
Give the names of the various denominations of length.
Give the names of the various denominations of capacity.
Give the names of the various denominations of weight.
Which of these terms are used in the U. S. Pharmacopœia?
What is the meaning of a micromillimeter?

What are the chief merits of the metric system?
What is the length of a meter?
What is the capacity of the liter in pints?
What is the measure of a gramme of distilled water?
What is the weight of a gramme in grains?
What is the chief disadvantage of the metric system?
How are the metric weights usually divided?
How can you convert meters into inches?
How can you convert centimeters into inches?
How can you convert millimeters into inches?
How can you convert liters into fluidounces?
How can you convert liters into pints?
How can you convert liters into Imperial pints?
How can you convert liters into Imperial gallons?
How can you convert cubic centimeters into fluidounces?
How can you convert cubic centimeters into Imperial fluidounces?
How can you convert grammes into grains?
How can you convert grammes into avoirdupois ounces?
How can you convert grammes into troy ounces?
How can you convert centigrammes into grains?
How can you convert milligrammes into grains?
How can you convert kilogrammes into avoirdupois ounces?
How can you convert kilogrammes into avoirdupois pounds?
How can you convert kilogrammes into troy ounces?
How can you convert inches into meters?
How can you convert inches into centimeters?
How can you convert inches into millimeters?
How can you convert pints into liters?
How can you convert fluidounces into cubic centimeters?
How can you convert Imperial pints into liters?
How can you convert Imperial gallons into liters?
How can you convert Imperial fluidounces into Cc.?
How can you convert grains into grammes?
How can you convert grains into centigrammes?
How can you convert grains into milligrammes?
How can you convert avoirdupois ounces into kilogrammes?
How can you convert avoirdupois ounces into grammes?
How can you convert aviordupois pounds into kilogrammes?
How can you convert troy ounces into kilogrammes?
How can you convert troy ounces into grammes?
How are the metric units spelled by the French?
How are the metric units spelled by the U. S. Pharmacopœia?
How should 0.050 m. be read?
How should 0.055 m. be read?
How should 0.0555 m. be read?
In measures of capacity less than a liter, what terms are used?
In weight, when the quantity is relatively large, what terms are used?
In quantities less than a kilogramme and greater than a gramme, what terms are used?
In quantities below the gramme, what terms are used?
What is a balance?
What particulars are necessary to obtain correct results?
Name the various kinds of pharmaceutical balances in use.
Describe a single beam, equal arm balance.
When the beam is in a horizontal position, where should the centre of gravity be?
Give a simple illustration of the principle of suspending a beam.
What particulars are necessary in regard to the end knife-edges?
What is the effect if the end knife-edges are not equidistant from the central knife-edge?
What if the central knife-edge is not in line with the end knife-edges?
What if the knife-edges are not parallel with each other?
What are the requisites for the beam of a fine balance in order to secure accuracy in weighing?
Why should the beam of the balance be rigid and non-elastic?

Why should it be no heavier than necessary in order to secure the requisite strength?
What advantages have agate knife-edges and planes over those made of steel?
How may a balance be tested for accuracy?
What are the advantages of having the balance supported by a rigid metallic column?
Wherein does an analytical balance differ from an ordinary prescription balance?
What sort of counter scales was formerly in use?
What has taken its place generally in more recent times?
Upon what principle are the single beam, unequal arm balances constructed?
What are the advantages of the "Ball scale?"
Describe the vest-pocket prescription balance.
Describe the double beam, unequal arm balance.
What are its advantages?
Describe a scale made to weigh liquids.
What is the principal objection to such balances?
What principle is adopted in making platform scales?
Describe the construction of a "compound lever balance". What are the advantages of such a balance?
What is a "box prescription scale"?
Is such a scale suitable for weighing quantities of a grain or less?
What is the principle of the torsion balance?
Of what weights does a pile of avoirdupois weights consist?
What is meant by block weights?
What is the objection to the use of a wooden block?
How are troy weights usually arranged?
How are iron metric weights usually shaped?
What weights are generally used for analytical purposes?
What is the best material and form for grain weights for prescription purposes?
Why are aluminum weights preferable to brass?
What are the advantages of aluminum wire weights?
What measures are commonly used for measuring liquids when the quantity is more than a pint?
What when the quantity is one pint or less?
What effect has denting upon tinned iron or copper measures?
Describe the forms of graduated glass measures in common use.
Which is preferable, and why?
Describe Hodgson's graduated measures.
Describe Hobb's graduated measures.
What is an objection to either of these, and how may it be remedied?
What objection is there to using minim graduated measures?
How may greater accuracy be obtained?
How is a pipette used?
Do the terms minim and drop always mean the same?
About how many drops are there in a fluidrachm of water? *Ans.* 60.
In a fluidrachm of syrup of acacia? *Ans.* 44.
In a fluidrachm of chloroform? *Ans.* 250.
In a fluidrachm of tincture of opium? *Ans.* 130.
What is specific gravity?
How much weight does a body lose by being immersed in water?
What is the rule for finding the specific gravity of a body?
How is the specific gravity taken of a solid, insoluble in but heavier than water, by means of a balance?
How by means of a specific-gravity bottle?
How by means of a graduated tube?
How by immersing it in a liquid of the same specific gravity?
How is the specific gravity taken of a solid soluble in but heavier than water?
How is the specific gravity taken of a solid insoluble in but lighter than water?
How of a solid soluble in but lighter than water?
Describe a specific-gravity bottle.
Can an ordinary bottle be used for this purpose?
State how this can be done?
What are Lovi's or specific-gravity beads?
What is a hydrometer or areometer?

What two classes of hydrometers are there?
Describe Baumé's hydrometer.
What is the difference between the one for light liquids and the one for heavy liquids?
Why is the zero mark placed near the top in hydrometers for heavy liquids?
Describe the specific gravity scale hydrometer.
What is the object of having two bulbs blown in the glass at the lower end of the hydrometer?
Which is the more accurate for taking specific gravity,—the hydrometer or the specific-gravity bottle,—and why?
Which is more likely to give a correct indication of specific gravity,—a hydrometer having an elongated bulb with cylindrical sides, or one having an oval or globular bulb,—and why?
What is a urinometer, and how is it usually graduated?
What is the specific gravity of healthy urine?
What is the specific gravity of diabetic urine?
What is a saccharometer, and how is it graduated?
What is an elæometer?
What is a lactometer?
What does an alcoholmeter usually indicate?
Describe Tralles's hydrometer.
Describe Cartier's hydrometer.
Describe Gay-Lussac's centesimal alcoholmeter.
Describe Sikes's hydrometer.
Describe Jones's hydrometer.
Describe Dica's hydrometer.
Describe Twaddell's hydrometer.
Describe Beck's hydrometer.
Describe Zanetti's hydrometer.
Describe Fahrenheit's hydrometer.
Describe Nicholson's hydrometer.
Describe Mohr's specific-gravity apparatus.
Describe Gannal's method of taking specific gravity of a liquid.
How can a specific-gravity pipette be used to show specific gravity?
Describe Rousseau's densimeter.
What is specific volume?
How can you obtain the volume of a given weight of a liquid?

CHAPTER II

OPERATIONS REQUIRING THE USE OF HEAT

According to the dynamical theory, how is heat produced? (See page 104.)
What solids are commonly used as fuels in developing heat?
What is the objection to using wood as a source of heat in pharmaceutical operations?
Is charcoal more or less convenient, and why?
What advantages has anthracite coal?
What is the objection to bituminous coal?
What are the advantages of coke as a fuel?
What fundamental parts constitute a furnace?
What percentage of carbon is present in anthracite coal?
What gases are produced by the combustion of coal?
How much air is required for the burning of one pound of coal?
Describe the construction of a range with water-back and tell its advantages.
What liquids are used for heating purposes in pharmaceutical operations?
What objection is there to the use of alcohol?
Describe a simple alcohol stove.
To what uses may methyl alcohol be put?
What is the arrangement of the so-called Russian blast lamp?
How may petroleum benzin or gasolin be burned without danger from explosion?

Is kerosene or coal oil safer as a fuel than gasolin? If so, why?
Does coal oil require a wick to burn satisfactorily?
What is the disadvantage of using a wick?
Describe the blue flame, wickless, coal oil stove.
Upon what principle is this stove constructed?
Of what does ordinary illuminating gas consist? How is it produced?
What valuable liquid and solid by-products are obtained in process of manufacture?
Give an explanation of the three zones that are apparent in an ordinary gas-flame.
How may ordinary gas be burned so as to become a source of heat rather than of light?
What is a Bunsen burner?
What is the objection to the ordinary Bunsen burners?
How may this be obviated?
How does the length of the perpendicular tube affect the smokeless character of the flame?
Describe Fletcher's radial burner.
How may the vapor of gasoline be used in the place of gas?
What are the chief points to be secured in a good gas stove?
Describe the Economy gas stove.
What are the chief advantages in this stove?
Describe an instantaneous water heater for use at the prescription counter.
What are the advantages of the use of illuminating gas as a source of heat?
How may electricity be used as a source of heat?
In pharmaceutical operations, how are degrees of temperature measured?
What is a thermometer?
What three scales of degrees of heat for thermometers are used?
Which is most largely used in this country?
Which is used in the U. S. Pharmacopœia?
What are the freezing and boiling points of Fahrenheit's scale?
How is the intervening space divided?
What are the freezing and boiling points of the Centigrade scale?
How is the intervening space divided?
What are the freezing and boiling points of Réaumur's scale?
How is the intervening space divided?
How may Centigrade degrees be converted into those of Fahrenheit above 32?
How may Fahrenheit degrees above 32 be converted into Centigrade degrees?
What are the essential points of a good thermometer?

Convert — 13.72° C. into F.
— 13.72
1.8
10976
1372
— 24.696
+ 32
8.696

Convert — 27.4° F. into C.
— 27.4
— 32
1.8) — 59.4 (— 33
54
54
54

Convert — 5° C. into F.
— 5
1.8
— 9.0
+ 32
23.

Convert — 2.2° F. into C.
— 2.2
— 32
1.8) — 34.2 (— 19
18
162
162

Convert 78° C. into F
78
1.8
624
78
140.4
32
172.4

Convert 62° F. into C.
62
32
1.8) 30 (16.66
18
120
108
12

What is a clinical thermometer?
Give the normal temperature for the human body.
What is meant by a melting point and of what value is such a factor?
Describe the ordinary method of taking a melting point and also Bensemann's method.

CHAPTER III

USE OF HEAT

What is a blowpipe, and how is it used? (See page 119.)
What is it used for?
How is a gas blowpipe arranged?
What is the construction of a footbellows?
What is a crucible, and what is its use?
Of what materials are crucibles made?
What sort will bear great heat without danger of breaking?
What is the best metal from which to make crucibles, and why?
What processes require the application of high heat?
What is ignition? Give an example of ignition.
What is fusion? Give an example of an official preparation in which this process is used.
What is calcination?
What is deflagration?
What is carbonization? Give an illustration.
What is torrefaction? Give an illustration.
What is incineration?
What is sublimation?
In operations requiring lower temperature, what contrivances are used for controlling the heat?
What is a sand bath?
What is an oil bath?
What temperature does an oil bath furnish?
What temperature does a glycerin bath furnish?
What temperature does a salt water bath furnish?
What is a water bath?
What is latent heat?
When water at 0° Centigrade is mixed with an equal weight of water at 100° Centigrade, what is the temperature of the mixture?
How much water will 100 parts (by weight) of steam raise from the freezing point to the boiling point?
What two classes of steam baths are used?
What temperature can be obtained by an open steam bath?
What is the pressure of the atmosphere to the square inch?
If water be heated continuously under pressure, what will be the result?
What would be the temperature of a steam bath carrying 100 pounds pressure to the square inch?
Describe an upright tubular steam boiler.
What is the objection to using tinned copper steam kettles?

What is the objection to using enamelled cast iron steam kettles?
What form of jacketed steam kettle is most convenient?
How may steam under pressure be used in vessels which are not jacketed?
Describe the construction of a jacketed steam kettle to be used over a naked fire without a boiler.

CHAPTER IV

VAPORIZATION

What is vaporization? (See page 129.)
What is evaporation?
What is distillation?
What is desiccation?
What is exsiccation?
What is granulation?
What is sublimation?
What is meant by ebullition or boiling?
What is meant by the boiling point of a liquid?
Is the boiling point of a liquid a definite temperature?
Is the evaporating point of a liquid a definite temperature?
What is the boiling point of water under the ordinary pressure of the atmosphere?
When confined under pressure, how high can its temperature be raised without boiling?
What will be the effect upon boiling if the pressure is made much less than that of the atmosphere?
How may the boiling point of a liquid be determined accurately?
What is meant by the tension of vapors?
What effect have cold and pressure upon vapors?
What effect have heat and removal of pressure upon vapors?
Upon what does the quantity of vapor that will form in a confined space depend?
How is the evaporation of a liquid influenced by the presence or absence of aqueous vapor in the air?
How may the rapidity of evaporation be increased?
Why does increase of temperature hasten evaporation?
In evaporation by boiling, temperature, pressure, etc., being equal, upon what does the rapidity of the process depend?
When a pure volatile liquid is evaporated by boiling in the open air, does the temperature change with the amount evaporated?
If there is solid matter dissolved in the liquid, what takes place on evaporation?
What inference should be drawn from this,—for example, in the preparation of extracts?
Which are most easily evaporated,—thin mobile liquids or dense and thick ones, and why?
Does the depth of a liquid influence its boiling point?
Why are rough metallic surfaces better for evaporation than smooth ones?
In evaporating liquids below the boiling point, temperature, pressure, etc., being equal, upon what does the rapidity of the process depend?
Therefore, what shaped vessels should be used for evaporating liquids below the boiling point?
What effect is produced by stirring an evaporating liquid?
Will water boil at a higher or lower temperature in more elevated positions, and why?
What application is made of this principle in pharmacy?
What is an evaporating chamber, and how should it be constructed?
Describe a method of surface evaporation which is economical, yet practical.
Why is flask evaporation not satisfactory?
What is the objection to evaporating liquids by direct heat?
In evaporating a liquid to a definite measure, how may it be ascertained when the measure has been reached?

What is a hood, and what is its use?
What is a grommet, and what are its uses?
What is meant by spontaneous evaporation?
How may it be advantageously conducted?

CHAPTERS V-VI

DISTILLATION AND SUBLIMATION

What are the elements of distillation? (See page 140.)
How many times its weight of water at 20° C. (68° F.) are required to condense steam at 100° C. (212° F.)?
What two forms of apparatus are used in distillation?
What is the form of an alembic?
What is the body of it called?
What is the form of a retort?
Has a retort any advantages over an alembic, and if so, what are they?
What is a plain retort?
What is a tubulated retort?
Of what materials are retorts made?
For what purposes are the various kinds used?
What are the essential qualities of a good retort?
What are the advantages of using a flask for distillation?
What is the best shape for a flask?
How may glass tubes be cut?
How may glass tubes be bent?
What is a cork borer, and how is it used?
How may rubber corks be cut?
What is the advantage of rubber corks?
What substitute for rubber corks may be made?
How may a satisfactory lute for closing joints be made?
How may bladder be used to join tubes?
How may paper be used to join tubes?
Is rubber superior to bladder for such purposes? If so, why?
How is it used?
What are receivers?
What are tubulated and quilled receivers?
What are adapters, and how are they used?
How may plain retorts be charged?
What is a Welter's safety tube?
For what purposes are retort stands used?
How may funnels or percolators be protected from the breakage due to contact with the iron rings of the ordinary retort stand?
What is meant by bumping in distillation?
How may it be prevented or lessened?
What is a Liebig's condenser?
Describe the pinchcock contrived by Dr. Squibb.
Describe Mohr's spring pinchcock.
Describe Hoffman's screw pinchcock.
How may vapors be condensed when the ordinary condensers and a steady supply of water are not at hand?
What is a condensing worm?
What is the best metal to use for making it?
What objection is there to copper?
What objection is there to iron?
What objection is there to tinned iron?
What objection is there to earthen-ware?
What is the best material to use for pharmaceutical stills?
Describe Procter's still.
Describe Wiegand's still.
Describe Curtman's still.

Describe the still made by Whitall Tatum Company.
Describe Game's still.
Describe Stevens's still.
Describe Prentiss's still.
Describe Rice's still and condenser.
What is the disadvantage of Liebig's condenser?
What is the disadvantage of a worm condenser?
Describe Remington's still and condenser.
Describe Herrick's water still.
What is meant by fractional distillation?
What is meant by destructive distillation?
What objection is there to using glass vessels in destructive distillation?
Give examples of products made by destructive distillation.
What is sublimation? (See page 161.)
What is the product called?
What are the objects of sublimation?
Of what material are the retorts or apparatus usually made?
What effect does the temperature of the condensation point of the vapors of solids have upon the character of the sublimate?
What is the difference between a cake sublimate and a powder sublimate?
How are cake sublimates obtained?
How are powder sublimates obtained?
What is the most important point to be observed in the operation of sublimation?

CHAPTERS VII–VIII

DESICCATION AND COMMINUTION

What is desiccation? (See page 163.)
What are the objects of desiccation?
How may roots, herbs, and leaves be conveniently dried on the large scale?
What is meant by "gruffs"?
What use is made of "gruffs"?
Why does the U. S. P. direct myrrh in substance and not in powder in making compound iron mixture?
Table showing loss in powdering medicinal substances.
What is comminution? (See page 168.)
What are the objects of comminution?
How may roots, barks, etc., be conveniently cut?
How upon the large scale?
How may drugs be most conveniently bruised or contused?
When it becomes necessary to use an iron mortar and pestle for a considerable length of time, how may the labor of lifting the pestle be lessened?
For what purposes are wooden mortars used?
For what purposes are marble mortars used?
In using marble mortars, what precautions are necessary?
What is the difference between grinding and pulverizing?
What drugs are most injured by drying?
What is a buhr-stone mill?
What two varieties are there, and what are they called?
What is the peculiarity of each?
What are roller mills?
What are the rollers usually made of?
What is the form of the rollers?
What are chaser mills?
How are the stones arranged?
How are powders of greater or less degrees of fineness obtained from chaser-mills?
What is a "jar mill" or a "pebble mill"?
For what kind of grinding is it used?
What are barrel mills?
How is the "Bogardus" mill constituted, and what is its peculiarity?

What is Mead's disintegrator?
What is requisite in running this mill?
Describe the Max mill.
What three classes of hand mills are there?
Describe Swift's mill (old style).
What improvements have been made in the new style Swift's mill?
Describe Troemner's mill.
Describe the Enterprise mill.
What are its advantages?
Describe the Quaker City mill and what are its advantages?
Describe Thomas's mill.
What are the principal objections to this mill?
Describe Swift's B mill.
Describe Hance's mill.
Is Hance's mill best adapted for light or heavy work?
What are the most usual difficulties met with in operating hand mills?
How may these be obviated?
What is a good method of cleaning a mill after an odorous drug has been ground?
What is trituration?
What shaped mortars and pestles are best adapted to the purpose of trituration?
What objection is there to the ordinary pestle of porcelain or wedgwood mortars?
How is this best remedied?
Is the hard-rubber handle any better, and if so, why?
What preparation, called a "trituration," has been made official in the U. S. P.?
Describe a device for facilitating trituration.
What is the objection to glass mortars and pestles?
Which are most useful,—mortars and pestles of porcelain, white glass, or green glass, and why?
What is a spatula, and what is its best form?
For what are spatulas covered with hard rubber useful?
How is the process of sifting accomplished?
Why is it important to thoroughly mix powders which have been ground and sifted?
Describe Jones's mixer and sifter.
Describe Hunter's sifter.
How are the degrees of fineness of powders designated in the U. S. P.?
How many degrees of fineness are so designated?
What is meant by a very fine powder? Fine powder? Moderately fine powder? Moderately coarse powder? Coarse powder?
In some special cases other degrees of fineness than these five are designated, as for example, No. 30 and No. 12: what is meant by these numbers?
For what is a horse hair sieve used?
When should bolting cloth be used as the sifting medium?
What is levigation?
What is meant by porphyrization? By elutriation?
Give an example of an elutriated powder.
What is trochiscation?
What is pulverization by intervention?
Give an example of this process.

CHAPTER IX

SOLUTION

What is meant by solution? (See page 189.)
What is the liquid used to make a solution called?
What is a saturated solution?
When is a substance said to be insoluble?
What two kinds of solution are there?
Give examples of each.
How may the solution of solids be facilitated?

What is the effect of dissolving a solid body specifically heavier than the solvent?
How may this be shown?
Is a saturated solution of one substance capable of dissolving some other substance?
Give an example.
When solids dissolve rapidly in liquids without chemical action, what takes place?
How are freezing mixtures made?
What is the effect if during the solution chemical action takes place?
How are solutions usually made by the pharmacist?
What is meant by circulatory solution?
Name the principal solvents used in pharmacy.
What are some of the advantages of alcohol as a solvent? Of glycerin?
For what substances is ether a good solvent?
What advantages has ether over chloroform?
What are objections to carbon disulphide as a solvent?
What value is the solubility of a substance as a test?
Does the temperature effect the solubility?
What temperature is taken as the standard in the U. S. P.?
Describe Rice's lysimeter.
Upon what do the methods for making solutions of gases in liquids depend?
Where a gas is freely soluble in a liquid, how is a solution usually effected?
What is the arrangement of a Woulffe's bottle?
Are gases generally more rapidly and thoroughly dissolved by cold or hot liquids?

CHAPTER X

SEPARATION OF FLUIDS FROM ACIDS

What is meant by lotion or displacement washing? (See page 198.)
How may it be effected?
What is a spritz bottle, and what is its use?
What is continuous washing?
How may it be effected?
What is decantation?
What is a guiding-rod, and how is it used?
What is a syphon?
What is the principle of its action?
Where a poisonous, caustic, or disagreeably tasting liquid is to be drawn off by a syphon, how may it conveniently be started?
What is colation?
What materials are used for the purpose?
In what cases are strainers used?
What are felt strainers?
How are woollen strainers used?
What advantages have cotton flannel strainers over those made of woollen?
How are muslin strainers used?

CHAPTER XI

FILTRATION

What is filtration? (See page 205.)
Of what are filters usually made?
What is the liquid that passes through a filter called?
What kind of filters are most useful and most employed?
What objection is there to the ordinary gray filtering-paper that is commonly used?
What is the difference between a plain and a plaited filter?
How is a plain filter folded?
What is its special advantage?

What is a disadvantage of a plain filter, and how may such disadvantage be obviated?
What is Rother's method of making a plain filter?
What advantage has this?
How is a plaited filter ordinarily made?
How can a plaited filter be folded differently, so as to strengthen its apex?
In folding a filter should the creases extend entirely to the apex? Why?
What exceptions are there to this plan?
What are the advantages of moistening a filter before filtration?
In what cases should a double filter be used?
How may a paper filter be strengthened?
How should the liquid be poured into a filter?
Should a filter extend beyond the edges of the funnel? Why?
In filtering into a bottle what precautions must be observed?
What are funnels used for?
What materials are they made of?
What angle should a funnel have?
What kind of funnels is most generally useful?
What are the advantages of a ribbed funnel? Of those having the outside of the neck triangular?
What is the advantage of tinned copper for funnels? Of hard rubber? Of porcelain?
For what purposes are earthen-ware funnels useful?
What is an objection to enamelled (called granite- or agate-ware) funnels?
What is an objection to tin funnels?
What are the advantages of a hard-rubber funnel?
Describe the construction of a funnel used for filling bottles?
How is upward filtration performed?
Describe Hadden's filter.
Describe William R. Warner's oil-filter.
How may continuous filtration be accomplished?
How may volatile liquids be filtered?
How may hot filtration be accomplished?
What is a jacketed funnel?
How may a coil of pipe be used to effect hot filtration?
Describe Dr. Hare's hot-water filter.
How may the rapidity of filtration be increased?
How may a fall of water be made to increase the rapidity of filtration?
Describe Lux's aspirator.
Describe Fisher's vacuum pump.
Describe Chapman's vacuum pump.
Describe Richard's vacuum pump.
What are the advantages of the vacuum pump made by Schutté and Goehring?

CHAPTER XII

CLARIFICATION AND DECOLORATION

What is clarification? (See page 219.)
In what various ways may it be effected?
How is it effected by the application of heat?
How is it effected by increasing the fluidity of the liquid?
How does albumen act in clarifying liquids?
When is gelatin useful in clarifying liquids?
How does milk act in clarifying liquids?
What is the action of paper pulp in clarifying liquids?
How does fermentation act in clarifying liquids?
What is the difference between a sediment and a precipitate?
What is decoloration, and for what articles is it used?
What substance is generally preferred in decolorizing operations?
How is the most powerful animal charcoal produced?
What valuable principles used in medicine does charcoal absorb?
For what class of substances has charcoal been used as an antidote?

CHAPTERS XIII–XIV

SEPARATION OF IMMISCIBLE LIQUIDS AND PRECIPITATION

What is a pipette, and how is it used? (See page 223.)
What is a separating funnel, and how is it used?
What are the advantages and uses of the pear-shaped separator?
Describe Dr. Mitchell's separator.
What is a Florentine receiver?
What is precipitation? (See page 226.)
What is the separated solid termed?
What is the substance which produces the precipitate termed?
What is the liquid which remains in the vessel above the precipitate called?
What are the objects of precipitation in pharmacy?
Give examples of each of these objects.
How and why is precipitation used in testing?
What descriptive terms are used for the precipitate?
What is meant by the term "magma"?
What various methods are there of effecting precipitation?
What is the best shape for precipitating vessels?
If two solutions are used to produce a precipitate, in what order should they be mixed?
If an acid and an alkaline solution are mixed, how may it be determined when the mixture is neutral, or nearly so?
Why is ammonia the most useful of alkaline precipitates?
How are heavy precipitates formed?
Are they more or less easily washed from adherent salts than light precipitates?
What advantage have heavy precipitates over light ones?
How should a filter be folded for collecting a precipitate in analytical work?
How may large amounts of precipitates be collected and washed?

CHAPTER XV

CRYSTALLIZATION

What is crystallization? (See page 229.)
What are non-crystallizable substances called?
In the classification of crystals, how many systems are recognized?
What is meant by the centre of a crystal?
What is meant by the axes of a crystal?
What are substances called that crystallize in two forms? In three forms? In more than three forms?
What are prismatic crystals? Tabular crystals? Laminar crystals? Acicular crystals?
Upon what are the systems of classification of crystals based?
What are those called in which the three axes intersect at right angles?
What are those called in which the angles caused by the intersection are oblique?
Describe the monometric, or regular system. The dimetric, or quadratic system. The trimetric, or rhombic system. The hexagonal, or rhombohedric system. The monoclinic, or oblique-prismatic system. The triclinic, or doubly-oblique prismatic system. The diclinic system.
How can the form of a crystal be determined, as to which system it belongs?
What is the instrument for measuring the angles of crystals called?
What is meant by cleavage?
Under what circumstances does the process of crystallization generally take place?
Do solids ever become crystallized without becoming liquefied?
Give an example.
By what various methods may crystals be obtained?
How may crystals be formed by fusion?

Do weak or strong solutions form crystals of the most perfect form?
How may large crystals be obtained?
How may small crystals be obtained?
Are crystals more readily deposited on rough or smooth surfaces?
How may perfect geometrical crystals be produced?
In what cases is the process of obtaining crystals by evaporation useful?
How may gold and copper be crystallized?
Give an example of the production of crystals by precipitation.
Also when two solutions are mixed together.
Why does the addition of alcohol to syrup cause the sugar to crystallize?
What is water of crystallization?
What is interstitial water?
What is water of decrepitation, and why is it so called?
What is efflorescence?
What is exsiccation?
What substances are hygroscopic?
What is deliquescence?
Give an example of a deliquescent salt.
What is mother-liquor?
What is meant by fractional crystallization?
How should crystallizing vessels be made?
How is alum usually crystallized?
On the small scale, how may crystals be obtained?
What is meant by intermediate crystallization?

CHAPTERS XVI–XVII

GRANULATION, EXSICCATION AND DIALYSIS

What is meant by granulation? (See page 237.)
How were granulated effervescent salts formerly prepared?
How are granulated effervescent salts now prepared?
What is exsiccation, and what is its object? (See page 239.)
What is dialysis? (See page 239.)
What are crystalloids? Give an example.
What are colloids? Give examples.
What is the most convenient substance to use for a dialyzing medium?
How is it prepared?
Describe Professor Graham's dialyzer.
What is the liquid called in which crystalloid matter is dissolved, which has been passed through a dialyzer?
What applications of the process of dialysis have been made?
What preparations have been called dialysates?
What is dialyzed iron?

CHAPTER XVIII

EXTRACTION

What is meant by extraction? (See page 242.)
What is meant by menstruum?
What are the principal modes of extraction employed in pharmacy?
What is meant by maceration?
What is meant by circulatory displacement?
How are all tinctures directed to be prepared by the German Pharmacopœia?
Which is the better process in unskilled hands, maceration or percolation, and why?
What is the principal objection to preparations made from weighed instead of measured liquids?
Define digestion.

CHAPTER XIX

EXPRESSION

What is expression? (See page 244.)
How many mechanical principles are recognized in the operation of expression, and what are they?
What is the principle of the spiral twist press?
What press is most useful in pharmaceutical operations, where very great power is not desired?
How many forms of screw presses are there?
Describe a single screw press.
What is the best material for press cloths?
What is the principal objection to the screw press?
Describe the Enterprise Co.'s horizontal screw press.
Describe the double screw press as proposed by Mr. Charles T. George.
What is the principle of the roller press?
Describe the wedge press.
What objection is there to it?
Describe the lever press.
What are its advantages?
What is an objection to it?
What is the principle of the hydrostatic or hydraulic press?
What are its special advantages?
In operating presses, what maxims should be observed?
Which can retain pressure most effectually, screw presses or hydraulic presses and why?
Describe a centrifugal machine or "centrifuge." Upon what principle does it operate?

CHAPTER XX

PERCOLATION

What is percolation or displacement? (See page 252.)
What is lixiviation?
To whom belongs the credit of first demonstrating the value of the process of percolation in its pharmaceutical applications?
What is the principal of action in displacement?
What is the instrument used to hold the powder called?
What is the liquid poured on the top of the powder called?
What is the liquid which passes through the powder called?
According to directions given in the U. S. Pharmacopœia, in what does the process of percolation consist?
When the process is successfully conducted, how will the first portion of the percolate compare with the succeeding portions as regards color, odor, etc.?
What shape or shapes are most suitable for percolating such quantities as are directed by the U. S. P.?
Of what material may it best be constructed?
Give the directions for preparing and putting into the percolator a powder for percolation.
Give directions for pouring on the menstruum and starting the percolation.
How may the flow of the percolate be regulated so as to run with greater or less rapidity?
How may a layer of menstruum be kept constantly above the powder, and why is this desirable?
In what cases may narrow percolators be advantageously used, and in what cases wide ones?
Why is a narrow percolator preferable for making fluidextracts?

Upon what depends the proper degree of comminution for a substance to be subjected to percolation?

What happens when a powder of unequal degrees of fineness is subjected to percolation?

What is the object of moistening a powder before subjecting it to percolation?

In what special cases should the substance not be moistened?

What is the object of the directions in the U. S. P. given for packing powders in percolation, such as "pack it moderately," "pack it firmly," etc.?

In packing a percolator or funnel, how is the powder prevented from running through?

How should a powder be packed in a percolator so as to insure its being packed uniformly?

After adding a portion of menstruum to a powder in a percolator, should the surface be allowed to become dry, or should the supply of menstruum be continuous? Why?

Is maceration previous to percolation desirable? Why?

In the process of percolation the direction is often given, "add the menstruum until the substance is exhausted." How may it be known when a drug is exhausted? Give examples.

In the choice of menstruums, in what cases would alcohol be indicated? In what cases diluted alcohol?

Where would the addition of glycerin be advisable?

What advantage has percolation or maceration as regards the absorbed liquid left in the residue?

How can alcohol absorbed in residues be recovered?

How can the alcohol so recovered be purified?

Describe several simple methods for controlling the flow of the percolate.

What directions are given in the U. S. P. for regulating the "rate of flow" of the percolate?

Describe Dursse's percolator, Dr. Squibb's well-tube percolator, the double-tube percolator.

What is the object of having a percolator suspended on trunnions?

What kind of percolators are chiefly used for large operations?

Describe percolation by pressure?

How may drugs be exhausted with the aid of a hot menstruum?

How are percolators ordinarily supported?

What is the objection to the ordinary retort-stands?

Describe a percolating stand that would be more satisfactory.

What is the advantage of a percolating closet?

How may receiving bottles be conveniently marked?

What is repercolation?

What is its principal object?

In what operations is repercolation useful?

What is fractional percolation?

PART II

OFFICIAL PHARMACY

CHAPTER XXI

AQUEOUS SOLUTIONS

How may the various forms of official preparations be classified? (See page 272.)
What are the preparations known as waters?
Are any other preparations recognized as waters by the French and German Pharmacopœias?
What various methods have been used for preparing official waters?
What are the advantages or disadvantages of the several processes?
How many official waters are there?
What are the medicated waters generally used for?
What processes may be used for preparing a medicated water from a volatile liquid?
How is a solution of a gas obtained?
How many distilled waters are there?
From what is aqua amygdalæ amaræ prepared, and of what strength is it?
What is the strength of aqua creosoti? Of aqua ammoniæ? Of aqua ammoniæ fortior?
How is chlorine water prepared and what is its official name?
Are the volatile oils generally more soluble in hot or in cold water?
In the preparation of medicated waters, what is the object of passing the liquid through an absorbent powder?
What substance has most generally been used for the purpose?
What is an objection to its use?
What other various substances have been used?
Where solutions of alkaloids or of nitrate of silver are to be made, what should be used?
What substance is used in the official process?
Describe the process.
What other methods are permitted by the U. S. P.?
What is the strength of the following waters: aqua anisi, aqua camphoræ, aqua cinnamomi, aqua fœniculi, aqua menthæ piperitæ, aqua menthæ viridis?
Of the various processes for preparing medicated waters, which is the best?
What precautions should be observed in order to obtain distilled waters of the best quality?
How may a drug be prevented from being injured by heat during distillation?
In distilling rose water or orange flower water, is a naked fire or steam heat preferable, and why?
How may distilled waters be preserved?
Is alcohol useful for the purpose?
What is the objection to it?
What is the strength of orange flower water?
What is the strength of rose water?
Write out in full the Latin name of bitter almond water.
Give the formula and mode of preparing it. Of preparing aqua anisi.
How is orange flower water prepared?
Give the formula and mode of preparing camphor water.
Give the formula and mode of preparing cinnamon water. Creosote water.
How is distilled water prepared?
Give the formula and mode of preparing fennel water. Peppermint water

What is the English title of aqua hydrogenii dioxidi? What is a frequently used synonym? What is its strength?
What precautions should be taken for its preservation?
Write out in full the Latin name of peppermint water. Of spearmint water
Give the formula and mode of preparing spearmint water.
How is rose water prepared?
What are Liquores of the U. S. P.?
How many official solutions are there?
Into what two classes are solutions divided?

CHAPTER XXII

AQUEOUS SOLUTIONS CONTAINING SWEET OR VISCID SUBSTANCES

What are syrups? (See page 284.)
What kinds of sugar should be used in making syrups?
How many methods of making syrups are recognized by the U. S. P.?
Describe the details for making syrups by heat. For making syrups without heat.
What objection is there to making syrups by the addition of fluidextracts, tinctures, etc., to syrup?
What official syrups were formerly made by digestion?
Is this method a satisfactory one?
What method is preferable?
How should syrup of tolu be made?
How is the process of percolation in making syrups conducted?
What precautions are necessary to percolate a syrup successfully?
What is the objection to using a sponge in this process?
How may syrups be preserved?
Is the addition of alcohol or chemicals objectionable? Why?
What is the best disposition to make of fermented syrups?
How may fruit juices be effectually preserved?
How many official syrups are there?
Name the official syrups made by solution with heat.
Which of these are made by solution involving chemical action?
How many are made by the simple addition of medicating liquid to syrup? Name them.
Which of these are made with mucilage?
Which with flavored acidulated solution?
Which with aromatic tincture?
Which with fluidextract?
Name the official syrups made by the agitation of sugar with medicating liquid without heat.
Which of these contain acetic acid?
Which one is made by cold aqueous infusion?
Which four from medicated water from tincture?
Which from medicated water from fluidextract?
How many are made from simple admixture or solution? Name them.
Which are made from solution involving chemical reaction?
How many are made by maceration or digestion? Name them.
Give the formula and mode of preparing Syrupus.
What is its specific gravity?
How is syrup of acacia made?
Does this syrup keep well?
Give the formula and mode of making syrup of citric acid.
What is the formula in symbols of hydriodic acid?
What is its molecular weight?
How is syrup of hydriodic acid made?
How much hydriodic acid does it contain?
Give the process for making syrup of almond. Syrup of orange.
What are the ingedients used in making the syrup of lactophosphate of calcium.

Give an outline of the process for making it.
Write out in full the Latin name.
How is syrup of lime prepared?
What is the formula in symbols of ferrous iodide?
What is its molecular weight?
How is the syrup of ferrous iodide prepared?
How much ferrous iodide does it contain?
Write out in full the Latin name of the "syrup of the phosphates of iron, quinine, and strychnine."
By what synonym is this syrup commonly known?
Of what hypophosphites does the syrup of hypophosphites consist?
How is the syrup prepared?
What are the ingredients in the compound syrup of hypophosphites?
How is this syrup prepared?
Write out its name in full.
How is syrup of ipecac made?
How much ipecac is there in two and a half troy ounces?
About how much in a fluidounce?
Write out the Latin name in full.
Give the formula for syrup of krameria. For syrup of lactucarium.
Write out in full the Latin name of syrup of tar.
How much tar is used to make one hundred parts of the syrup?
How is the syrup made?
What is the object in mixing the tar with sand and washing it with water?
Write out in full the Latin name of syrup of wild cherry.
How much wild cherry is used to make one hundred parts?
What degree of fineness is directed for the powder?
How is the syrup made?
How much glycerin does it contain?
Why is this syrup made without heat?
What is the object of maceration for twenty-four hours prior to percolation?
Give the formula for syrup of rhubarb.
How is the syrup made?
Give the formula and mode of preparing the aromatic syrup of rhubarb.
Give the formula for syrup of rose. For syrup of rubus.
What are the ingredients of compound syrup of sarsaparilla?
How is the syrup prepared?
Give the formula and mode of preparing syrup of squill.
What are the ingredients of compound syrup of squill?
How is this syrup prepared?
How much antimony and potassium tartrate is there in a troy ounce?
What is its synonym?
What is its dose?
Give the formula and mode of making syrup of senega.
What aromatic is used in making syrup of senna?
How is the syrup of senna made?
How much senna is there in one hundred parts of syrup?
Give the formula and mode of making syrup of tolu.
How is syrup of ginger made?
What is the strength of it?
What are official honeys? How many are there? Name them.
Give the Latin name and mode of preparing commercial honey. Clarified honey. Honey of rose.
What are official mucilages, and how many are there?
How many mucilages are prepared without heat? Name them.
How is mucilage of acacia prepared?
Give the Latin name, formula, and mode of making mucilage of sassafras pith. Mucilage of tragacanth. Mucilage of elm.
What are official emulsions, and how many are there? Name them.
What were these preparations called in the 1880 U. S. P.?
Give the formula and mode of making emulsion of almond. Emulsion of asafetida. Emulsion of chloroform. Emulsion of cod liver oil. Emulsion of cod liver oil with hypophosphites. Emulsion of oil of turpentine.
What is the popular name or synonym of emulsion of asafetida?

What are official mixtures, and how many are there.
Give the Latin name, formula, and mode of making chalk mixture.
Should chalk mixture be kept on hand?
What is the Latin name of compound iron mixture?
What is the popular name or synonym of compound iron mixture?
Why is myrrh in small pieces preferable to the powder?
Give the formula and mode of preparing it.
In what form does the iron exist in the finished mixture?
Should the mixture be freshly made?
What change takes place on keeping?
How many of the mixtures contain insoluble powder in suspension? Name them.
How many do not contain insoluble powder in suspension? Name them.
Give the Latin name, formula, and mode of preparing mixture of rhubarb and soda.
What are glycerites, and how many are official? Name them.
Give the formula and mode of making glycerite of starch. Glycerite of phenol. Glycerite of tannic acid. Glycerite of boroglycerin. . Glycerite of hydrastis. Glycerite of the phosphates of iron, quinine and strychnine.

CHAPTER XXIII

ALCOHOLIC SOLUTIONS

In pharmacy, what are spirits? (See page 309.)
In how many different ways are the official spirits made?
How many of them are there?
What is the most usual method of making them?
How many of them are made in this way?
In making spirits, what is the object of maceration?
What spirit is made by gaseous solution? By chemical reaction?
What official spirits are made by distillation?
Where spirits can be made either by distillation or by solution, which is the better process, and why?
Give the formula and process for making spirit of ether and compound spirit of ether.
What is the official name in Latin and in English.
What is spirit of nitrous ether?
How much of the crude ether does it contain?
What is the formula in symbols of ethyl nitrite?
What is its molecular weight?
How is this obtained?
What is its popular name or synonym?
How is it made?
What is spirit of ammonia?
How is it prepared?
What percentage of gas by weight does it contain?
What is the formula in symbols of ammonia?
What is its molecular weight?
Which is the stronger of the two preparations, spiritus ammoniæ or aqua ammoniæ?
What is aromatic spirit of ammonia?
How is it prepared?
What is the Latin name of spirit of bitter almond?
How is it made? For what is it used?
Give the official name, formula, and mode of making spirit of anise. Compound spirit of orange. Spirit of camphor. Spirit of chloroform. Spirit of cinnamon.
What is whisky? (as official in the U. S. P.)
Give the formula and mode of making spirit of gaultheria.
What are its synonyms?
What is the Latin name of spirit of nitroglycerin?
What was its formerly official English title?
How much nitroglycerin does it contain?
What is the chemical name of nitroglycerin?

Why should great care be exercised in using this preparation?
What is the specific gravity of spirit of nitroglycerin? How is spirit of juniper prepared? Compound spirit of juniper? Spirit of lavender?
Give the formula and mode of making spirit of peppermint.
Give the formula and mode of making spirit of spearmint.
What is the official definition of brandy?
How much alcohol does it contain?
What are elixirs?
What is the formula for adjuvant elixir? For what is it used?
What is aromatic elixir used for?
How is it made?
Enumerate the ingredients in elixir of the phosphates of iron, quinine and strychnine.
Describe the procedure in making this preparation.

CHAPTERS XXIV–XXV

ETHEREAL SOLUTIONS AND OLEAGINOUS SOLUTIONS OR EXTERNAL APPLICATIONS

What are collodions, and how are they used? (See page 319.)
How many are official, and what are their names?
Give the formula and mode of making collodion.
What is the official name of cantharidal collodion?
Give its formula and mode of preparation.
What is a well known synonym for this preparation?
What is flexible collodion?
Give its formula and mode of preparation.
What is styptic collodion?
Give its formula and mode of preparation.
What are liniments? (See page 321.)
How many are official?
What substances are used as the bases for these liniments?
How is ammonia liniment made?
What is its popular name or synonym?
Give the formula and mode of making belladonna liniment. Lime liniment. What is this sometimes called? Camphor liniment. Chloroform liniment. Soap liniment.
What kind of soap should be used?
What is the Latin name of liniment of soft soap?
What was its official name in the U. S. P. 1880?
How is it made?
Give the formula and mode of making turpentine liniment.
What are official oleates?
How many are there, and what are their names?
What advantage are they supposed to possess over the fatty substances that are commonly used in ointments?
Give the formula and mode of making oleate of atropine, oleate of cocaine, oleate of mercury, oleate of quinine, and oleate of veratrine.

CHAPTER XXVI

AQUEOUS LIQUIDS MADE BY PERCOLATION OR MACERATION

What are infusions? (See page 326.)
In making infusions, should the substances be boiled?
In what cases is hot water preferable? Cold water?

What inert principles found in drugs are extracted by hot water, and what by cold water?
What is the objection to using fine powders in making infusions?
How many official infusions are there?
By what four methods are infusions usually made?
Which process is most frequently used in the U. S. P.?
Describe Alsop's infusion jar. Squire's infusion mug.
What special advantage has this mug?
How may a cheap and convenient apparatus be made?
What official infusions are made by maceration?
How is the process of digestion used in making infusions?
Is percolation a good process for making infusions?
What are its advantages?
What is its chief disadvantage?
What official infusion is made by percolation?
How may infusions be preserved?
What is the objection to the use of antiseptics?
Describe Almen's method of preserving infusions.
Is the method of making infusions from fluidextracts a desirable one?
What are the objections to it?
Give the general official formula for infusions.
Give the formula and mode of making infusion of digitalis. Infusion of wild cherry. Compound infusion of senna.
What is the popular name or synonym of this preparation?
Give the formula and mode of making compound infusion of gentian.
What is the formula for making compound infusion of rose? Infusion of sage?
What are decoctions?
What is the object sought in preparing decoctions?
What are the disadvantages attending decoctions?
In making decoctions, should all the ingredients be put in together? Why?
How may the empyreumatic odor which sometimes occurs in decoctions be avoided?
Are iron vessels used advantageously in making decoctions? Why?
Are there any decoctions now official? Name the decoctions official in the U. S. P. 1890.
Give the general official formula for making a decoction, where the strength has not been directed or specified.
Give the Latin name, formula, and mode of making Zittmann's stronger decoction. Zittmann's milder decoction.
In what pharmacopœia are these two decoctions official?

CHAPTER XXVII

ALCOHOLIC LIQUORS MADE BY PERCOLATION OR MACERATION

What are tinctures? How many are official? (See page 336.)
Wherein do they differ from spirits?
What exception is there to this rule?
By what different methods are tinctures made?
What menstrua are used in making tinctures?
What are the advantages, and what the disadvantages, of using alcohol as a menstruum?
Where the alcohol is objectionable, what other preparation may be substituted for a tincture?
Which will extract a larger amount of the soluble principles of a drug, a pint of diluted alcohol or half a pint of alcohol and half a pint of water, used separately?
Name some of the principal substances that are soluble in alcohol.
What substances are soluble in diluted alcohol?
For what purpose is glycerin used in tinctures?
In what different ways are official tinctures made?
Which is the best method for making tinctures?

What are the special advantages of percolation?
Which will be found more convenient in practice, the use of measures or the use of parts by weight in making tinctures?
In what cases is the process of maceration preferably used?
What tincture is made by simple solution?
What official tincture is made by dilution?
What standard of strength was adopted for potent tinctures by the International Conference at Brussels and afterwards by the U. S. P. (8th Rev.)?
What is the strength of tinctures in the U. S. P. for those which are not considered powerful in action?
Name any official exception in strength to those in these two classes. Which tinctures are assayed?
Give the formula and mode of making tincture of aconite.
What is the drug strength of tincture of aconite? What was the U. S. P. 1890 strength?
How much aconitine should be present in 100 Cc. of tincture?
What part of the plant is meant by aconite?
What fineness of powder is used in this formula?
Give the official name, formula, and mode of making tincture of aloes. Tincture of aloes and myrrh. Tincture of arnica.
Give the official name, formula, and mode of making tincture of asafetida. Tincture of bitter orange peel. Tincture of sweet orange peel. Tincture of belladonna leaves. What amount of alkaloids should be present in 100 Cc. of tincture of belladonna leaves? Tincture of benzoin. Compound tincture of benzoin, Tincture of calendula. Tincture of calumba. Tincture of Indian cannabis. Tincture of cantharides. Tincture of capsicum. Tincture of cardamom. Compound tincture of cardamom. Tincture of cimicifuga. Tincture of cinchona.
What kind of cinchona is used in this tincture?
What alkaloidal strength is required for tincture of cinchona?
Give the formula and mode of making compound tincture of cinchona.
What kind of cinchona is used in this tincture?
What degree of fineness is directed for the powder?
Give the formula and mode of making tincture of cinnamon. Tincture of colchicum seed. How much colchicine should be present in 100 Cc. of tincture of colchicum seed? Tincture of digitalis.
Give the formula for tincture of ferric chloride.
What salt of iron does it contain?
Give the formula and mode of making tincture of nutgall. Compound tincture of gambir. What tincture of the U. S. P. 1890 does this tincture replace? Tincture of gelsemium. Compound tincture of gentian.
What degree of fineness is directed for the powder?
Give the formula and mode of making tincture of guaiac. Ammoniated tincture of guaiac. What degree of fineness is directed for the powder in these last two tinctures? Tincture of hydrastis. How much hydrastine should be contained in 100 Cc. of the tincture? Tincture of hyoscyamus. What amount of alkaloids should be present in 100 Cc. of tincture of hyoscyamus?
Give the formula and mode of making tincture of iodine.
Give the formula for making tincture of ipecac and opium.
What synonym is frequently used for this tincture?
Give the formula and mode of making tincture of kino. Tincture of krameria. Tincture of lactucarium. Why is tincture of lactucarium first treated with purified petroleum benzin? Compound tincture of lavender.
What degree of fineness is directed for the powder?
What is the strength of tincture of lemon peel? What precautions must be taken in preparing the lemon peel?
Give the formula and mode of making tincture of lobelia.
What part of the plant is meant by lobelia?
Give the formula and mode of making tincture of musk. Tincture of myrrh. Tincture of nux vomica.
How much dry extract of nux vomica does each 100 parts of tincture contain?
What percentage of strychnine should extract of nux vomica contain?
What quantity of strychnine should be contained in 100 Cc. of the tincture?
How is tincture of opium made?

How much opium is there in each 100 parts of tincture?
About how much is there in a teaspoonful of tincture?
How much morphine should be present in 100 Cc. of tincture?
Give the formula and mode of making camphorated tincture of opium.
How much opium is there in each 100 parts of this tincture?
How is deodorized tincture of opium made?
How much opium is there in each 100 parts of tincture?
Give the formula and mode of making tincture of physostigma. How much ether soluble alkaloids should be present in 100 Cc. of tincture of physostigma? Tincture of pyrethrum. Tincture of quassia. Tincture of quillaja. Tincture of rhubarb. Aromatic tincture of rhubarb. Tincture of sanguinaria. Tincture of squill. Tincture of serpentaria. Tincture of stramonium. State the amount of alkaloids which should be present in 100 Cc. of tincture of stramonium. Tincture of strophanthus. What is the strength of this tincture and what was its strength in the U. S. P. 1890? What is the dose? Tincture of tolu. Tincture of valerian. Ammoniated tincture of valerian. Tincture of vanilla. Tincture of veratrum. Tincture of ginger.
How should tinctures of fresh herbs be made when no special direction has been given?
What are medicated wines?
Which are preferable preparations, wines or tinctures? and why?
How many official wines are there?
In how many different ways are official wines prepared?
Which are not medicated?
How many are made by solution? Name them.
Name those made by maceration. By percolation.
How are they made?
What is white wine?
What percentage of alcohol should it contain?
What is red wine? How much alcohol should it contain?
What wine is used in making the official wines?
Give the formula and mode of making wine of antimony.
What percentage of antimony and potassium tartrate does it contain?
About how much in a teaspoonful?
Give the formula and mode of making wine of coca. Wine of colchicum seed. Wine of ergot. Wine of iron. Bitter wine of iron. Wine of ipecac. Wine of opium.
How much opium is there in 100 parts of the wine?
What are fluidextracts?
When were they made official in the U. S. P. for the first time?
How many are there in the present Pharmacopœia?
What are the special advantages of fluidextracts?
How is permanency secured?
What is the advantage of concentration?
Are the fluidextracts of the present Pharmacopœia of the same strength as those of the U. S. P. 1870?
What difference is there between them?
Are they different from those of the U. S. P. 1880?
Upon what is the present system arranged?
How many fluidextracts are standardized? Name them.
In what different methods are fluidextracts made?
What is the official process?
Give a typical formula for preparing a fluidextract.
Explain the process of percolation with incomplete exhaustion in making fluidextracts.
What is the principal disadvantage of this process, and why is the official process better?
Give a description of the process of repercolation. What is "continuous percolation"? Of vacuum maceration and percolation.
How may fluidextracts be best preserved?
What are "fluidacetracts"? What advantages have this class of preparations? How many of them are official?
Into how many classes are fluidextracts divided?
How many have for a menstruum alcohol? Name them. Why is alcohol used for these in preference to other menstruums?

How many have for a menstruum 4 parts alcohol, 1 part water?
How many have for a menstruum 3 parts alcohol, 1 part water? Name them.
Which fluidextract has a menstruum of alcohol 7, water 3?
How many have for a menstruum 2 parts alcohol, 1 part water? Name them.
Name the fluidextract made with a menstruum, alcohol 65, water 35; with alcohol 2, water 3; with alcohol 5, water 8.
Why is there a difference in the alcoholic strength and menstruum of some of the fluidextracts?
How many have for a menstruum diluted alcohol? Name them.
How many have for a menstruum 1 part alcohol, 2 parts water? Name them.
Which fluidextracts have acetic acid added to the menstruum? Why is it added in each case?
Which fluidextracts contain small percentages of solution of potassium hydroxide? Why is the alkali added?
Mention the fluidextracts in which glycerin is added to the menstruum. What is the value of glycerin when added to a menstruum?
Which fluidextracts are made by using acetic acid as a menstruum? What is the strength of the acetic acid?
Give the menstrua for the following fluidextracts: apocynum, bitter orange peel, cinchona, frangula, glycyrrhiza, hamamelis leaves, pareira, uva ursi, wild cherry.
What two fluidextracts have for a menstruum boiling water?
Give the alkaloidal strength adopted for the following fluidextracts: aconite, belladonna root, cinchona, coca, colchicum seed, conium, guarana, hydrastis, hyoscyamus, ipecac, nux vomica, pilocarpus, scopola, stramonium.
Why is the drug in aromatic fluidextract of cascara sagrada, treated with magnesium oxide?
What is the object in exhausting senna with alcohol before adding the regular menstruum and preparing the fluidextract?

CHAPTERS XXVIII–XXIX

OLEORESINOUS AND ACETOUS LIQUIDS MADE BY PERCOLATION

What are oleoresins? (See page 426.)
In what respects do they differ from fluidextracts?
How are they prepared?
How many oleoresins are official? Name them.
Give the official name, menstruum, and mode of preparing oleoresin of aspidium.
Should the deposit which usually occurs in this oleoresin upon standing be filtered out?
Give the Latin name, menstruum, and mode of preparing oleoresin of capsicum. Oleoresin of cubeb.
Should the waxy and crystalline matter which is deposited from oleoresin of cubeb be separated from the oleoresin?
Give the Latin name, menstruum, and mode of preparing oleoresin of lupulin. Oleoresin of pepper.
Should the latter oleoresin be separated from the piperin which is deposited?
Give the Latin name, menstruum, and mode of preparing oleoresin of ginger.
What are medicated vinegars? (See page 430.)
Why was vinegar chosen as a menstruum, and why is acetic acid used in place of vinegar?
How many vinegars are official? Name them.
What is their percentage strength?
How are they made?
Give the Latin name and menstruum of vinegar of opium. Vinegar of squill.
What are the ingredients of acetum opii, and in what condition of fineness are they directed?

CHAPTER XXX

SOLID PREPARATIONS MADE BY PERCOLATION

What are extracts? (See page 432.)
What various menstrua are used in making them?
By what names are such extracts called?
What are inspissated juices?
Why are alcoholic extracts preferred to those made from inspissated juices?
How are these juices prepared by the British Pharmacopœia?
How have extracts been prepared by the freezing process?
Do the percolates or expressed juices of drugs contain anything in addition to the active principles?
What proximate principles are most commonly present in extracts?
Which of these principles are absent when a menstruum of part alcohol is used?
What is meant by extractive?
What name was proposed for this substance by Berzelius?
Why are extracts variable in strength?
What is the Pharmacopœia's standard for the consistence of extracts?
In what respect have "abstracts" an advantage over "extracts"?
Are extracts a reliable class of preparations?
How may extracts be preserved?
What are powdered extracts?
How is such an extract prepared?
What precaution should be taken in preserving powdered extracts?
Why is the temperature, during evaporation, kept below 70° C.?
Give the general formula for alcoholic extracts.
To what kind of extracts is glycerin added?
How many official extracts are there?
Give the Latin official name, menstruum, and mode of preparing extract of Indian cannabis, cimicifuga, physostigma, rhubarb, scopola, ergot, belladonna leaves, colocynth, colchicum corm, nux vomica, aloes, hematoxylon, malt, opium, glycyrrhiza, glycyrrhiza (pure), colocynth (compound).
How many extracts are made with an alcoholic menstruum? Name them.
How many official extracts are made with an aqueous menstruum? Name them.
Which one is percolated with water containing five per cent. of water of ammonia?
Which are made with a menstruum of water containing official acetic acid?
What percentage of acetic acid is used in each case?
Which by evaporating fluidextracts?
Which by mixing extracts with aromatics?
How many powdered extracts are official?
State the alkaloidal standard adopted by the U. S. P. (8th Rev.) for the following extracts: belladonna leaves, colchicum corm, hyoscyamus, nux vomica, opium, physostigma, scopola, stramonium.
What are the ingredients of compound extract of colocynth?
What fineness of powder is directed?
What is the consistence of the finished product?
What is the strength of extract of ergot?
From what plant is extract of glycyrrhiza obtained?
How much of it should be soluble in cold water?
Why should the use of metallic vessels be avoided in making extract of hæmatoxylon?
Should metallic vessels be avoided in making extract of krameria? Why?
What are abstracts?
When were they introduced into the U. S. P.?
Are abstracts now official?
Give the general formula for their preparation.
What advantages do they possess over ordinary extracts?
What improvements for making abstracts may be suggested?
What is Dr. Squibb's modification of the process?
Can abstracts be made satisfactorily from solid extracts? Why not?
What are official resins?

How are they prepared?
In what respect do they differ from alcoholic extracts?
How many resins are official? Name them.
Give the Latin name and menstruum of resin of jalap.
How is it prepared?
How may it be distinguished from resin of podophyllum? From resin of scammony?
Give the Latin name and menstruum of podophyllum. Resin of scammony.
How may these be distinguished?

PART III

INORGANIC SUBSTANCES

CHAPTERS XXXII-XXXIII

HYDROGEN, OXYGEN, WATER AND THE INORGANIC ACIDS

What are the atomic weights of hydrogen? Of oxygen? Of water? (See page 463.)

Give a description of hydrogen. Of oxygen.

What percentage of oxygen by weight does water contain?

What is the formula in symbols of water? How may metallic impurities be detected?

If the transparency or color of distilled water is affected by any of the following tests, what impurity is indicated?—viz.: Test solution of barium chloride; test solution of silver nitrate; test solution of ammonium oxalate; test solution of calcium hydroxide; test solution of diphenylamine; test solution of sulphanilic acid with test solution of naphthylamine acetate; Nessler's Reagent.

What amount of residue is permitted in 1000 Cc. of distilled water?

Describe the test for the absence of organic or oxidizable substances.

What are the uses of distilled water in pharmacy?

What is the Latin official name of solution of hydrogen dioxide?

When freshly prepared, how much pure hydrogen dioxide does it contain?

To what amount of available oxygen does this correspond?

How is it prepared?

What are the uses of solution of hydrogen dioxide? What precautions should be taken to prevent decomposition?

How are acids distinguished from other bodies? (See page 466.)

What do the suffixes "ous" and "ic" designate when applied to acids?

How may glass stoppers be removed without injury from bottles in which they have become tightly fastened?

Why should corks not be used as stoppers for strong acids?

How may carboys containing strong acids be handled conveniently and safely?

What grades of acid are found in commerce?

What injurious results may follow the use of weak and impure acids?

Are the official inorganic acids uniform in strength?

What is the strength of hydrochloric acid? Of nitric acid? Of sulphuric acid?

Which of the diluted acids are uniform in strength?

What per cent. of absolute acid do they contain?

What are the medical properties of the inorganic acids?

How may their injurious action on the teeth be avoided?

What are the proper antidotes for strong acids which may have been taken in poisonous doses?

Give the formula in symbols and molecular weight of hydrochloric acid.

What is official hydrochloric acid? How is it made?

Explain the reaction which takes place in its manufacture.

For what purposes in pharmacy is hydrochloric acid used?

To what is the yellow color of the common acid usually due?

What is the cause of the white fumes which are produced when the acid is exposed to the air?

What are tests for the following impurities?—viz: Non-volatile impurities; bromine; iodine; free chlorine; sulphuric acid; sulphurous or arsenic; heavy metals.

What is the specific gravity of hydrochloric acid?

Give the formula for diluted hydrochloric acid.
How much absolute hydrochloric acid does it contain?
What is the official test of its strength? What are its uses?
What is the composition of diluted hydrobromic acid?
Give the formula in symbols and molecular weight of diluted hydrobromic acid.
How is diluted hydrobromic acid usually made? Describe the distillation process.
Explain the chemical reaction. Describe the precipitation process.
What chemical reaction takes place in this process?
What is the specific gravity of diluted hydrobromic acid?
How may free bromine be detected? How may sulphuric acid be detected?
For what is diluted hydrobromic acid used, and what is the dose?
What is the strength of diluted hydriodic acid? How is this acid made? For what is diluted hydriodic acid used? Why is potassium hypophosphite added to the formula?
Give the symbol and molecular weight of absolute nitric acid.
How much is contained in official nitric acid?
What five compounds are there of nitrogen and oxygen?
From which of these is nitric acid formed, and how?
How is nitric acid prepared commercially?
If two molecules of the sodium salt and one of sulphuric be used, what will be the reaction? Upon raising the heat, what further reaction takes place?
What is the specific gravity of the official acid? Of the commercial acid?
What is the composition of the reddish acid called nitrous acid?
What are tests for the following impurities?—viz.: Non-volatile impurities; sulphuric acid; hydrochloric acid; heavy metals; arsenic; iodine or bromine; iodic or bromic acids.
By what name is nitric acid sometimes called?
For what is nitric acid used in pharmaceutical operations?
Explain the decomposition which takes place when nitric acid is exposed to a red heat. What acids are produced by its action on phosphorus and sulphur?
What does it form in combination with salifiable bases?
What are its medicinal properties?
To what is the yellow stain due when nitric acid is applied to the skin?
Give the formula for diluted nitric acid. How much real nitric acid does it contain?
What is its specific gravity? What is the official test of its strength?
What is its medicinal use and dose?
Give the formula for nitrohydrochloric acid.
What reaction takes place when nitric acid is mixed with hydrochloric acid?
What is the liquid thus formed popularly called?
Upon what does the value of this acid depend?
Why should it be kept in a cool and dark place? Describe its physical properties.
What is its medicinal use? What is the dose?
Why is especial care necessary in dispensing this acid?
Give the formula for diluted nitrohydrochloric acid.
Should the ingredients be all mixed together at once? Why?
Describe its physical properties. What are its medicinal uses and dose?
Give the symbol and molecular weight of absolute sulphuric acid.
How much does the official sulphuric acid contain?
How is sulphuric acid obtained?
Explain the reactions that take place in the process.
What is the principal source of production of sulphuric acid in America? What in Europe? What is the foreign commercial article apt to be contaminated with?
What is the "contact method" for preparing sulphuric acid?
What is the specific gravity of the official acid?
What are the tests for the following impurities?—viz.: Lead; nitric or nitrous acids; hydrochloric acid; heavy metals; non-volatile impurities; arsenic; sulphurous acid; selenium.
What are its uses?
How is it administered internally?
Give the formula for aromatic sulphuric acid.
How much official sulphuric acid does it contain?
What is its specific gravity? What is its popular name?
What are its uses? What is the dose?
Give the formula for diluted sulphuric acid.

How much official sulphuric acid does it contain?
What is its specific gravity?
When commercial sulphuric acid is diluted, what precipitate is thrown down, and why?
What are the uses of sulphuric acid? What is the dose?
Give the formula in symbols and molecular weight of sulphurous acid gas?
How much of this does the official sulphurous acid contain?
How is the official acid prepared?
Explain the reaction which takes place in its production.
What is its specific gravity?
How may excess of sulphuric acid be detected?
What are its uses? Give the dose.
What is official phosphoric acid?
Give the formula in symbols and molecular weight of orthophosphoric acid.
How may the official acid be prepared?
Explain the rationale of the reaction which takes place.
What dangerous impurity is likely to be present? Where does it come from?
What is the specific gravity of the official acid?
What is its principal use?
How may the following impurities be detected?—viz.: Phosphorous acid; arsenic; phosphates; nitric acid; heavy metals; sulphuric acid; hydrochloric acid; pyrophosphoric and metaphosphoric acids.
How is diluted phosphoric acid made?
How much orthophosphoric acid does it contain?
What is its specific gravity?
If a precipitate occurs when this acid is mixed with tincture of ferric chloride, what is indicated?
What are its uses and doses?
What is the strength of hypophosphorous acid? How may it be prepared?
How may the following impurities be detected: barium; heavy metals; potassium; arsenic?
For what is this acid used?
What is the Latin official name of diluted hypophosphorous acid?
How much absolute hypophosphorous acid does it contain?
Give the formula in symbols and the molecular weight of hypophosphorous acid.

CHAPTER XXXIV

PREPARATIONS OF THE HALOGENS

What is meant by the term "halogen"? (See page 484.)
What four elements are called "halogens"?
Describe chlorine. Give its symbol and molecular weight.
What is its specific gravity?
What is its most characteristic property?
What is its principal use, and how is it generally employed?
What is its principal hydrogen compound?
What are its compounds with metals and bases termed?
When combined with oxygen, what are its compounds with metals and bases termed?
How may chlorides in solution or hydrochloric acid be recognized?
How may chlorates be recognized?
What is the Latin official title of chlorine water?
What amount of the gas should it contain?
What substances does it contain besides chlorine gas?
Explain the reaction which takes place in its production.
How was chlorine water prepared by the U. S. P. 1890 process? What advantage has the U. S. P. (8th Rev.) process?
What are the uses of chlorine water?
How may chlorine be conveniently used as a disinfectant?
What is chlorinated lime? Give its Latin name.

How much available chlorine should it contain?
How is it prepared?
What is a popular name for it?
What are the official Latin and English titles for Labarraque's solution?
How much chlorine should it contain?
How is it prepared?
For what is it used?
Wherein does it differ from the French preparation known as "Eau de Javelle" (Javelle's Water)?
Give the symbol and atomic weight of bromine.
Where is it obtained, and how is it prepared?
Describe the process.
What is bittern, and what does it contain?
What is the character of the vapor of bromine?
What is its combination with hydrogen called?
What are its salts called?
What are the tests for bromine?
What is its specific gravity?
How may the presence of iodine be detected?
What is its medicinal use?
What is "Bibron's antidote" to rattlesnake poison?
Why should the utmost care be taken in handling bromine?
Give the symbol and atomic weight of iodine.
How was it formerly obtained, and how is it now obtained?
Explain the reaction which takes place in its production.
What tests may be used to detect iodine or iodides?
How soluble is iodine in alcohol?
How may the following impurities be detected?—viz.: moisture; iodine cyanide; more than traces of chlorine or bromine.
In what form is its combination with hydrogen official?
What is its use in medicine?
What is tincture of iodine?
Why has potassium iodide been added to this tincture in the U. S. P. (8th Rev.)?
How may its strength be tested?
Give the formula for compound solution of iodine.
What is the official name and synonym of compound solution of iodine?
How much iodine does a fluidounce of the solution contain?
What is the object of using potassium iodide in this preparation?
How is it used medicinally, and what is the dose?
What is iodine ointment and how much iodine does it contain?
What was the purpose of introducing diluted hydriodic acid?
How much absolute acid should it contain?
How is syrup of hydriodic acid prepared?
How much absolute hydriodic acid does it contain?
What is its specific gravity?
What are the objects of this preparation?
What is the chemical reaction which takes place when hydrosulphuric acid is passed into a solution containing iodine?
What is the use of syrup of hydriodic acid, and what is the dose?

CHAPTER XXXV

SULPHUR AND PHOSPHORUS

Give the symbol and atomic weight of sulphur. (See page 493.)
Where does it come from, and how is it prepared?
What is roll-sulphur?
In what forms is sulphur official?
What gas is formed by it in combination with hydrogen?
For what is this gas used?
What are sulphides?

What are salts, called sulpho-salts by Berzelius?
What combination does sulphur form with oxygen?
What do these oxides form by their union with water?
Give their formulas in symbols.
What is hyposulphurous acid?
Is there an oxide corresponding to this acid?
What is thiosulphuric acid?
What acids are known as the thionic series of acids?
What are the salts which sulphurous acid forms with bases called, and what are those which are similarly produced from sulphuric acid?
Which are more important salts, sulphates or sulphites?
What are the tests for sulphites and sulphurous acid? For sulphates and sulphuric acid?
What is sublimed sulphur?
What are its physical properties?
How is it used medicinally, and what is the dose?
By what name is it generally known?
What is "flour of sulphur"?
How is washed sulphur prepared?
What is the use of adding ammonia in washing it?
At what temperature does it melt?
How may impurities of free acid be detected? Of arsenic?
Why is washed sulphur preferred for medicinal purposes?
What is the dose?
In what official preparations is it used?
How is precipitated sulphur prepared?
Explain the reaction that takes place between lime and sulphur in the above process.
What would be the result if sulphuric acid were used instead of hydrochloric acid to precipitate the sulphur?
What is the popular name of this preparation?
How may the following impurities be detected?—viz.: free acid; alkalies, arsenic.
For what uses is precipitated sulphur preferable to other forms of sulphur?
What is the dose?
How is sulphur iodide prepared?
What is it called chemically?
Is it a definite chemical compound?
How may it be tested?
What is its use?
Carbon disulphide—Give formula in symbols and molecular weight.
How is it prepared, and how may it be purified?
What are its physical properties?
What is its specific gravity?
How may the following impurities be detected?—viz.: sulphur dioxide; sulphur; hydrogen sulphide.
For what is it used? Is it ever used internally?
Phosphorus—Give symbol and atomic weight.
What is phosphorus, and how is it prepared?
How is acid calcium phosphate obtained?
Explain the reaction which takes place in its formation.
How is red phosphorus, or amorphous phosphorus, obtained?
What are its peculiar properties?
What oxides does phosphorus form with oxygen.
Give their formulas in symbols.
What three acids correspond to phosphoric oxide?
How is orthophosphoric acid formed?
What is its formula in symbols?
How is pyrophosphoric acid obtained?
Give its formula in symbols.
How is metaphosphoric acid obtained?
Give its formula in symbols.
Can phosphorous acid be formed directly from phosphorous oxide?
What is the character of its basicity?
Can hypophosphorous acid be obtained directly from hypophosphorous oxide?

What is the character of its basicity?
What are the tests for phosphates and phosphoric acid?
What are the tests for hypophosphites?
What is the specific gravity of phosphorus? What is its melting-point?
How may impurities be detected?—Sulphur; arsenic.
What is its medicinal action, and what is the dose?
Upon what does its value depend?
Does phosphoric acid have the same action?

CHAPTER XXXVI

CARBON, BORON, AND SILICON

Carbon—Give symbol and atomic weight. (See page 501.)
In what forms is carbon found in nature?
What compounds with oxygen are known? Give their formulas.
What are the physical properties of carbon dioxide?
What is carbonic acid? Is it a strong acid?
What is carbon monoxide?
What is cyanogen?
What are the tests for carbonates?
How is animal charcoal made?
What is the composition of bone?
What are the products when bones are subjected to destructive distillation?
Describe official animal charcoal.
For what purpose is it used?
How is "purified animal charcoal" made?
What is the object of purifying animal charcoal?
How is charcoal prepared?
What is its medicinal use? What is the dose?
Boron—Give symbol and atomic weight.
In what forms does boron exist?
What combination of it is formed with oxygen and hydrogen?
What are the tests for borates and boric acid?
What is boric acid? What is its synonym? Give symbol and atomic weight.
How is it prepared? Where does it come from?
What chemical reaction takes place when borax is decomposed by hydrochloric acid?
How may the following impurities be detected?—viz.: sulphate, chloride; calcium; magnesium; heavy metals; arsenic; iron.
What are the uses of boric acid?
What are the ingredients in antiseptic solution?
Why is 100 Cc. of alcohol reserved, in preparing the solution of the oils, and afterwards added directly to the clear filtrate?
For what is this solution used?
Silicon—Give symbol and atomic weight.
In what forms is silicon obtained?
In what combinations is it important, commercially?
How is it found in nature?
What is silica, and how may it be obtained pure?
Give the chemical reaction when a solution of sodium silicate is treated with hydrochloric acid.
What are the tests for silicates?
What is kaolin? How may it be purified for pharmaceutical purposes?
What impurities must be guarded against?
For what is it used?
What are the ingredients in cataplasm of kaolin? What medicinal uses has this preparation?
What is talc? Describe it?
What extensive use has this substance?
How may it be purified? What is it then called officially? For what is it used in the U. S. P. (8th Rev.)? What amount of soluble substance is permitted?

CHAPTERS XXXVII-XXXVIII

ALKALIES AND THEIR COMPOUNDS AND THE POTASSIUM SALTS

What are alkalies, and what are their properties? (See page 510.)
What are the alkali-metals, and their properties?
How many chlorides are obtained from the alkali-metals?
Are their oxides acid or basic?
Are the alkaline hydroxides decomposable by heat?
What two processes are used for obtaining the alkali-metals?
What is ammonium, and why is it classed with the metals?
What was formerly the source of the potassium salts? (See page 511.)
What is the present source, and how are they obtained?
How may potassium in its combinations be recognized?
Potassium hydroxide—Give formula in symbols and molecular weight.
What percentage of pure potassium hydroxide should it contain?
What is caustic potash or potassa, and how is it made?
What is meant by "potassa by alcohol"?
What is meant by "potassa by barytes"?
What are the physical properties of potassium hydroxide?
How may the following impurities be detected?—viz.: heavy metals; carbonate.
For what is potassium hydroxide used?
How much water does commercial caustic potassa usually contain?
What is the solution of potassium hydroxide, and how is it made?
What is its Latin official name?
How much potassium hydroxide does it contain?
How may the percentage of potassium hydroxide present be determined?
How strong should the potassium hydroxide be? and if it is not of the proper strength, how may it be used?
By what other process was it made in the U. S. P. 1890?
Explain the chemical reaction which takes place between the lime and the potassium bicarbonate in making this solution.
Why is potassium bicarbonate used in preference to the carbonates (which are cheaper) in preparing this solution?
Is the proportion of water used in making the solution of the bicarbonate a matter of indifference? How much should be used?
Should more than the theoretical quantity of lime be used? Why?
How is this solution injured by exposure to air?
Why use a "green glass" bottle for this solution and what precaution should be taken in stoppering the bottle?
How may this solution be distinguished from solution of soda?
What is its medicinal use? Give the dose.
If a large quantity should be swallowed, what would be the proper antidotes?
Potassii acetas—Give formula in symbols and molecular weight.
How may this salt be made?
Explain the chemical reaction which takes place between potassium bicarbonate and acetic acid.
What are its solubilities?
How may it be identified?
What are the tests for the following impurities?—viz.: heavy metals; arsenic.
How is the quantitative test carried out?
What are its uses in medicine? Give its dose.
Potassii bicarbonas—Give formula in symbols and molecular weight.
What purity is demanded for the salt?
How is it made?
What is saleratus, and how is it prepared?
What are the physical properties of potassium bicarbonate?
What are its solubilities?
How much of its weight does it lose at a red heat?
How may it be identified?
How may the following impurities be detected?—viz.: carbonate; heavy metals.
What are the uses of this salt, and what is the dose?

Cream of tartar—Give formula in symbols and molecular weight.
What percentage of purity is required for potassium bitartrate?
How is it made?
What is argol?
Give the physical properties of cream of tartar.
What are its solubilities?
How may it be identified?
How may the following impurities be detected?—viz.: Insoluble matter; heavy metals; ammonia; alum; phosphates.
What chemical substance besides potassium bitartrate is always present in grape juice?
How much of this impurity is permitted by the official test?
For what purposes in pharmacy is it used?
What are its medicinal uses? Give the dose.
Potassium bromide—Give formula in symbols and molecular weight.
What process was formerly official for making this salt?
Explain the chemical reaction which takes place.
In what other way may it be made?
Explain the reaction which takes place.
Where does this salt come from?
Describe its physical properties and solubilities.
How may it be identified?
How may the following impurities be detected?—viz.: Excess of alkali; bromate; iodides; heavy metals; barium.
Upon what does the official test to indicate the presence of more than 3 per cent. of chloride depend?
What is its medicinal use? Give the dose.
Potassium carbonate—Give formula in symbols and molecular weight.
What is the commercial name of this salt?
How is it made?
How may a purer carbonate be produced?
What reaction takes place when potassium bicarbonate is heated to redness?
Describe the physical properties of potassium carbonate.
What are its solubilities?
How much pure anhydrous potassium carbonate should it contain?
How may this be tested?
How may the following impurities be detected?—viz.: Earthy impurities; heavy metals; nitrates.
What is its medicinal use, and what is the dose?
What are its effects in an overdose?
What are the proper antidotes to administer?
Potassium chlorate—Give formula in symbols and molecular weight.
How was this formerly made?
What is the objection to this process?
How is it now prepared?
Explain the reactions which take place in its preparation.
Describe its physical properties and solubilities.
How may it be identified?
How may the following impurities be detected?—viz.: Heavy metals; nitrates and nitrites.
What follows when potassium chlorate is triturated with readily oxidizable or combustible substances?
For what is potassium chlorate used chemically?
What is its medicinal use? Give the dose.
Potassium citrate—Give formula in symbols and molecular weight.
How is this salt made?
When made from carbonate instead of potassium bicarbonate, what impurity is apt to be present?
What are its physical properties and solubilities?
How may it be identified?
How may the following impurities be detected?—viz.: Heavy metals; tartrate
What are its medicinal uses? Give the dose.
Into what official preparations does it enter?
Give the Latin name, formula, and mode of preparation of effervescent potassium citrate.

Why are some of the ingredients directed to be thoroughly dried? What is the dose?
By what name is the solution of potassium citrate sometimes known?
What percentage of potassium citrate does it contain? How is it prepared?
What is "Neutral mixture" in some localities?
What is its medicinal use and dose?
Potassium cyanide—Give formula in symbols and molecular weight.
What is the process for making this salt, which was formerly official?
Explain the reaction which takes place between potassium ferrocyanide and potassium carbonate.
In what form does it occur in commerce?
Describe the physical properties of the official salt.
What are its solubilities?
How may it be identified?
What per cent. of pure potassium cyanide should it contain, and how may this be tested?
How may the impurity of carbonate be detected? Of ferrocyanide? Of sulphocyanate?
What is the medicinal use of it, and what is the dose?
What advantage has it over hydrocyanic acid?
Potassium dichromate—What was the former official title?
Give the formula in symbols and the molecular weight.
What is the source of this salt?
How is it prepared?
Explain the chemical reaction which takes place.
What are its physical properties?
What are its solubilities?
How may it be identified?
For what is this salt used?
What is its proper dose? What is the effect of an overdose?
In case of poisoning by it, what would be the proper antidote?
Rochelle salt—Give formula in symbols and molecular weight.
What are the Latin and English titles of Rochelle salt?
How is this salt made?
Explain the reaction which takes place.
What is meant by saying that tartaric acid is a dibasic acid?
Describe its physical properties and solubilities.
How may its identity and purity be tested?
What are the tests for the following impurities?—viz.: heavy metals; ammonia.
What is its medicinal use, and what is the dose?
Of what well-known powder is it the most important ingredient?
Potassium ferrocyanide—Give formula in symbols and molecular weight.
How is this salt made?
What reaction takes place when potassium cyanide is mixed with ferrous carbonate in the presence of water?
What renders this salt important?
Describe its physical properties and solubilities.
What are the tests for the following impurities?—viz.: Carbonate; ferricyanide.
Is this salt poisonous?
Of what importance is it chemically?
Potassium hypophosphite—Give formula in symbols and molecular weight.
How may this salt be prepared?
Explain the reaction which takes place.
Should the evaporation of the solution be conducted at a high heat or a low one? Why?
How may the salt be rendered pure?
Describe its physical properties and solubilities.
How may it be identified?
What are the tests for the following impurities?—viz.: Carbonate; heavy metals; arsenic.
Into what official preparations does it enter?
What is the dose of it?
Potassium iodide—Give formula in symbols and molecular weight.
How is it prepared, and what reaction takes place?

Should it be crystallized from an acid or an alkaline solution? Why?
How may it be identified?
What are the tests for the following impurities?—viz.: Limit of alkali; less soluble salts; limit of iodate; heavy metals; limit of nitrates and nitrites; barium; cyanide; limit of bromides and chlorides; absence of thiosulphate.
What are its uses, and what is the dose?
Potassium nitrate—Give formula in symbols and molecular weight.
What is a commonly used name for potassium nitrate?
Where does it come from?
How is it made?
Describe its physical properties.
How may it be identified?
What are the tests for the following impurities?—viz.: Heavy metals; iodide; chlorate and perchlorate.
What are its uses? What is the dose?
Potassium permanganate—Give formula in symbols and molecular weight.
Describe the processes for making this salt.
Explain the reactions which take place in its formation.
Describe its physical properties and solubilities.
How may its identity and purity be tested?
How may the following impurities be detected?—viz.: Nitrate; chloride; sulphate.
Why is the cautionary official note appended, as follows?—viz.: "It should not be brought in contact with organic or readily oxidizable substances."
What renders it useful as a disinfectant, and what special care should be used in its application?
How and why is it used chemically?
Potassium sulphate—Give formula in symbols and molecular weight.
How is this salt obtained?
Describe its physical properties and solubilities.
How may its identity and purity be tested?
What are the tests for the following impurities?—viz.: Heavy metals; arsenic.
For what was it formerly used in pharmacy?
What is now used as a substitute for it?

CHAPTER XXXIX

THE SODIUM SALTS

Why are sodium salts more frequently used than potassium salts? (See page 532.)
Describe sodium.
How may sodium be recognized in its salts?
Table of preparations of sodium.
Sodium hydroxide—Give the formula in symbols and molecular weight.
What is the formerly official title?
By what other names is it known?
How is it obtained?
Give rationale of process and chemical reaction; odor, taste, and tests for identity.
How may the following impurities be detected?—viz.: Organic matter; insoluble impurities; potassium; heavy metals; carbonate; silicate.
Why is sodium hydroxide preferred to potassium hydroxide?
How is it used pharmaceutically?
Solution of sodium hydroxide—Give the Latin official name. How is it made?
How much sodium hydroxide does it contain?
By what process is it made officially?
Of what strength should the sodium hydroxide used in this process be; and if not of the proper strength, how can it be used?
By what other process may solution of sodium hydroxide be obtained? Give rationale of process; chemical reaction; description and specific gravity; odor, taste, and tests for identity.
What is the dose?
Sodium acetate—Give formula in symbols and molecular weight.

How is it obtained? How much water does it contain?
Give rationale of process and chemical reaction.
Describe the odor and taste. Give the tests for identity.
How may the following impurities be detected?—viz.: Potassium; arsenic; heavy metals.
What is the dose?
Sodium arsenate—Give formula in symbols and molecular weight.
Give the process for making it which was formerly official. Give rationale of process.
How much water does it contain? Give chemical reaction.
What is the dose?
What is the chemical name for exsiccated sodium arsenate? How is it prepared?
How may arsenite, as an impurity, be detected? How lead, copper, iron, etc.?
What are the advantages of the exsiccated sodium arsenate?
In what official preparation is it used?
Sodium benzoate—Give formula in symbols and molecular weight.
How is it made? Give rationale of process and chemical reaction.
For what is this salt used medicinally?
Sodium bicarbonate—Give formula in symbols and molecular weight.
How is this prepared?
What is the object of washing the commercial bicarbonate?
How much of its weight does it lose on being heated?
What percentage of pure sodium bicarbonate is required in the official preparation?
Give rationale of process.
What chemical reaction takes place during the process?
How may the following impurities be detected?—viz.: Carbonate; sulphocyanate; heavy metals.
What is the dose?
How is commercial sodium bicarbonate prepared?
How much water of crystallization does it contain?
How much water of crystallization does sodium carbonate contain?
What is Solvay's process, or the ammonia soda process?
Give rationale of process.
What percentage of pure sodium bicarbonate is it required to contain?
How may the following impurities be detected?—viz.: Chloride, sulphate; carbonate.
What is the dose?
Sodium bisulphite—Give formula in symbols and molecular weight.
How is it prepared?
Give rationale of process.
What change takes place on exposure to the air?
For what purpose is it used in the arts?
How may an impurity of thiosulphate be detected? Of heavy metals?
For what is it used?
What is the dose?
Sodium borate—Give formula in symbols and molecular weight.
Where does the commercial article come from, and how is it obtained?
What other names has it?
Where is it found native?
How is it made from boric acid?
How much water of crystallization does it contain?
Give odor, taste, and chemical reaction.
What are the tests for identity?
How may the following impurities be detected?—viz.: Carbonate or bicarbonate; heavy metals; phosphate; nitrate.
What are its medicinal uses?
For what is it used in pharmacy?
Sodium bromide—Give formula in symbols and molecular weight.
What percentage of purity is required?
How is this generally made? Give the rationale of the process. Describe the chemical reaction.
How else may it be made?
How may the following impurities be detected?—viz.: Limit of alkali; iodide; heavy metals; bromate; barium.
What is the dose?

Monohydrated sodium carbonate—Give the formula in symbols and molecular weight.
What is Leblanc's process for the manufacture of sodium carbonate?
Give the rationale of the process.
What is soda-waste, and for what is it used?
How much sodium carbonate does the soda-ash thus prepared contain?
How may sodium carbonate be obtained from the bicarbonate, and in what process is it so obtained?
What is the process known as the cryolite process?
What is cryolite, and how much sodium is contained in 100 parts of it? What is its formula in symbols?
How is sodium carbonate obtained from cryolite?
Give the rationale of the process.
What is a common name for sodium carbonate?
What are the advantages of the monohydrated sodium carbonate?
How is it prepared?
What percentage of water does monohydrated sodium carbonate contain? Describe odor, taste, and chemical reaction. Give the tests for identity.
How may heavy metals be detected if present as an impurity?
What is its use in pharmacy?
What is the dose of it?
Sodium chlorate—Give formula in symbols and molecular weight.
What is Wittstein's process for preparing this salt?
Give the rationale of the process.
What special cautionary direction is given with this in the U. S. P., and for what reason? Describe the odor, taste, and chemical reaction.
How may the following impurities be detected?—viz.: Potassium; lead, copper, etc.
What is the dose?
What advantage has it over potassium chlorate?
Sodium chloride—Give formula in symbols and molecular weight.
Where does it come from?
Describe the odor, taste, and chemical reaction.
How may the following impurities be detected?—viz.: Heavy metals; iodide or bromide.
For what is sodium chloride used?
What is the dose?
Sodium citrate—Give formula and molecular weight.
How is this salt prepared?
Give description, taste, reaction and solubilities.
What are the identity tests?
How may an impurity of carbonate be detected? Of heavy metals?
What are its uses and dose?
Sodium hypophosphite—Give formula in symbols and molecular weight.
How is the salt prepared?
What danger attends the use of too great heat?
What gases are evolved by heat?
What acid is present in this salt, and what is its composition?
Why should it not be prescribed with combinations of mercury or of silver? Describe the odor, taste, and chemical reaction. Give the tests for identity.
How may the following impurities be detected?—viz.: Caustic alkali and carbonate; heavy metals; arsenic.
What are its uses in medicine and in pharmacy?
Sodium iodide—Give formula in symbols and molecular weight.
How may it be prepared? Give rationale of process. Describe the odor, taste, and chemical reaction. What are the tests for identity?
How may the following impurities be detected?—viz.: Alkali; potassium; heavy metals; free iodine; iodate; barium; cyanide; nitrate; nitrite; chloride; bromide; thiosulphate.
What is its dose?
Sodium nitrate—Give formula in symbols and molecular weight.
What are the common names of this salt, and where is it found? Describe the odor, taste, and chemical reaction. Give the tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; iodide.
Sodium nitrite—Give formula in symbols and molecular weight.

How is it prepared?
How is it described? What is its taste and chemical reaction?
How may the presence of heavy metals be detected?
What are its uses?
Sodium phenolsulphonate—What was the U. S. P., 1890, Latin and English title for this salt?
What is its formula in symbols and molecular weight?
How may this salt be made? Describe rationale of process. Describe odor, taste, and chemical reaction. Give the tests for identity.
For what is this salt used? What is the dose?
Sodium phosphate—Give formula in symbols and molecular weight.
By what process may it be prepared?
Describe rationale of process.
Describe the odor, taste, and chemical reaction. Give the tests for identity.
How may the following impurities be detected?—viz.: Calcium; heavy metals; carbonate; arsenic.
What is the dose?
For what is it used medicinally?
What is bone-phosphate or bone-ash?
Sodii phosphas effervescens—What are the ingredients in this preparation? How is it made? How much exsiccated sodium phosphate does it contain? This is equivalent to how much crystal sodium phosphate? What is the dose?
Sodii phosphas exsiccatus—How is this salt made?
What are its advantages over the crystal salt?
Compound solution of sodium phosphate—What are the ingredients in this preparation? How is it made?
What percentage of crystal sodium phosphate does it contain?
What is the dose?
Sodium pyrophosphate—Give formula in symbols and molecular weight.
How is it prepared?
How much water of crystallization does sodium phosphate contain?
Describe the odor, taste, and chemical reaction. Give the tests for identity.
How may the following impurities be detected?—viz.: Carbonate; heavy metals; arsenic.
For what is it used?
Sodium salicylate—Give formula in symbols and molecular weight.
How is it made?
What precautions must be used in evaporating the solution in order to obtain the salt white and free from the odor of phenol or carbolic acid?
Describe the odor, taste, and chemical reaction. Give the tests for identity.
How may the following impurities be detected?—viz.: Sulphites; heavy metals.
What is the dose?
Sodium sulphate—Give formula in symbols and molecular weight.
How is this salt obtained?
What is the common or popular name? Describe odor, taste, and chemical reaction. Give the tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; arsenic.
How much water of crystallization does it contain?
For what is this salt used in medicine?
What is the dose?
Sodium sulphite—Give formula in symbols and molecular weight.
How may this salt be prepared? Describe rationale of process.
What difference is there between the crystallized salt and the granulated salt?
Describe odor, taste, and chemical reaction. Give the tests for identity.
How may impurity of thiosulphate or heavy metals be detected?
What is the dose?
Sodium thiosulphate—Give formula in symbols and molecular weight.
What was this salt called in the U. S. P. 1890?
How may it be prepared?
Describe the odor, taste and chemical reaction.
How may the following impurities be detected?—viz.: Arsenic; heavy metals; calcium; sulphide.
For what is this salt used?
By what abbreviated name is it well known?

CHAPTER XL

THE LITHIUM SALTS

What salts do the lithium salts resemble? How is lithium obtained? (See page 558.)
What is its specific gravity? What is its chemical quantivalence?
What are the tests for lithium salts?
Lithium benzoate—Give formula in symbols and molecular weight.
How may it be made? Describe rationale of process. Give tests for identity.
Describe odor, taste, chemical reaction, and solubility.
How may the following impurities be detected?—viz.: Salts of alkalies; iron; aluminum, etc.; heavy metals.
For what is it used and what is the dose?
Lithium bromide—Give formula in symbols and molecular weight.
In what various ways may this salt be made? Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Iodine; potassium; other alkalies; iron, aluminum, etc.; heavy metals.
For what is it used and what is the dose?
Lithium carbonate—Give formula in symbols and molecular weight. How may it be prepared? Describe odor, taste, and chemical reaction. What is the dose?
Lithium citrate—Give formula in symbols and molecular weight.
What is the process for making it which was formerly official?
Give rationale of process. Describe odor, taste, chemical reaction, and solubility.
What is the official Latin name of effervescent lithium citrate?
Give its formula and mode of preparation and dose.
Lithium salicylate—Give formula in symbols and molecular weight.
How may it be prepared? Describe rationale of process. Describe odor, taste, chemical reaction, and solubility. Give the tests for identity.
How may the following impurities be detected?—viz.: Iron and organic coloring matter; carbonate; other alkalies; iron aluminum, etc.; heavy metals.
For what is it used and what is the dose?

CHAPTER XLI

AMMONIUM

Is ammonium a metal? Has it been isolated? (See page 564.)
What is ammonium amalgam?
What are the tests for ammonium salts?
Ammonia—Give formula in symbols and molecular weight.
What is ammonia water?
How much by weight of the gas does it contain?
What is the process by which it was directed to be made in the U. S. Pharmacopœia of 1870? Describe rationale of process.
What is its specific gravity? Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Readily oxidizable substances; heavy metals; sulphates; chlorides; coal-tar bases and fixed impurities.
For what is ammonia water frequently used? What is "20° ammonia"?
What is an old name for this substance?
What is the dose?
Stronger ammonia water—How much by weight of the gas does this contain?
Give description and specific gravity.
For what is stronger ammonia water used ?
Spirit of ammonia—How much gas does it contain?
How is it made? How may its strength be tested?

Give description and specific gravity. What is the dose?
Aromatic spirit of ammonia—Give Latin official name. How is it made?
Why does this preparation become dark-colored upon being kept? Give description and specific gravity.
Why is precipitation very apt to take place?
What is the object of adding aqua ammoniæ? What is the dose?
What is spirit of Mindererus? Give Latin official name.
How is it made? What is the alternative formula?
Give rationale of process. Which of the formulas is the more satisfactory, and why?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
What is its use medicinally?
What is the dose?
Ammonium benzoate—Give Latin official name, formula in symbols, and molecular weight.
Describe the process formerly official for making it.
Describe rationale of process.
What is the object of retaining an excess of alkali?
Describe the odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Sulphate; chloride; heavy metals.
For what is it used in medicine?
What is the dose?
Ammonium bromide—Give Latin official name, formula in symbols, and molecular weight.
By what different methods may this be prepared?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Iodide; bromate; iron; barium; heavy metals. What is the dose?
Ammonium carbonate—Give Latin official name, formula in symbols, and molecular weight.
Which is the usual process for making this salt? Give rationale of process.
Why is ammonium sulphate preferred to ammonium chloride?
What is official ammonium carbonate, chemically?
If the official salt is exposed to the air, what change takes place?
How may the bicarbonate be converted into carbonate?
How may "smelling salts" be made?
What is the principal impurity in the commercial salt, and how may it be detected?
What is the official description?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Sulphate; thiosulphate; chloride; empyreumatic or non-volatile substances.
For what is ammonium carbonate used medicinally?
How is it used pharmaceutically?
Ammonium chloride—Give Latin official name, formula in symbols, and molecular weight.
What are its common or popular names? How is it obtained?
How may it be purified from traces of iron?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; sulphate; barium; calcium; sulphocyanate: iron; empyreumatic or non-volatile substances.
For what is it used in medicine?
What precaution should be observed in compounding it?
What is the dose?
Ammonium iodide—Give Latin official name, formula in symbols, and molecular weight.
How may a salt, which has become dark, be rendered colorless and fit for use?
Describe the process formerly official by which it may be made.
Give rationale of process.
What is the object of cooling the mixture and adding alcohol.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Barium; iron; free iodine; heavy metals; more than 3 per cent. of chlorides or bromides. What is the dose?

Ammonium salicylate—Give the Latin official name, formula in symbols and molecular weight.
How may this salt be prepared?
Describe its odor, taste, and chemical reaction. What is its solubility. Give tests for identity?
What is the dose?
Ammonium valerate—What were the formerly official Latin and English titles?
Describe the process formerly official by which it may be prepared.
Why should ammonia water be added to the commercial salt in making solutions of it?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Acetate; heavy metals.
For what is it used in medicine and pharmacy?
What is the dose?

CHAPTER XLII

MAGNESIUM, CALCIUM, BARIUM, AND STRONTIUM

Magnesium—Give formula in symbols and molecular weight. (See page 582.)
How is it found?
What are the tests for the salts of magnesium?
Magnesium carbonate—Give formula in symbols and molecular weight.
What is the process of the British Pharmacopœia for making this?
Describe rationale of process. How may light magnesium carbonate be prepared?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz : Foreign soluble salts; calcium; iron; heavy metals.
What is the dose?
Magnesia—Give formula in symbols and molecular weight.
What is the U. S. P. (8th Rev.) official Latin title? What was the Latin title in the U. S. P. 1890? By what other names is it commonly known?
How is it prepared? Describe rationale of process.
What change takes place on exposure to air and moisture?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Foreign soluble salts; carbonate; calcium; iron; heavy metals.
How can an excess of water of hydration be detected?
For what is magnesium oxide used in medicine? and how is it best administered? Give the dose.
Heavy magnesia—What is the present official Latin title for this substance?
What was the U. S. P. 1890 Latin title?
How does it differ from light magnesia?
Magnesium sulphate—Give formula in symbols and molecular weight.
What is the common name or synonym?
How is this salt obtained in the United States?
How is it sometimes prepared in England?
How much water of crystallization does it contain?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; arsenic.
What is its medicinal use and dose?
Magnesii sulphas effervescens—What are the ingredients in this preparation? How is it made? What is the dose?
Solution of magnesium citrate—Give Latin official name.
How is it prepared?
What modifications of the official process are advisable?
What is the dose? How is it often preferably administered?
Calcium—Give symbol and atomic weight.
In what forms does calcium occur?
What are its physical properties?
What are the tests for salts of calcium?

Lime—Give formula in symbols and molecular weight.
What is the Latin official title?
What is lime, chemically?
How is it obtained?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Carbonate; insoluble matter.
What is the dose?
Lime water—Give Latin official name. What is the official title which expresses its chemical character?
How is it made?
How much calcium hydroxide does it contain?
Give formula in symbols and molecular weight of calcium hydroxide.
Is lime more soluble in hot or in cold water?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurities of alkalies or their carbonates be detected? What is the dose?
For what is lime water used medicinally?
How is syrup of lime made?
What is the object of making a syrup of lime?
What is lime liniment? What is a popular name for it?
For what purpose is it used?
Chlorinated lime—Give Latin official name.
Upon what does the activity of this compound depend?
What is sulphurated lime? How is it made?
How much calcium sulphide should it contain? How may this be tested?
How is sulphurated lime made?
Describe odor, taste, chemical reaction, and solubility. What is the dose?
Calcium bromide—Give formula in symbols and molecular weight.
In what two ways may this preparation be made?
Explain the reaction which takes place between milk of lime and solution of ammonium bromide when mixed.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Iodides; insoluble impurities; heavy metals; barium; bromate; limit of nitrate and ammonia.
What is the dose?
Precipitated calcium carbonate—Give the formerly official British process for making it.
How may the fineness of the powder be promoted?
In what process is this salt obtained as a by-product?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Limit of iron, aluminum, phosphates; heavy metals; limit of soluble impurities. What is the dose?
Which is preferred for chalk mixtures—this, or prepared chalk, and why?
What is prepared chalk?
By what synonym is this commonly known?
What is the process for making it (formerly official)?
What is the object of this process?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
For what is it used, and into what official preparation does it enter?
What is whiting, and for what is it used?
Calcium chloride—Give formula in symbols and molecular weight.
How may this salt be prepared?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Limit of iron, aluminum phosphates; limit of magnesia and alkalies; arsenic.
For what purpose is it used?
Calcium hypophosphite—Give Latin name, formula in symbols, and molecular weight.
What precaution is it wise to observe in dispensing calcium hypophosphite?
How is this salt prepared? Describe rationale of process.
What temperature should be employed in evaporating the solution?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Phosphate and sulphate; arsenic; heavy metals.

What is the dose?
How is syrup of hypophosphites made?
How is the compound syrup of hypophosphites made?
Precipitated calcium phosphate—Give Latin name, formula in symbols, and molecular weight.
How is it prepared?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Carbonate; chloride; barium; heavy metals; arsenic.
What is the dose?
Syrup of calcium lactophosphate—Give Latin official name.
How is it made? What is the dose?
Give the Latin name of dried calcium sulphate. What is its common name or synonym. How is it prepared? What is its composition?
Compound chalk powder—Give Latin official name.
How is it made? For what is it used?
How is chalk mixture made?
Barium—Give symbol and atomic weight.
What salts of barium are used officially, and for what?
How is it found in nature?
What are the tests for salts of barium?
Strontium—Give symbol and atomic weight.
What salts of strontium are used officially, and for what?
By what tests may strontium salts be recognized?
Strontium bromide—Give Latin name, formula in symbols and molecular weight.
How is this salt made?
Describe the appearance, characteristics and solubility.
Give the tests for identity.
How may the following impurities be detected?—viz.: Iodide; heavy metals; barium.
What is the dose and for what is it used?
Strontium iodide—Give Latin name, formula in symbols and molecular weight.
How may it be made?
How is it described? Give the solubilities and test for identity.
How may the following impurities be detected?—viz.: Heavy metals; barium.
Strontium salicylate—Give Latin title, formula in symbols and molecular weight.
How may it be prepared?
Describe odor, taste, appearance and solubility.
How may the following impurities be detected?—viz.: Heavy metals; barium.
For what is it used medicinally and in what dose?

CHAPTER XLIII

ZINC, ALUMINUM, CERIUM, AND CADMIUM

Zinc—Give symbol and atomic weight. (See page 602.)
In what form is zinc official.
How is it made?
What is its quantivalence?
What are the tests for zinc salts?
Describe odor, taste, chemical reaction, and solubility.
How may the following impurities be detected?—viz.: Sulphur; arsenic; antimony and phosphorus; cadmium, lead and copper.
What are its uses?
Zinc acetate—Give formula in symbols and molecular weight.
Describe the process (formerly official) by which it may be prepared.
Describe rationale of the process.
Describe odor, taste, chemical reaction, and solubility.
Give tests for identity.
How may the following impurities be detected?—viz.: Arsenic; cadmium, lead and copper; sulphate; chloride.

For what is it used?
Zinc bromide—Give formula in symbols and molecular weight.
How may zinc bromide be made (process of Lyons)?
In what other way may it be made?
Describe odor, taste, chemical reaction, and solubility.
Give tests for identity.
How may the following impurities be detected?—viz.: Iodide; arsenic; cadmium; lead and copper; sulphate; chloride.
What is the dose? For what is it used medicinally?
Precipitated zinc carbonate—Give Latin name, formula in symbols, and molecular weight.
What is the British process (formerly official) for making this salt? Give rationale of the process.
Describe odor, taste, chemical reaction, and solubility.
Give tests for identity.
How may the following impurity be detected?—viz.: Alkali.
For what is it used?
Zinc chloride—What is its formula in symbols? What is its molecular weight?
How is it prepared? Describe rationale of the process.
Describe odor, taste, chemical reaction, and solubility.
Give tests for identity.
How may the following impurities be detected?—viz.: Arsenic, cadmium, lead and copper; oxychloride; sulphate.
For what purposes is it used?
Solution of zinc chloride—What is the Latin official name? Give formula in symbols and molecular weight.
How much zinc chloride does it contain?
How is it prepared?
How may it be freed from iron which is usually present in the zinc from which it is prepared? Give description and specific gravity.
What is this solution sometimes called?
For what is it used?
Zinc iodide—Give Latin name, formula in symbols, and molecular weight.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Arsenic, cadmium, lead and copper; sulphate; chloride.
What is the dose?
Zinc oxide—Give Latin name, formula in symbols, and molecular weight.
What is the process (formerly official) by which it may be made?
How is it made on the large scale?
What is the difference between commercial zinc oxide and the official preparation?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Alkali; chloride; sulphate.
For what purposes is it used?
How is ointment of zinc oxide made?
Zinc phenolsulphonate—What is the Latin title, formula in symbols and molecular weight?
By what other name is it known? How may it be made?
Give the description, odor, taste, chemical reaction, and solubility.
What are the tests for identity?
How may the following impurities be detected?—viz.: Arsenic, cadmium, lead and copper; sulphate; chloride.
For what purpose is it used?
Zinc stearate—What is the Latin title?
How may this salt be made?
Give description, odor, taste, reaction and solubility. What are the tests for identity?
How may the following impurities be detected?—viz.: Alkalies; alkali earths; chlorides.
For what is it used medicinally?
How is ointment of zinc stearate made?
Zinc sulphate—How is it prepared? Give rationale of the process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Arsenic, cadmium, lead and copper; chloride; free acid.
What is the dose?
Zinc valerate—What is the official Latin title? What were the formerly official Latin and English titles? How is this salt prepared? Give rationale of the process.
What is meant by upward precipitation?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Arsenic, cadmium, lead and copper; sulphate; chloride; acetate; butyrate.
What is the dose?
Aluminum—Give symbol and atomic weight.
Where is this found? Give description and specific gravity?
What is its chemical quantivalence?
What are the salts known as alums?
What are the tests for salts of aluminum?
Alum—Give formula in symbols and molecular weight.
By what other names is the official alum known?
How is it generally made?
With how many molecules of water does it crystallize?
What kind of alum is generally found in the market?
What is its chemical composition?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; iron.
For what is it used medicinally?
What is the dose?
Exsiccated alum—Give its Latin official name.
What other names are used for exsiccated alum?
How is it prepared?
How much water does alum contain?
Describe odor, taste, chemical reaction, and solubility.
For what is it used?
Aluminum hydroxide—Give formula in symbols and molecular weight.
How is it prepared? Describe rationale of the process.
In what manner should the solutions be mixed, and why?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Iron; sulphate; alkali salts; heavy metals. For what is it used medicinally?
What is the dose?
Aluminum sulphate—Give formula in symbols and molecular weight.
Give the process (formerly official) by which it may be made.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Ammonia; free acid; heavy metals; iron. What is it used for?
Cerium—Give symbol and atomic weight.
Where is it found, and what are its physical properties?
What oxides are known, and what is their composition?
What is the test for cerium compounds?
What official preparation is there of cerium?
Cerium oxalate—Give Latin name, formula in symbols, and molecular weight.
How is this salt made?
What two rare metals are usually found in combination with cerium?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Carbonate; heavy metals; arsenic; aluminum; zinc. For what is this salt used in medicine.
What is the dose?
Cadmium—Give symbol, atomic weight, description, and specific gravity.
Describe odor, taste, and chemical reaction.
What combinations does it form?
What are the tests for cadmium salts?

CHAPTER XLIV

MANGANESE, IRON, AND CHROMIUM

Manganese—Give Latin name, symbol, and atomic weight. (See page 619.)
How is it found?
How many compounds does it form with oxygen?
Give their names and chemical composition.
What are the tests for the salts of manganese?
Precipitated manganese dioxide—What is it?
How is the official dioxide prepared?
How much per cent. of pure manganese dioxide does it contain?
Does the commercial article always contain this much?
How may its quality be tested?
Describe odor, taste, and chemical reaction.
How may an impurity of antimony sulphide and insoluble substances be detected?
Manganese hypophosphite—What is the Latin title, formula in symbols and molecular weight? Give the description, odor, taste, chemical reaction and solubility.
Give the tests for identity.
How may the following impurities be detected?—viz.: Carbonate, phosphate, calcium; arsenic.
For what is this salt used and in what dose?
Manganese sulphate—Give Latin name, formula in symbols, and molecular weight.
Give Prof. Diehl's process for making this salt.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Iron; heavy metals; salts of alkalies and of magnesium; zinc. For what is it used medicinally?
What is the dose?
Potassium permanganate—Give Latin name.
Iron—Give Latin name, symbol, and atomic weight.
With which of the non-metallic elements does it not combine?
What compounds does it form with oxygen?
What are the tests for iron salts?
In what form is iron official?
Reduced iron—Give Latin name.
Describe Prof. Procter's process for making it.
How may its quality be tested?
Describe appearance, odor, taste, and chemical reaction.
How may the following impurities be detected?—viz.: Sulphide; arsenic.
For what is it used medicinally and in what dose?
Saccharated ferrous carbonate—Give Latin name. What is the dose?
How is it prepared? Give rationale of process.
Describe odor, taste, chemical reaction, and solubility.
How may impurity of sulphate be detected?
What is the dose?
Mass of ferrous carbonate—Give Latin name.
How is it made? Describe rationale of process.
What are syrup and honey used for in this preparation?
What is a common or popular name for it?
Compound iron mixture—Give Latin name.
Upon what ingredient does the usefulness of this depend?
Pills of ferrous carbonate—Give Latin name.
What is the composition of one of these pills?
Ferric chloride—Give Latin name, formula in symbols, and molecular weight.
Is this a ferrous or a ferric salt?
What is another name for this salt?
How is it made? Describe rationale of process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; nitric acid; ferrous salts.
What are the uses of this salt?

What is the dose?
Solution of ferric chloride—Give Latin name.
How much anhydrous ferric chloride does it contain?
How is it made?
If this solution when finished has a blackish color, what is indicated? What is the remedy?
If a brown precipitate occurs upon dilution or standing, what is indicated? What is the remedy?
Describe rationale of process.
Describe appearance, odor, taste, chemical reaction, and state specific gravity. Give tests for identity.
How may the following impurities be detected?—viz.: Zinc or copper; salts of fixed alkalies; nitric acid; ferrous salts; oxychloride.
What are its uses?
Tincture of ferric chloride—Give Latin name.
How is this tincture prepared?
What is the object of allowing the mixture to stand three months before it is to be used?
If a brownish-red precipitate occurs upon diluting the solution of ferric chloride, what is indicated?
Describe its appearance, odor, taste, chemical reaction. Give the specific gravity and tests for identity.
How may the presence of nitric acid be detected?
For what is it used medicinally and in what dose?
Ferric citrate—Give Latin name.
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurities of tartrate and citrates and tartrates of the alkali metals be detected?
What are its advantages and uses?
What is the dose?
Iron and ammonium citrate—Give Latin name.
By what other names is it known?
How is it prepared?
What is Lloyd's modification of this process?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Tartrate; citrate and tartrate of the alkali metals.
What is the dose?
Solution of ferric citrate—What was its Latin official name?
How much anhydrous ferric citrate does it contain?
How is it prepared? Describe rationale of process.
What is the strength of this preparation as compared with the scaled salt?
What is the dose?
Wine of iron—What is the Latin name?
How is it made? What is the dose?
Iron and quinine citrate—Give Latin name.
How is it prepared?
To what is the green color of the salt as frequently found in the market owing?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
Describe the assay for quinine; also for iron.
What is the dose?
Soluble iron and quinine citrate—How is this prepared?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How much quinine should it contain?
How may its quality be tested?
How is bitter wine of iron made? What is the dose?
Iron and strychnine citrate—How is this salt prepared?
How much strychnine does it contain?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.

Describe the assay for strychnine; also for iron.
What is the dose?
Glycerite of the phosphates of iron, quinine and strychnine—What is the Latin official title? How is it made?
For what is it used and what are its advantages?
Elixir of the phosphates of iron, quinine and strychnine—What is the Latin official title? How is it prepared?
Syrup of the phosphates of iron, quinine and strychnine—What is the Latin title?
How is it made?
What is a common or popular name for it?
What is the dose?
Ferric ammonium sulphate—Give Latin name, formula in symbols, and molecular weight.
What is its synonyms?
Describe the process (formerly official) by which it may be made.
With how many molecules of water does the salt crystallize?
Is it a stable compound?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurity of aluminum and chlorides be detected?
What is its use?
Iron and ammonium tartrate—?
By what other name is it known?
How is it made?
What is its chemical composition, theoretically?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurity of citrates and tartrates of the alkali metals be detected?
Iron and potassium tartrate—What is the Latin official title? By what other name is it known?
How is iron and potassium tartrate made?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
What is the dose?
What is "Boule de Mars," and how is it used?
Ferric hydroxide—What is the Latin title? What were the Latin and English titles in the U. S. P. 1890?
How is it made? State the reaction which takes place. Why is ammonia water preferred as a precipitant? Give a description of appearance. How does it act as an antidote to arsenic poisoning?
What are the uses and advantages?
Ferric hydroxide with magnesium oxide—Give the Latin title. What were the names in the U. S. P. 1890?
By what name is it commonly known?
How should it be kept for use?
What are its uses?
Ferric hypophosphite—Give Latin name, formula in symbols and molecular weight. Describe rationale of process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Carbonate; calcium phosphate; heavy metals.
What is the dose?
Syrup of ferrous iodide—How much ferrous iodide does it contain?
How is it made?
What is the object of exposing this syrup to the light?
Describe its appearance, taste and chemical reaction.
Give the specific gravity and test for identity.
How may free iodine be detected?
Describe the assay?
What is the dose, and how should it be taken?
How are pills of ferrous iodide prepared to preserve them from change?
How much ferrous iodide is there in each pill?
What is the dose?
Soluble ferric phosphate—How is it made?

Is this a definite chemical compound?
What other salt does it closely resemble?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
What is the dose?
Ferric pyrophosphate—How is this made?
What is this salt chemically?
In what respect does it differ from the salt which was formerly official?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
What is the dose?
Ferrous sulphate—Give Latin name, formula in symbols, and molecular weight.
By what other name is it known?
What is the British process for making this salt?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; salts of the alkali metals; free acid.
What is the popular name of the impure ferrous sulphate?
How much water of crystallization do the crystals contain?
For what is this salt used? What is the dose?
Exsiccated ferrous sulphate—Give Latin name, formula in symbols, and molecular weight.
What other title or name is used?
How is it prepared?
How many parts of the exsiccated salt will one hundred parts of the crystallized salt make?
Granulated ferrous sulphate—Give Latin name, formula in symbols, and molecular weight. What were the Latin and English titles in the U. S. P. 1880?
Does this differ in composition from "ferri sulphas"?
How is it prepared?
What is the use of alcohol in this formula?
What advantages does this powder possess over the ordinary form of crystals?
Describe odor, taste, chemical reaction, and solubility.
How may its quality be tested?
Solution of iron and ammonium acetate—What is the Latin name?
How is it made? What is its popular name?
What is the dose?
Solution of ferric subsulphate—Give Latin name.
What synonym has this solution?
How much basic ferric sulphate does it contain?
How is it prepared? Give description and specific gravity.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Nitric acid; ferrous salt.
What is the dose?
Solution of ferric tersulphate—What is the Latin name?
What sulphate of iron does this solution contain, and how much?
How is it made? Describe rationale of process.
Wherein does this solution differ from the solution of ferric subsulphate?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Nitric acid; ferrous salt.
For what is this solution used?
Chromium—What is its formula in symbols? What is its molecular weight?
How does it occur in nature, and whence is it obtained?
What compounds does it form with oxygen?
What are the tests for chromium salts?
Chromium trioxide—What is the Latin name?
What were the formerly official Latin and English titles?
What is its formula in symbols? What is its molecular weight?
How is it obtained? Describe rationale of process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurity of sulphuric acid be detected?
What are its uses?
Why should care be used in mixing it with deoxidizing bodies?
Potassium dichromate—What is the Latin official title?

CHAPTERS XLV-XLVI

NICKEL, COBALT, TIN, LEAD, COPPER, SILVER, AND MERCURY

Nickel—What is the Latin name? Give symbol and atomic weight. (See page 653.)
Give description and specific gravity. Where is it obtained?
What alloy does it form with copper?
For what purpose are the salts of nickel used?
What are the tests for compounds of nickel?
Cobalt—Give symbol and atomic weight. Give description and specific gravity.
How is it found? What classes of salts does it form?
What is flystone, and how is it used?
What is barometer paper, and what is the explanation of its use?
What color does cobalt give to glass?
Are any of the salts of cobalt official?
What are the tests for salts of cobalt?
Tin—Give symbol and atomic weight.
Give description and specific gravity.
What classes of salts does it form?
What are the tests for compounds of tin?
Lead—Give Latin name, symbol, and atomic weight. (See page 655.)
Give description and specific gravity.
How is it obtained?
What compounds does it form with oxygen?
What are the tests for compounds of lead?
Is water rendered poisonous by passing through lead pipes?
Lead acetate—Give Latin name, formula in symbols, and molecular weight.
What is its synonym?
How is it made? Describe rationale of process.
Is the commercial salt fit for pharmaceutical use? Why?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Carbonate; iron and copper; zinc; salts of alkali metals and of magnesium; calcium, zinc and iron.
For what is it used medicinally?
What is the dose?
Why is solution of lead acetate in water turbid?
Solution of lead subacetate—How much lead subacetate does this solution contain?
How is it prepared, and what is the object of the process? Describe rationale of process.
What is its specific gravity? Describe odor, taste, and chemical reaction.
How may its strength be tested?
What is its popular name?
What are its properties and uses in medicine?
Diluted solution of lead subacetate—What is its synonym? Why is this solution usually opalescent?
Is this an advantage or a disadvantage? Why?
For what is it used?
Cerate of lead subacetate—How is it prepared, and what are its properties?
What is its popular name?
How may it be prevented from turning yellow?
Lead iodide—What is the formerly official British process for making this salt?
Why is lead nitrate preferred to the acetate?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Chromate and other insoluble foreign salts; nitrate; acetate; soluble foreign salts.
For what is it used medicinally and in what dose?
Lead nitrate—Give Latin official name, formula in symbols, and molecular weight.
How may this salt be prepared?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Copper and iron; zinc and iron; salts of alkalies and of magnesium, calcium, zinc, and iron.
How is it used?
Lead oxide—Give Latin official name, formula in symbols, and molecular weight.
By what synonym is it commonly known?
How is the commercial salt usually obtained?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Silicates, and barium sulphate; copper; iron; insoluble impurities; soluble impurities; carbonate and moisture.
What is red lead, and how is it made?
Lead plaster—What is it and how is it made?
What synonym is used for this substance?
For what is it used?
Diachylon ointment—What is it, and for what is it used?
Copper—Give Latin name.
What is its symbol? What is its atomic weight? Give description and specific gravity.
How is it found?
What oxides does it form? Give their formulas.
What are the tests for compounds of copper?
Copper sulphate—Give formula in symbols and molecular weight.
How is it made?
How much water of cystallization does it contain?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Iron, aluminum, etc.; heavy metals.
What is the dose?
Silver—Give Latin name, symbol, and atomic weight. Give description and specific gravity.
How is it found?
What combination does it make with oxygen?
What are the tests for silver salts?
Silver cyanide—Give formula in symbols and molecular weight.
How is it prepared? Describe rationale of process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
For what is it used?
Silver nitrate—Give formula in symbols and molecular weight.
Give the process (formerly official) by which this may be made.
How is the copper separated from the silver, with which it is usually mixed, in making this solution?
Describe rationale of process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurities of copper, lead and foreign salts be detected?
Describe the quantitative test.
For what is it used medicinally?
What is the dose?
Moulded silver nitrate—What is the Latin official title? What synonyms are commonly used? How is it prepared?
What is the object of adding hydrochloric acid?
How may it be prevented from becoming discolored during the process of casting?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may its quality be tested?
For what is it used?
How may a convenient caustic-holder be made?
Mitigated silver nitrate—What is the Latin title?
What were the U. S. P. 1890 Latin and English titles? How is it made?
Describe appearance, odor, taste, chemical reaction, and solubility.
How may the following impurities be detected?—viz.: Copper; lead and bismuth.
What is the object of this preparation?
For what is it used?

Silver oxide—Give Latin name, formula in symbols, and molecular weight.
Describe the process (formerly official) by which it may be made.
Describe rationale of process. Describe odor, taste, chemical reaction, and solubility.
How may impurity of carbonate be detected?
What is its use? Why should it not be triturated with oxidizable or combustible substances?
What action does ammonia have upon it?
Mercury—Give Latin name, symbol, and atomic weight.
Describe it and give specific gravity.
How is it found, and where does it come from?
At what temperature does it solidify?
What two series of compounds does it form?
Is it used in medicine in the metallic state?
What are the tests or compounds of mercury?
How may mercury be purified?
Describe odor, taste, and chemical reaction.
How may the following impurities be detected?—viz.: More than slight traces of foreign metals.
For what is it used medicinally?
Mass of mercury—Give the Latin name.
How is it made?
What is the object of this preparation? What is the dose?
Describe the method, devised by Dr. Squibb, for extinguishing mercury.
What is this process termed?
Mercury with chalk—Mention a synonym. How is it made?
What is the object of this preparation?
What is Matter's process for making it?
Describe its appearance, odor, and taste.
How may the following impurities be detected?—viz.: Mercurous oxide; mercuric oxide. For what is it used medicinally?
What is the dose?
Mercurial ointment—How is it made?
What is the object of this preparation?
Blue ointment—How does this differ from mercurial ointment? What is the Latin official title? Why has this preparation been introduced?
Mercurial plaster—How is it made?
What percentage of mercury does it contain?
Ammoniated mercury—Give formula in symbols and molecular weight.
What is the synonym for ammoniated mercury?
How is it made? Give rationale of process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Mercurous salt; carbonate; foreign salts, metals and arsenic.
How is it used?
Ointment of ammoniated mercury—How is it made?
For what is it used?
Corrosive mercuric chloride—Give Latin name, symbolic formula, and molecular weight.
Describe the process (formerly official) by which it may be made.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurities of foreign salts; arsenic and foreign metals be detected?
In case of poisoning, what are the proper antidotes?
For what is it used medicinally?
What is the dose?
Mild mercurous chloride—Give Latin name, symbolic formula, and molecular weight.
Describe the process (formerly official) by which it may be made.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Heavy metals; soluble impurities; mercuric chloride; ammoniated mercury; foreign salts; arsenic; foreign metals.
For what is it used medicinally?
What is the dose? What caution is necessary in prescribing calomel?

Yellow mercurous iodide—Give Latin name, symbolic formula, and molecular weight.
By what synonym is it commonly known?
How is it made?
Describe appearance, odor, taste, chemical reaction, and solubility.
Give the tests for identity. How may an impurity of mercuric iodide be detected?
For what is it used medicinally?
What is the dose?
Red mercuric iodide—Give Latin name, formula in symbols, and molecular weight.
What are the common names or synonyms?
How is it made?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Mercuric chloride; soluble iodides or chlorides.
What is the dose?
Yellow mercuric oxide—How is it prepared? Describe rationale of process.
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Chlorides; foreign salts; metals; arsenic.
For what is it used?
Ointment of yellow mercuric oxide—How is it made, and for what is it used?
Oleate of mercury—What is the Latin name?
How is it made?
Red mercuric oxide—What is the Latin name?
What is the synonym?
Give the formula in symbols and molecular weight.
Describe the process (formerly official) by which this may be made.
Give rationale of process.
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurities of nitrate; chlorides; foreign salts, metals, or arsenic be detected?
Wherein does it differ from yellow mercuric oxide?
For what is it used?
Ointment of red mercuric oxide—What is the Latin name?
How is it made, and for what is it used?
Solution of mercuric nitrate—What is the Latin name?
Give description and specific gravity.
How much mercuric nitrate does this solution contain?
How is it made?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the presence of mercurous salt be indicated?
What is its use?
Ointment of mercuric nitrate—How is it made? Give rationale of process.
For what is it used?

CHAPTER XLVII

ANTIMONY, ARSENIC, AND BISMUTH

Antimony—Give Latin name, symbol, and atomic weight. (See page 681.)
What is its melting point? How is it found?
What combinations does it form with oxygen?
From which of these oxides are antimonites formed?
From which of these oxides are antimoniates formed?
What are the tests for salts of antimony?
Antimony and potassium tartrate—Give Latin name, formula in symbols, and molecular weight.
What are the synonyms?

Describe the process (formerly official) by which this may be made.
Give rationale of the process. Describe odor, taste, chemical reaction, and solubility. What are the tests for identity?
How may the following impurities be detected?—viz.: Sulphate; chloride; calcium; iron; heavy metals; potassium bitartrate; arsenic.
In case of poisoning by an overdose, what is the proper antidote?
Give formula in symbols and molecular weight.
For what is it used medicinally and what is the dose?
Give rationale of the process. Describe odor, taste, chemical reaction, and solubility. What are the tests for identity?
How may the following impurities be detected?—viz.: Chloride; sulphate; iron and other metals.
In what official preparations is it used?
Wine of antimony—Give the Latin name.
How is it made? What is the dose?
Arsenic—Give the Latin name, symbol, and atomic weight.
Where is it found, and how is it obtained?
What combinations does it form with oxygen?
What combinations does it form with sulphur?
What are the tests for arsenic and its salts?
Arsenic trioxide—Give Latin name, formula in symbols, and molecular weight.
What were the official Latin and English titles of the U. S. P. 1890?
What are the synonyms?
How is it made?
Chemically, is it regarded as an acid? What is true arsenous acid?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
What is the dose?
What are the official antidotes to arsenical poisoning?
Solution of arsenous acid—Give Latin name.
How is it made?
How can its quality be tested? What is the dose?
Solution of potassium arsenite—What is the Latin name?
By what name is this solution commonly known?
How is it made? Give rationale of the process.
Wherein does it differ from the British "liquor arsenicalis"?
How may its quality be tested? What is the dose?
Sodium arsenate—Give Latin name, formula, in symbols, and molecular weight.
Exsiccated sodium arsenate—What is the Latin title?
Solution of sodium arsenate—What is the official Latin title?
How is it made? For what is it used? What is the dose?
Arsenic iodide—Give Latin name, formula in symbols, and molecular weight.
What objection is there to this process? How otherwise may it be made?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
For what is it used chiefly?
What is the dose?
Solution of arsenic and mercuric iodide—Give the Latin name. How is it made?
What is the common name or synonym by which the solution is known?
Give a description of the odor and taste.
How may the color of the solution, which has become dark upon standing, be restored? What is the dose?
Bismuth—Give the symbol and atomic weight.
Give description and specific gravity.
How is it found? What are tests for salts of bismuth?
Bismuth citrate—What is its formula in symbols? Give its molecular weight.
How is it made? Give rationale of the process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may impurities of nitrate, arsenic, lead, copper, silver, chlorides, and sulphates be detected? For what is it used?
Bismuth and ammonium citrate—How is it made?
Why is the solution of this salt sometimes not perfectly transparent, and how may it be made so?
What is liquor bismuthi, and how is it made?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.

How may impurity of nitrate or arsenic be detected? What is the dose?
Bismuth subcarbonate—Give formula in symbols and molecular weight.
Why is such an elaborate process adopted for obtaining this salt?
Give rationale of the process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Chlorides; lead, copper; sulphate; silver; alkalies and alkali earths; bismuth subnitrate; arsenic.
For what is it used medicinally?
What is the dose?
Bismuth subgallate—What is the Latin title? By what name is it commonly known?
How may it be prepared?
Describe its appearance, odor, taste and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Free gallic acid; nitrate; arsenic.
For what is it used? What is the dose?
Bismuth subnitrate—How is the separation of arsenic accomplished? Give rationale of the process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Carbonate; insoluble foreign salts; arsenic. For what is it used? What is the dose?
Bismuth subsalicylate—What is the Latin title? Describe Thibault's process for making it? Describe appearance, odor, taste, and solubility. Give the tests for identity.
How may the following impurities be detected?—viz.: Free salicylic acid; nitrates; arsenic.
For what is it used and in what dose?

CHAPTER XLVIII

GOLD AND PLATINUM

Gold (See page 697.)—What is the Latin name? Give the symbol and atomic weight.
In what form is it official? How is it found?
What are the tests for gold salts?
Platinum—Give the symbol and atomic weight.
What salt of it is official, and for what is it used? How is it found?
What are the tests for platinum salts?
Gold and sodium chloride—What is the composition of this salt?
Give the formulas and equivalents of each of the ingredients.
How is it made?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may its quality be tested? How may free acid and metallic impurities be detected?
For what is it used medicinally?
What is the dose?

PART IV

ORGANIC SUBSTANCES

CHAPTER LXIX

THE CELLULOSE GROUP

What is cellulose? (See page 715.) What is its formula in symbols? What is lignin?

What are some other special forms of cellulose?

Give an example of pure cellulose. Describe it, and give specific gravity.

In what solution is it soluble, and to what purpose is this fact applied?

When cellulose is treated with strong sulphuric acid, what change takes place?

If the mixture be diluted with water and heated, what will be produced?

How is parchment paper made, and for what is it used?

When cellulose is treated with nitric acid, what is produced?

Purified cotton—What is the Latin official name? By what name is it commonly known? What kind of cotton is meant?

How is it obtained? For what purposes in pharmacy is purified cotton used?

Describe appearance and solubility.

How may it be tested for purity?

Pyroxylin—What is the Latin official name? What is the synonym? How is it made?

What compounds are made by the action of nitric acid on cellulose?

Explain the reactions which take place in their formation.

Give the official characteristics and description.

Give solubility and test for impurity.

What are the uses of pyroxylin?

What is celluloid? For what purposes is it used?

Oxalic acid—Give its formula in symbols and molecular weight.

How may it be made?

In combination with bases, what salts does it form?

What are the most important of these salts?

What is "salt of sorrel" or "essential salt of lemons"?

How do these act in removing iron rust from linen?

For what is oxalic acid used?

In case of poisoning by oxalic acid, what is the best antidote?

What is the result when wood is distilled in close vessels?

From dry woods about what per cent. of charcoal is obtained, and about what per cent. of liquid products?

Name some of the principal solid, liquid, and gaseous products.

Of these products, which are the most important?

Acetic acid—What is the official Latin name?

How much absolute acetic acid does it contain? Give its formula in symbols and molecular weight.

How is the best acid for medicinal purposes obtained?

How is acetic acid made in Germany? Describe odor, taste, chemical reaction, and solubility. Give tests for its identity.

How may the following impurities be detected?—viz.: Copper; fixed impurities; heavy metals; sulphuric acid; hydrochloric acid; formic or sulphurous acids; empyreumatic substances.

What two strengths of acid are found in commerce?

Why is one of them called No. 8?

What is the specific gravity of each of these acids?

What is the difference between the two kinds?
What are the salts of acetic acid called? How may they be recognized?
Diluted acetic acid—What is the Latin name? Give description and specific gravity. How is it made, and for what is it used?
How much absolute acetic acid does it contain?
Why is it superior to vinegar as a menstruum?
Glacial acetic acid—What is the Latin official name? Give its formula in symbols and molecular weight.
How is it made? Give rationale of process. Describe odor, taste, and chemical reaction. What is its specific gravity? How may its strength be tested?
Can its specific gravity be relied on as a criterion of its strength? Why?
How may the glacial acid be distinguished from the weaker acid having the same specific gravity?
For what substances is glacial acetic acid a solvent? What are its uses?
Trichloracetic acid—What is the Latin title, the chemical formula in symbols, and molecular weight. How may it be made?
Describe appearance, odor, chemical reaction, and solubility. What are the tests for identity.
For what is it used medicinally?
Acetone—What is the Latin title, the chemical formula in symbols, and the molecular weight.
By what chemical name is it known?
How may it be made? Describe its appearance, odor, taste, chemical reaction, and solubility. What is the specific gravity?
Give tests for identity. How may the impurity of empyreumatic substances be detected?
For what is it used in pharmacy and the arts?
Tar—What is the Latin official name? What is it, and how is it obtained?
Describe its physical properties. What are its uses?
What are its solubilities?
What official preparations are there of tar?
Oil of tar— hat is the Latin official name? How is it obtained? Give description, specific gravity and solubility.
What is black pitch?
Why is it generally preferred to tar for medicinal uses?
Oil of cade—What is its Latin official name? What are the common names or synonyms? How is it obtained? Give description and specific gravity. What are its uses?
What is creosote, and of what phenols does it consist?
How is it obtained? Describe odor, taste, chemical reaction, and solubility.
How may it be distinguished from phenol? What are its uses?
In case of poisoning by it, what would be the proper treatment?
For what is creosote used medicinally and what is the dose?
What official preparation is there of creosote?
What is the strength of it, and what is the dose?
Guaiacol—How does this differ from creosote? How is it obtained?
Describe appearance, odor, and solubility.
Give specific gravity and tests for identity.
How may an impurity of oily hydrocarbons or of creosote be detected?
For what is it used and what is the dose?
Guaiacol carbonate—Give the Latin title, chemical formula in symbols and molecular weight.
How is it made?
Describe appearance, odor, taste, chemical reaction, and solubility. What are the tests for identity and the presence of free guaiacol?
What is a common name for it?
What is its use and dose?
What is coal? Explain the differences in its structure and composition.
What is coal tar?
When coal tar is subjected to distillation and rectification, what products does it yield? 1. Solids; 2. Liquids; 3. Gases.
Naphthalene—What is its Latin official name? What were the Latin and English titles in the U. S. P. 1890? How is it obtained? Give description, tests, and uses? By what name is it commonly known?
Betanaphthol—What is its Latin official name? What was the U. S. P. 1890

Latin title? How is it obtained? Give description, tests, dose, and uses.

Cresol—Give chemical formula in symbols and molecular weight. How is it obtained? By what other name is it known? What varieties of cresol constitute the official substance? How does it differ from phenol?

Describe appearance, odor, and solubility. What is its specific gravity and boiling point?

How may the impurity of hydrocarbons be detected?

For what is it used and in what form?

Compound solution of cresol—What is the Latin title? How is it made? Give the details of the process. This compound is similar to what well known solutions?

Phenol—Give formula in symbols and molecular weight.

What were the Latin and English titles official in the U. S. P. 1890?

What is phenol and how obtained? How much absolute phenol is present? Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Creosote and cresol. What is the official assay for the quantity of phenol present?

For what purpose is it used? What antidote should be used in case of poisoning by phenol? What is the dose? What official preparations are there of it?

What is the strength of the ointment?

Liquefied phenol—What is the Latin official title? How much absolute phenol does it contain? How is the phenol liquefied?

Describe appearance, odor, taste, chemical reaction, and solubility. What is the specific gravity?

What are its advantages? What is the dose?

What official preparation is made from it?

Thymol—Give the chemical formula and molecular weight. To what class of chemicals does this substance belong? How is it obtained and from what source?

Describe appearance, odor, taste, and solubility. What are the specific gravity and tests for identity? What is the value medicinally? In what official preparation does it enter? If triturated with certain substances what results? Name some of them. Give the dose.

Thymol iodide—Give Latin title, chemical formula in symbols, and molecular weight.

How is it obtained? What per cent. of iodine should it contain?

How may it be prepared?

Describe appearance, odor, and solubility.

How may the following impurities be detected?—viz.: Halogen salts; alkalies; free iodine; ash.

By what name is it commonly known?

For what is it used in medicine?

Resorcinol—What is the Latin official title? What were the Latin and English titles in the U. S. P. 1890?

What other names are given to it? How is it obtained?

Describe its appearance, tests, and solubilities. What are its medicinal properties? Give the dose.

Salicylic acid—Give Latin name, formula in symbols, and molecular weight.

Describe Kolbe's patent process for obtaining it. Give rationale of the process.

Describe odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Iron; phenol; coloring matter; readily carbonizable organic impurities; hydrochloric acid.

What is the dose? What salts of this acid are official?

Phenol salicylate—What is its Latin official name? What were the Latin and English titles official in the U. S. P. 1890? How is it obtained?

Describe its appearance, tests, and solubilities.

How may the following impurities be detected?—viz.: Free acids; uncombined phenol or salicylic acid; sulphates; chlorides.

What are its medical properties? Give the dose

Acetphenetidin—Give the Latin title, chemical formula, name, and molecular weight. How is it obtained?

Describe appearance, odor, taste, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Acetanilide; paraphenetidin.

By what name is it commonly known? For what is it used? Give the dose.

Methylene blue—Give the Latin and other English titles also chemical formula and molecular weight. How is it obtained?
Describe appearance and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Commercial dye or other mineral impurities; arsenic.
For what is it used? What is the dose?
Acetanilide—What is its Latin title? By what other name is it known? How is it made?
Describe its appearance, odor, taste, chemical reaction, and solubility.
Give the tests for identity. How may the presence of aniline salts be detected?
For what is it used medicinally and what is the dose?
What preparation of acetanilide is official?
Antipyrine—What is the Latin title, the chemical formula in symbols, the molecular weight, and the chemical name?
How is it made by Knorr's process?
Describe its appearance, odor, taste, chemical reaction, and solubility. How may the presence of acetanilide and acetphenetidin be detected?
For what is it used medicinally and what is the dose?

CHAPTER L

AMYLACEOUS AND MUCILAGINOUS PRINCIPLES AND THEIR PRODUCTS

What is starch? (See page 743.) Give the Latin official name and description.
What is its chemical composition?
How is it made?
What is gluten?
Upon what is the purity of starch largely dependent?
What change takes place when starch is subjected to the action of diluted acids, diastase, or heat?
Under what names is dextrin largely used in the arts? Describe its appearance.
How may it be distinguished from gum arabic.
In what solutions is starch soluble?
What is the composition of inulin?
Where is it found?
In what particulars does it differ from starch?
For what is starch used? Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
What is the official preparation of starch?
From what other sources is unofficial starch derived?
Malt—What is the source? Give a description. What per cent. of soluble constituents should be present in malt? Describe the process by which it is made.
For what is it used? What is the official preparation?
Irish moss—Give the Latin official name. Where does this alga come from?
What principle does it contain?
Wherein does this principle differ from gum?
Wherein does this principle differ from starch?
Wherein does this principle differ from pectin?
For what is chondrus used?
What is arabin?
What three proximate principles are found in gums?
In what gums are these principles found?
Wherein do gums differ from starch or cellulin?
Wherein do gums differ from sugars?
Gum arabic—What is the Latin official name? Describe odor, taste, and chemical reaction. What is its specific gravity?
Of what does this gum mainly consist?
Does neutral lead acetate precipitate its aqueous solution?
Does basic lead acetate precipitate its aqueous solution?
What action is produced by soluble silicates on ferric salts?

What are its uses in pharmacy?
What are the official preparations of acacia?
Tragacanth—What is the Latin official name? Whence obtained?
What are its constituents? What is its specific gravity?
What color is produced when iodine T. S. is added to mucilage of tragacanth?
Wherein does the portion soluble in water differ from acacia?
What official preparation is there of tragacanth?
Elm—What is the Latin official name? What is the synonym? Of what tree is this the bark?
What does the bark contain?
For what is it used?
What official preparation is there of it?
Sassafras pith—What is the Latin official name? Whence obtained?
What does it contain, and for what is it used?
What official preparation is there of it?
Marshmallow—What is the Latin official name? What part is official?
Where does it come from?
What does it contain, and for what is it used?
Linseed—What is the Latin official name? What is the other English title? Whence obtained?
What does it contain?
What percentage of a fixed oil should be present?
For what purposes is it used?
Why is the fixed oil especially valuable?

CHAPTER LI

SUGARS AND SACCHARINE SUBSTANCES

What are sugars? (See page 751.)
To what is the term sugar popularly applied?
Into what two classes may sugars be divided?
Into what two sub-classes may fermentable sugars be conveniently divided?
What are glucoses, and what are saccharoses?
What are the non-fermentable sugars sometimes called?
Glucose—What is its formula in symbols?
How is it obtained on the large scale?
To what is the term "grape sugar" applied?
Is glucose more or less sweet than cane-sugar?
How does its solubility compare with cane sugar?
What is its specific gravity when anhydrous?
Wherein does the action of strong mineral acids and of alkalies upon glucose differ from their action upon cane sugar?
In what direction does its solution rotate the plane of polarization of polarized light?
Is it capable of direct fermentation?
What effect has it in boiling solution upon alkaline cupric tartrate?
What impurity does it almost always contain?
How may this be detected?
Sugar—What is the Latin name?
Give its formula in symbols and molecular weight.
By what name is it commonly known?
How is it prepared commercially?
What is the difference between the "open pan process" and the "vacuum process"?
What is the best sugar for pharmaceutical purposes?
What is "lozenge sugar"; "pulverized sugar"; "rock candy"?
Why is ultramarine sometimes added to sugar?
What is Trommer's test to distinguish the difference between cane sugar and grape sugar?
How is the polariscope used to determine the value of sugar and sugar solutions?
Describe odor, taste, chemical reaction, and solubility.

How may the following impurities be detected?—viz.: Insoluble salts, ultramarine, Prussian blue, etc.; glucose, and more than a slight amount of inverted sugar.
What change takes place when sugar in dilute solution is exposed to warm air?
When cane sugar is heated to 185° C. (365° F.), what change takes place, and what is formed?
At a higher temperature, 204.4° to 215.5° C. (400° to 420° F.), what change takes place?
At a still higher temperature what occurs?
For what purposes in pharmacy is sugar used?
What are saccharures?
What are oleo-saccharures (elæosacchara)?
What is aromatic sugar and how is it made?
Honey—Whence is it obtained?
Describe odor, taste, chemical reaction, and solubility.
How may the following impurities be detected?—viz.: Chlorides; sulphates; starch sugar; cane sugar; starch.
For what is honey used in pharmacy?
In what form is it official?
What is manna?
What is its solubility in water? In alcohol?
What is the principal constituent of manna?
What are the physical properties of mannite?
What is its chemical composition, and to what class is it considered to belong?
How may it be obtained?
For what is manna used, and what is the dose?
Liquorice root—What is the Latin official name? How is the English name sometimes spelled? Whence obtained?
What sweet principle does glycyrrhiza contain?
What is its chemical composition, and in what combination does it exist in the root?
To what does the root owe its acridity?
What are the official preparations of glycyrrhiza?
Ammoniated glycyrrhizin—What is the Latin official name?
How is it made?
What amount is obtained from glycyrrhiza?
What effect do alkalies have upon glycyrrhizin?
For what is this compound useful?
What is triticum, and how is it found in commerce?
What principles does triticum contain?
For what is it used?
What official preparation of triticum is there?

CHAPTER LII

DERIVATIVES OF SUGARS THROUGH THE ACTION OF FERMENTS

What is fermentation, and what is the difference between fermentation and putrefaction? (See page 759.)
What are the two theories of fermentation?
Into what two classes may ferments be divided?
What are the necessary conditions to cause cane sugar to undergo vinous fermentation?
What is the probable action of the ferment?
Explain the reactions which take place in the conversion of cellulin or starch, first, into maltose, then into glucose, then into alcohol, and finally into acetic acid.
What is the most important derivative of sugar by the action of a ferment?
What are the sources of the various ardent spirits of commerce? Of brandy? Rum? Whisky? Holland gin? Common gin? Arrack?
Chemically considered, why are the carbon compounds called alcohols?

What are ethers? What are compound ethers?
Explain the reaction which occurs when alcohol is decomposed by acetic acid.
Whisky—What is the Latin official name? What is its official definition?
How is it obtained, and what are the operations termed by which it is obtained from grain?
Describe it. What is its specific gravity?
What is its alcoholic strength?
How may the following impurities be detected?—viz.: More than traces of fusel oil from grain or potato spirit; an undue amount of solids; glycerin, added sugar, or spices; traces of oak tannin from casks; an undue amount of free acid.
What are its medicinal uses?
Alcohol—Describe it and give its specific gravity.
How much ethyl alcohol does it contain?
Give its formula in symbols and molecular weight.
What are the natural sources of alcohol, and how is it made?
How much alcohol, specific gravity .835, is obtained from good whisky?
What is its principal impurity?
How may it be deprived of odor?
What is absolute alcohol?
What is the strongest alcohol which can be obtained by simple distillation?
How may it be freed from water?
Alcohol of what specific gravity may be obtained by the use of lime?
What is its boiling point, and to what degree of cold may it be reduced without congealing?
How may its freedom from water be ascertained?
What is the empirical formula of alcohol?
What strengths of alcohol are official?
Describe the appearance, odor, taste, chemical reaction, and solubility of alcohol.
How may it be identified?
How may the following impurities be detected?—viz.: Fusel oil constituents; amyl alcohol or non-volatile, carbonizable, organic impurities; aldehyde or oak tannin.
Describe the test for the presence of methyl alcohol.
Why was deodorized alcohol dropped?
What uses has alcohol in pharmacy?
What is the composition of diluted alcohol? How much absolute alcohol does it contain? What is its specific gravity?
How is it made?
How may it be made from alcohol of greater than the official strength?
If 55 gallons of alcohol be mixed with 45 gallons of water, how much will the mixture measure?
What is the difference between diluted alcohol and United States proof spirit?
What is the specific gravity of the latter?
What are the uses of diluted alcohol?
Ether—What is its composition? What is its specific gravity?
What is the formula in symbols of ethyl oxide?
What is stronger ether?
How is ether made?
Describe odor, taste, chemical reaction, and solubility.
How may the following impurities be detected?—viz.: Residue; foreign odor; undue amount of alcohol or water; aldehyde.
What are its uses?
How is spirit of ether made? What is the Latin official name?
What is the dose?
Compound spirit of ether—What is the Latin name? Give the synonym.
How is it made?
How may the cheap commercial article be known?
Where castor oil has been used to give it opalescence, how may the fraud be detected?
What is the dose?
What is ethereal oil? What is the Latin official name?
Give description and specific gravity.
How is it made?

What is ethyl-sulphuric acid?
If alcohol is distilled with a large excess of sulphuric acid, what is formed?
What are the physical properties of ethereal oil?
What is its use?
Spirit of nitrous ether—What is the Latin official name? What is its synonym?
Give description and specific gravity.
How much ethyl nitrite does it contain?
Give formula in symbols and molecular weight.
How is it made?
How does the U. S. P. (8th Rev.) process for its preparation differ from that official in the U. S. P. 1890?
Give rationale of process. What is the object of this process?
Pure ethyl nitrite—What is the specific gravity?
Give odor, taste, chemical reaction.
Spirit of nitrous ether—How may its quality be tested?
What impurity is always present and what change results from its presence?
If in considerable proportion, how may it be detected?
Is its specific gravity a reliable test of the amount of ethyl nitrite present? Why?
Is there any reliable test to ascertain its quality?
Describe the official assay method.
Describe the simplified assay method devised by Dr. Squibb.
What is the dose?
Acetic ether—What is the Latin official name?
Give the formula in symbols and molecular weight.
What is probably the best method of making it? Give rationale of process.
Describe odor, taste, chemical reaction, and solubility.
How may the following impurities be detected?—viz.: Butylic and amylic derivatives; undue amounts of water or alcohol; readily carbonizable organic impurities.
What is the dose?
Ethyl chloride—What is the Latin title? Give the chemical name, chemical formula in symbols and molecular weight. How is this liquid preserved and why this precaution? Describe its physical characteristics, odor, taste, and solubility. Give the tests for identity.
How may the following impurities be detected?—viz.: Hydrochloric acid; alcohol; sulphur compounds.
For what is this liquid used in medicine?
Ethyl carbamate—Give the Latin title, chemical formula in symbols, and molecular weight. How can it be made?
Describe appearance, odor, taste, and solubility. What are the tests for identity?
How may the absence of urea and carbamate be determined?
By what name is it commonly known? For what is it used in medicine? Give the dose.
Sulphonmethane—What is the chemical name? What is the common name by which it is known? How is it made?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the impurity of chlorides, sulphates, and readily oxidizable organic impurities be detected? For what is it used and what is the dose?
Sulphonethyl methane—Give chemical name, chemical formula in symbols, Latin title and common name. How is it made?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity and impurities.
For what is it used and what is the dose?
Amyl nitrite—What is the Latin official name?
Give formula in symbols and molecular weight.
What per cent. of absolute amyl nitrite does it contain?
Give description and specific gravity.
How may it be made? Describe rationale of process.
How may the following impurities be detected?—viz.: Free acid; aldehyde; water
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
What is Tanner's process for preparing it?
If strong nitric acid is used, what occurs?
What is the dose?
For what is it used medicinally and in what form?
How is it administered?

CHAPTER LIII

ALDEHYDE, ITS DERIVATIVES AND PREPARATIONS

What is meant by the term aldehyde? (See page 778.) What is the derivation of the word?
What is its chemical composition?
What is produced when 2H is added to aldehyde? What is the dose?
Paraldehyde—Give Latin name, formula in symbols, and molecular weight.
How is it made? Describe appearance, odor, taste, chemical reaction, and solubility. What is the specific gravity? Give the tests for identity.
How may the following impurities be detected?—viz.: Fusel oil; amyl alcohol; hydrochloric acid; free acid; sulphuric acid.
What are its uses and dose?
Solution of formaldehyde—What is the Latin title? What percentage of absolute formaldehyde should this solution contain? How is it made?
Describe appearance, odor, taste, chemical reaction, and solubility. Give the specific gravity. What are the tests for identity?
How may the following impurities be detected?—viz.: Fixed impurities; limit of formic and other acids; chloride; sulphate; iron, lead and copper; calcium.
Describe the assay process.
For what is it used?
Hexamethylenamine—Give the Latin title, chemical formula in symbols, and chemical name.
How is it made?
Describe appearance, odor, chemical reaction, and solubility. Give the tests for identity.
By what common name is it known?
For what is it used? Give the dose.
Hydrated chloral—Give Latin name, formula in symbols, molecular weight, and the U. S. P. 1890 titles.
From what is the name derived?
How is it made? Describe the rationale of the process.
What is the difference in composition between chloral and aldehyde?
Hence, what is its name in systematic nomenclature?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Hydrochloric acid; chlorides.
What is the dose?
Chloralformamide—Give the Latin title, chemical formula in symbols, and molecular weight.
Describe appearance, odor, taste, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Formic, hydrochloric, and other free acids; decomposition products.
By what common name is it known?
For what is it used? Give the dose.
Chloroform—What is the Latin name?
Give formula in symbols and molecular weight. What percentage of absolute chloroform should it contain? How is it made?
What is the object of this process, and how does it act?
What is it termed chemically, and why?
What is the reaction when it is produced by acting on hydrated chloral with an alkali?
What are the reactions occurring when it is made from alcohol and chlorinated lime?
What are the identity tests of the U. S. Pharmacopœia?
Describe odor, taste, chemical reaction, and solubility.
How may the following impurities be detected?—viz.: Chloride; free chlorine; impurities decomposable by sulphuric acid; odorous decomposition products; chlorinated decomposition products.
By what process may it be purified?
What are its uses in medicine? What is the dose?
What are its official preparations?

Bromoform—Give the Latin title, chemical formula in symbols, and molecular weight.
What percentage of absolute bromoform should it contain? How may it be made?
Describe appearance, odor, taste, and solubility. What is the specific gravity? Give tests for identity.
How may the following impurities be detected?—viz.: Free acid; bromides and brominated compounds; free bromine; acetone.
For what is it used? In what dose?
Iodoform—What is the Latin name?
Give formula in symbols and molecular weight.
What is Filhol's process for making it? What is the rationale of the process?
Describe odor, taste, chemical reaction, and solubility. What are the tests for its identity? What is the dose?
How may the following impurities be detected?—viz.: Fixed impurities; soluble yellow coloring matter, picric acid, etc.; free acids; soluble iodides.
For what is it used in medicine?
What is the dose? What preparation of it is official?
Iodol—Give the Latin title, chemical formula in symbols, molecular weight, and chemical name. How is it made?
Describe appearance, odor, taste, and solubility.
How may the following impurities be detected?—viz.: Inorganic impurities; hydriodic acid or soluble metallic iodides; free iodine.
For what is it used medicinally? Give the dose.

CHAPTER LIV

PRODUCTS OF THE ACTION OF FERMENTS UPON ACID SACCHARINE FRUITS

What is white wine? (See page 790.) Describe it and give its specific gravity.
What is red wine? Describe it and give its specific gravity. What is must?
How is wine made?
What is meant by the following terms as applied to wines?—viz.: Sweet, dry, light, strong or generous, sparkling, still, sour, rough.
What kinds of wine are official?
Describe odor, taste, chemical reaction, and solubility. How may the alcoholic strength of wine be ascertained?
How much alcohol should wine contain?
White wine—How may the following impurities be detected?—viz.: Free acid; tannic acid; saccharin; salicylic acid.
Red wine—How may the following impurities be detected?—viz.: Free acid: red aniline color; acid fuchsine; saccharin; salicylic acid.
What is the aroma of wines termed, and upon what does it depend?
What ethers are said to be formed in wines?
What is meant by argol?
What is the difference between red and white argol?
Why is argol deposited during the clarification of wine?
What salt is obtained from argol?
What are the uses of wine?
What alcoholic strength is required of wine for pharmaceutical purposes?
How is it obtained, and why is it required?
Brandy—What is the Latin official name? What is its official definition?
Describe the best kind.
What kind of brandy is recognized by the U. S. Pharmacopœia?
How much alcohol should brandy contain?
Give description and specific gravity. Describe odor, taste, and chemical reaction.
How may the following impurities be detected?—viz.: Fusel oil from grain or potato spirit; added sugar; glycerin and aromatic substances; traces of oak tannin from casks; free acid.
To what does brandy owe its aroma?
What is œnanthic ether chemically, and what is its commercial name?

Is any preparation of brandy official?
What is its medicinal use?
Tartaric acid—What is the Latin name? Give formula in symbols and molecular weight.
How is it prepared? Describe rationale of process.
What is its quantivalence?
Does it contain water of crystallization?
What tartrates are official?
How may they be recognized?
How may tartaric acid be recognized? Describe rationale of test.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Sulphuric acid; oxalic acid; calcium; heavy metals.
What official preparations contain tartaric acid?
Lemon juice—What is the Latin title and from what source is it obtained?
To what does lemon juice owe its acidity?
How much acid should it contain?
What should be its specific gravity?
Citric acid—What is the Latin name? Give formula in symbols and molecular weight.
How is this acid obtained commercially? Describe rationale of process.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Calcium; heavy metals; sulphuric acid.
How much water of crystallization does it contain?
What is its quantivalence? What citrates are official and what other official preparations contain citric acid?
What is the dose?
What is tamarind?
What acids are contained in the pulp of tamarinds?
For what is it used?
Rhus glabra—Give origin and description.
To what does it owe its acidity?
How may malic acid be obtained from it?
What is the quantivalence of malic acid?
For what is rhus glabra used, and what is the dose?
What official preparation is there of it?
What is pectase, and what is pectose?
To what substance do green (unripe) fruits owe their hardness?
In the ripening of fruits, what change takes place whereby the fruits are rendered soft?
When fruit is over-ripe, what substances are produced?
How is the formation of fruit jellies explained?
What action do alkalies have upon pectosic acid and pectin?
Give an illustration of the application of this principle.
Fruit juices—What are these used for?
How may they be prepared?

CHAPTER LV

VOLATILE OILS

What are volatile oils, and whence are they obtained? (See page 800.)
What other term is applied to these oils?
Into what four classes may they be divided?
What are the characteristics of terpenes?
Give the chemical formula and mention a typical oil.
What are the characteristics of oxygenated oils?
Mention a typical oil.
What are sulphurated oils? Mention an example.
What are the characteristics of nitrogenated oils? Mention an example.

Enumerate some of the constitutents found in volatile oils. Mention several synthetic products which are chemically identical with volatile oils.
Of what two principles do volatile oils proximately consist?
How may they be separated?
Why are some stearoptens called camphors?
What is the color of most volatile oils when pure?
What effect does exposure to air have upon the color?
What is the most characteristic feature of volatile oils?
In what manner does the taste of volatile oils vary?
What variation exists in the specific gravity of volatile oils?
What are good solvents of volatile oils, and of what substances are they solvents?
What effect does exposure to light and air have on them?
How should they be kept?
What effect does strong nitric acid have upon them?
What effect does strong iodine have upon them?
How are they affected by alkalies?
How may their adulteration with fixed oils be detected?
How may the presence of alcohol be detected?
How may the presence of inferior qualities of the same kind of oil be detected?
In what ways are volatile oils obtained from plants?
What is the method most frequently employed?
What is the general formula for this process?
How should dried substances be treated before being subjected to distillation?
What purposes does water serve in distilling vegetable substances along with it?
When vegetable substances contain volatile oils which do not readily distil at the temperature of boiling water, how are they treated?
Where oils are injured by heat, and it is desirable to distil them at as low a temperature as possible, how may the distillation be accomplished?
What will be the effect where too much water is used?
What will be the effect where not enough water is used?
What is the process known as cohobation?
How may oils be freed from the disagreeable odor which they are apt to have when first procured?
When altered by exposure to air, how may they be partially restored to their former quality?
What is meant by distillation "per se"?
In what cases and for what reason is this used?
Expression—Is this a good method of obtaining oils?
What is the principal objection to it?
What is meant by the process of solution or absorption?
How is the process of maceration conducted?
How is the process of digestion conducted?
What is the process known as enfleurage?
How is the "pneumatic process" conducted?
How are oils prepared by the "percolation process"?
Bitter orange peel—Give the Latin official name. Whence is it obtained?
What principles does it contain? What is the dose?
What are official preparations of it?
Sweet orange peel—Give the Latin name. Whence is it obtained?
To what does it owe its virtues, and for what is it used?
What are the official preparations of it?
Oil of orange peel—Give the Latin official name. How is it obtained?
What is its composition? Give description and specific gravity.
How may an impurity of oil of turpentine be detected?
Describe the assay.
For what is it used?
What preparation of this oil is official?
What is lemon peel, and for what is it used?
What does it contain?
Oil of lemon—What is the Latin official name? How is it obtained?
Describe an "ecuelle" and illustrate its use.
What is its chemical composition? Give description, specific gravity, and tests for identity.
How may it be preserved from the effects of oxidation?

Describe the assay for citral.

Mention two volatile oils from the Rutaceæ, official in the U. S. P. 1890, and state their source.

Peppermint—What is the Latin official name? What part of the plant is official?

To what are its properties due?

Oil of peppermint—What percentage of ester and what percentage of menthol should be present in this oil? Give Latin name, description, odor, taste, chemical reaction, specific gravity, solubility and tests for identity.

What are the official preparations of oil of peppermint?

Menthol—Describe odor, taste, chemical reaction, and solubility. What are the tests for identity?

How may the following impurities be detected?—viz.: Wax, paraffin, or inorganic substances; thymol.

For what is it used?

Spearmint—What is the Latin official name? To what does it owe its properties?

What is the yield of volatile oil?

Oil of spearmint—Describe odor, taste, solubility, and tests for identity.

Give its specific gravity.

What does it contain? For what is it used?

What are the official preparations of it?

Oil of lavender flowers—What is the Latin name? Describe appearance, odor, taste, and solubility.

What is its specific gravity?

What preparations of it are official?

How may the presence of alcohol be detected?

Where does the best quality come from?

Oil of rosemary—What percentage of ester and what percentage of borneol should it contain? What is the Latin name? Give description and specific gravity.

Give the tests for identity. Describe the assay.

Of what does it consist?

In what preparations is it used?

Hedeoma—What is its synonym? Give description. Where does it come from?

To what does it owe its virtues?

What are its medicinal properties?

Oil of hedeoma—What is the Latin name? What is the synonym? Give description, specific gravity, and tests for identity. What is its solubility? What is the dose? For what is it largely used?

Marrubium—What is its synonym? What part of the plant is official? Describe the herb.

What does it contain?

What are its medicinal properties?

Oil of thyme—What is the name of the herb?

What percentage of phenols should be present?

By what name is this oil known commercially?

What is the difference between the red oil and the white oil?

Does this oil vary in composition?

Of what does the more volatile portion consist? What is the less volatile portion?

What is the formula in symbols of the latter?

In what other oil is this substance found?

Give description and specific gravity. Describe the odor, taste, chemical reaction, and solubility.

Give tests for identity. How may an impurity of phenol be detected? Describe the assay.

For what purpose is oil of thyme used?

Salvia—What is its synonym? What part of the plant is official?

Of what does its volatile oil consist?

For what is it used?

Scutellaria—What is the name of the plant from which it is derived?

What is its synonym? What does it contain? For what is it used?

What official preparation is made of it?

Mention other plants of the Labiatæ.

Caraway—What is the official Latin title? From what plant is it derived?

What does it contain? What are its medicinal properties?

Oil of caraway—What is its specific gravity? Describe the odor, taste, chemical reaction, and solubility. Of what does it consist? For what is it used? Give the dose.
Fennel—What is the Latin name? From what plant is it derived?
What does it contain? For what is it used?
Oil of fennel—What is its specific gravity? Describe odor, taste, chemical reaction, and solubility. Give tests for identity. How may the presence of other volatile oils containing phenols be detected? Of what does it consist?
What official preparation is made of it?
Coriander—Whence is it derived?
How much volatile oil does it yield?
How much fixed oil does it yield?
Oil of coriander—What is its specific gravity?
Describe odor, taste, chemical reaction, and solubility. Give the test for identity.
What is its chemical composition?
For what is it used?
Sumbul—From what plant is it derived?
What is the synonym?
What does it contain, and for what is it used?
What official preparation is made of it?
Anise—From what plant is it derived?
Describe the appearance and characteristics.
How may the presence of conium be detected?
What does it contain? For what is it used?
Oil of anise—From what plants is it obtained?
Are these products identical? What is its specific gravity?
Describe odor, taste, chemical reaction, and solubility.
What are the tests for identity? How may the following impurities be detected? —viz.: Oil of fennel; petroleum; most fixed oils and oil of turpentine; some volatile oils containing phenols; alcohol.
Of what does it consist?
What is the chief constituent and in what other oils is the same substance found?
What preparations of it are official and in what other official preparations is it an ingredient?
Saigon cinnamon—Give the Latin official name.
What is the source of Saigon cinnamon?
How is it officially described?
Ceylon cinnamon—Give the Latin official title. What is its source?
How is it officially described?
To what does cinnamon bark owe its virtues?
What other constituents are present?
Into how many official preparations does Saigon cinnamon enter?
In what one is it the sole active ingredient?
Oil of cinnamon—What is the official Latin title? By what other English title is it known? What percentage of cinnamic aldehyde should it contain?
Has the oil from Ceylon cinnamon any advantage over the official oil of Cassia?
Describe appearance, odor, taste, and solubility. What are the specific gravity and tests for identity?
How may the following impurities be detected?—viz.: Lead and copper; petroleum and rosin.
Describe the assay for cinnamic aldehyde.
Give chemical reaction, specific gravity, solubility; percentage of cinnamic aldehyde and eugenol and congealing point of oil of Ceylon cinnamon.
In what respect does the oil of cassia differ from oil of Ceylon cinnamon?
Of what does oil of cinnamon consist?
When slightly oxidized what is produced?
Upon further oxidation what is produced?
Why is cinnamon water made from Ceylon cinnamon cloudy?
What official preparations are made from it?
Cinnamic aldehyde—What is the official Latin title?
Give chemical formula in symbols and molecular weight.
What is the synonym? How may it be obtained?
Give description, odor, taste, specific gravity, solubility, and tests for identity.
How may an impurity of chlorinated products be detected? Describe the assay.

For what is it used? Has it any advantage over oil of Cassia? What is the dose?
Cloves—What is the Latin name? What are cloves?
What two crystallizable principles do they contain?
What other constituents do they contain?
For what is it used? In which official preparation does it enter?
Oil of cloves—What percentage of eugenol should it contain? What is the Latin name?
Give description, odor, taste, specific gravity, solubility and tests for identity.
How may phenol as an impurity be detected?
Describe the assay for eugenol.
Of what does the oil of cloves consist?
How may these oils be separated?
What combination is formed when oil of cloves is mixed with a concentrated solution of potassium hydroxide?
What is the composition and specific gravity of light oil of cloves?
Heavy oil of cloves—Give description and specific gravity.
What is its boiling-point?
Of what does it consist, and what effect does it have on alkalies?
Into what principle may eugenol be converted?
What is its use and dose?
Eugenol—What is the natural source and how is it separated?
Give description, odor, taste, specific gravity, solubility, and tests for identity.
How may phenol, as an impurity, be detected?
For what is it used? Give the dose.
Pimenta—What is the Latin official name? What is the synonym? How is it officially described?
How much volatile oil does it contain? What else does it contain?
Oil of pimenta—What is the synonym? What percentage of eugenol should it contain? Describe the assay for eugenol. What is its specific gravity?
Describe odor, taste, chemical reaction, and solubility.
Of what does it consist?
For what is it used?
Vanilla—Whence is it obtained?
What are its constituents?
Considered chemically, what is vanillin?
How is the agreeable odor and taste of vanilla bean developed?
What official preparation is made from vanilla?
Vanillin—What is the chemical formula in symbols and chemical name? What are the sources and how is it made artificially?
Is the flavor of vanillin equal to that of the natural vanilla bean?
With what substances has it been adulterated?
Give description, odor, taste, chemical reaction, solubility, and tests for identity and impurity.
For what is it used? Give the dose.
Oil of cajuput—From what is it obtained?
What percentage of cineol should it contain?
Describe odor, taste, and chemical reaction.
What is its composition, and what is it termed chemically?
What is its solubility? Its specific gravity?
To what is its green color due?
Give tests for identity and for the presence of copper as an impurity.
Describe the assay for cineol.
For what is it used? Give the dose.
Eucalyptus—From what tree is it obtained? How is it described?
What are its constituents?
Upon which of these do the virtues depend?
What are its properties?
What official preparation is made from it?
Oil of eucalyptus—Whence is it obtained? What percentage of cineol should it contain? What is another name for cineol? Describe the assay for cineol.
Give tests for identity and impurity. What is its specific gravity?
Describe odor, taste, chemical reaction, and solubility.
Of what does it consist?
Eucalyptol—Give chemical formula in symbols, and synonyms?

What is it chemically and from what source is it obtained?
At what temperature does it congeal or form crystals?
Give description, odor, taste, specific gravity, solubility, tests for identity, and tests for phenol as an impurity.
For what is it used? Give the dose.
Myristica—What is it? What is the common name?
How is myristica officially described?
To what does it owe its activity?
How much fixed oil does it contain?
In how many official preparations is it found? Name them.
Oil of myristica—What is the Latin name? What is the synonym?
Give description, odor, taste, specific gravity, solubility, and tests for identity.
Of what does it consist?
Expressed oil of nutmeg?—What is this usually called?
How is it made? What is its chemical composition?
What official preparation is made from oil of myristica?
Sassafras—What is its source? How is it described officially?
What are its constituents?
For what is it used, and into what preparations does it enter?
Oil of sassafras—Describe it. What is its specific gravity?
Describe odor and taste. Give tests for identity.
What action does nitric acid have upon it?
Where is it largely produced, and what is the yield?
Of what does it consist?
Safrol—What is the chemical formula in symbols? What is it chemically? What are its natural sources and how is it obtained?
Give description, odor, specific gravity, solubility and tests for identity. For what is it used?
Oil of gaultheria—What is the Latin name? What is the synonym?
What is the official definition?
Of what does it consist?
What action does concentrated solution of sodium or potassium hydroxide have upon it?
Give description, odor, taste, specific gravity, and tests for identity.
To what is its reddish color due?
How may its adulteration with chloroform or alcohol be detected?
How may the presence of oil of sassafras be detected?
What official preparation is made from it?
Into which official preparation does it enter?
For what is it used medicinally?
Oil of Betula—What is the Latin official title? What was the Latin title in the U. S. P. 1890? What is the synonym? What is its source? In what respect does it differ from oil of gaultheria?
Methyl salicylate—What is its chemical formula in symbols? What is the Latin official title? What was the title in the U. S. P. 1890? What are its synonyms?
What is its natural source? How is it made synthetically?
Give description, odor, taste, chemical reaction, specific gravity, solubility, tests for identity and tests for impurities.
Calamus—What is its synonym? What is the official definition and description?
What are its constituents?
What are its properties and use?
What official preparation is made from it?
Cardamom—Give the Latin name.
What is the official definition? Frow what country is it imported?
What do the seeds contain? What is the specific gravity of the volatile oil?
How is it usually made?
When made in this way, is it pure?
Of what two preparations is it the principal ingredient?
Into what other official preparations does it enter?
Ginger—What is its Latin official title? Give the official definition and description. To what does it owe its virtues?
How much volatile oil does it contain?
What are the official preparations of it? In what dose is it administered?
Camphor—What is the Latin name? Give the chemical formula in symbols and the molecular weight.

What is camphor?
How is refined camphor usually made?
What is compressed camphor? What is its specific gravity?
Describe odor, taste, and solubility.
Give its identity tests.
What occurs if camphor is triturated with menthol, thymol, phenol, hydrated chloral, etc.? Give the test for the presence of chlorinated products.
What is the dose?
What are the official preparations of camphor and in what other official preparations is it an ingredient?
Camphoric acid—Give Latin title, chemical formula in symbols, and official definition. How is it made?
Give description, odor, chemical reaction, solubility, tests for identity, and tests for impurity.
For what is it used medicinally? Give the dose.
Monobromated camphor—Give Latin name, formula in symbols, and molecular weight.
Describe a process for making monobromated camphor.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
For what is it used medicinally?
What is the dose?
Bitter almond—What is the Latin name? What is the source of bitter almond? Give the official definition and description.
What is the result when it is triturated with water? What does it contain?
Into what is amygdalin decomposed in the presence of water? Give the reaction which takes place.
For what is bitter almond used?
Oil of bitter almond—Give Latin official name.
What percentage of benzaldehyde should this oil contain? What amount of hydrocyanic acid?
Does this oil pre-exist in the almond?
Why can it not be obtained from sweet almond?
How is it made? Describe rationale of process. Give description, odor, taste, reaction, specific gravity, solubility and tests for identity.
How may the following impurities be detected?—viz : Chlorinated products; artificial oils containing chlorinated products.
Describe the assay for benzaldehyde; for hydrocyanic acid. For what is this oil used?
What precaution must be taken in its use? Give the dose.
Name the official preparations made from this oil.
Benzaldehyde—Give the Latin official title, the chemical formula in symbols, the synonym.
What percentage of pure benzaldehyde should it contain? How may it be made?
Does this substance contain hydrocyanic acid? What is nitrobenzol? For what is nitrobenzol used?
Is it in any way identical with benzaldehyde?
Give description, odor, taste, specific gravity, solubility, and test for identity.
How may the following impurities be detected? viz.: Hydrocyanic acid; chlorinated products. Describe the assay. For what purpose is benzaldehyde used?
Wild cherry—What is the Latin name? Of what tree is this the bark?
When should it be collected?
What does it contain?
Why should the preparations of wild cherry be made without heat?
What are its properties?
What official preparations are made from it?
Diluted hydrocyanic acid—What is the Latin name? What is its synonym?
How much absolute hydrocyanic acid should it contain?
How is it made officially? How may its strength of 2 per cent. be tested?
How may it be identified? Give appearance, odor, taste, and reaction. Should it be tasted?
What is cyanogen? Does it exist ready formed in nature?
Combined with hydrogen, what does it form?
Combined with metals and bases, what are formed?
What is Scheele's hydrocyanic acid?
When hydrocyanic acid is decomposed upon keeping what substance is formed?

How may its decomposition be prevented or lessened? What is the dose?
What is the effect of prescribing cyanide of potassium in combination with an acid?
White mustard—What is the Latin name? Give the official definition and description. What does it contain?
Under the influence of myrosin and water, into what substances is sinalbin decomposed?
Is this volatile oil the official oil of mustard?
What are the other constituents of white mustard?
Does it contain starch? For what is it used? What is the emetic dose?
Black mustard—What is the Latin name? Give the official definition and description. What does it contain?
Under the influence of myrosin and water, into what is potassium myronate converted?
Does this action take place at ordinary temperatures?
What official preparation is made from black mustard?
Volatile oil of mustard—What is the Latin name? What percentage of allyl isothiocyanate should it contain? How is it obtained?
What is this oil chemically considered?
How is it prepared artificially? Give description and specific gravity.
Describe odor, taste, and solubility.
Give the test for identity.
How may the following impurities be detected?—viz.: Alcohol, chloroform, petroleum, fatty oils, or more than traces of carbon disulphide; phenols.
Describe the assay for allyl isothiocyanate.

CHAPTER LVI

OFFICIAL DRUGS AND PRODUCTS CONTAINING VOLATILE OIL WITH SOFT RESIN

Pepper—(See page 841.) Give the Latin name. What is its synonym? Give the official definition and description. What does it contain?
How much volatile oil, and what is its composition?
What is its principal use?
What official preparation is made from it?
Piperine—Give the Latin name and formula in symbols. What is piperine?
How is it prepared?
What effect is produced upon it by alkalies in alcoholic solution?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
What are its properties, and upon what do its virtues depend?
Matico—Whence is it obtained?
What do the leaves contain? What are its properties?
What official preparation is made from it?
Cubeb—What is the Latin official name?
Give the official definition and description.
What does it contain? Upon what do its virtues depend?
Is cubebin active? What effect does strong sulphuric acid have upon cubebic acid, cubebic resin, and cubebin?
What are its medicinal properties?
What official preparations are made from it?
Oil of cubeb—What is the Latin name? What is the specific gravity?
Describe odor, taste, chemical reaction, and test for identity.
What are the constituents of this oil?
What is sometimes deposited upon standing?
What are the medicinal properties of the oil and the dose?
Capsicum—What is its synonym? What is capsicum?
Give the official description.
What are its principal constituents?
What are the properties of capsaicin?
What are the medicinal properties of capsicum?
What official preparations are made from it?

Copaiba—What are its synonyms? What is copaiba?
Where does it come from? What are its constituents?
What is the composition of copaivic acid?
How may it be obtained pure?
Give description and specific gravity.
Describe appearance, odor, taste, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Gurgun balsam; paraffin oils; fixed oils; limit of resin.
For what is copaiba used medicinally?
What is the dose?
Oil of copaiba—How is it obtained? What is its specific gravity?
Describe odor, taste, and test for identity.
Of what does it consist? What is the dose?
Oil of santal—What is its synonym? What percentage of alcohols, calculated as santalol, should it contain? How is it obtained?
What is its specific gravity? Describe appearance, odor, taste, chemical reaction, and solubility.
Give the tests for the detection of the following impurities: Other varieties of sandalwood oil; chlorinated products.
Describe the assay for santalol. For what is it used medicinally?
What is its chemical composition? What is the dose?
Buchu—Whence derived?
Give the official description.
What are its constituents, and to what does it owe its valuable properties?
What stearopten does it contain, and how is this acted upon by ferric chloride?
What are its medicinal properties? Name the official preparation.
Serpentaria—What is its synonym? What is this defined to be?
Describe the difference between the Virginia and Texas serpentarias.
What are its constituents? How may its virtues be extracted?
Into what official preparations does it enter?
Hops—What is the Latin name? What are hops? Give the official description.
To what do they owe their virtues?
Lupulin—What is the Latin name? What is lupulin? Give the official description.
What are the constituents of lupulin?
What change takes place in the volatile oil on exposure?
What is the bitter principle and its chemical composition?
What are the best solvents for lupulin? Name the official preparations.
Indian cannabis—What is the Latin name? What is its synonym?
What is its definition and description? What are its constituents? What is its best solvent?
What are its properties? What are its official preparations?
Valerian—Give the official definition and description. What are its constituents?
What are good solvents for its active principles?
For what is it used? What are its official preparations?
Viburnum opulus—What is the synonym?
Give the official definition and description.
What is the dose? Name the official preparation.
Viburnum prunifolium—What is its synonym? What is its source? What part of the plant is used?
What are its constituents?
What is the best solvent for its active principles?
What are its properties and uses? Name the official preparation.
Oil of chenopodium—What is its synonym?
What is the source of oil of chenopodium?
Describe odor and taste.
Of what does it consist? For what and how is it used?
Oil of juniper—What is the official definition?
Describe odor, taste, and chemical reaction.
What is its chemical composition?
What are its medicinal properties?
What are its official preparations?
Savine—What is the Latin name? What is its definition and description?
What does it contain? What is its best solvent?
What is its official preparation?

Oil of savin—What is the Latin name?
Give the definition, odor, taste, specific gravity, solubility, and test for identity.
What is its composition? What is the dose? Should it be dispensed cautiously?
Arnica—What were the Latin and English titles official in the U. S. P. 1890?
Give the official definition and description. What do these flowers contain?
What is the bitter principle? What are good solvents?
What is its official preparation?
Calendula—What is its synonym? What is its definition?
What does it contain? Is calendulin the active principle?
What is the official preparation?
Oil of erigeron—What is the Latin name? What is the synonym?
Whence is it obtained? What is the specific gravity?
Describe appearance, odor, taste, chemical reaction, solubility, and test for identity.
Of what does it consist? What is its use, and how is it best administered?
Anthemis—What are its synonyms? What is its definition and description?
To what does it owe its virtues?
What is the name of the bitter principle?
For what and how is it generally used?
What is the color of the volatile oil?
Matricaria—What is its synonym? Whence is it derived? Give the official description. Mention the source of similar flower-heads and wherein they differ from the official variety.
What are its constituents? What is the name of the bitter principle?
What are its medicinal properties?
Eupatorium—What are its synonyms? What is its definition and description?
What are its constituents? What are good solvents?
What are its medicinal properties? What is the official preparation?
Grindelia—What is its definition and official description?
What does it contain? What is its best solvent?
What is its official preparation?
Mezerum—What is its definition and description?
What does it contain? What is its best solvent?
How is it generally used medicinally? What is the dose?
What is its official preparation?
Aspidium—What is its synonym? What is its definition and description?
What should be the color of the rhizome, internally? What should be the color of the powdered drug?
What are its constituents? For what is it used?
What part of the rhizome is active? What are its official preparations?
Cypripedium—What is its synonym? What is its definition and description?
What are its constituents? What is a good solvent?
What is the dose? What is the official preparation?
Phytolacca—What is the Latin name? What is its synonym and what was its Latin title in the U. S. P. 1890?
Whence is it derived?
What are its constituents? What are its uses and dose?
Zea—What is its synonym? Give the official definition and description. What constituents are present?
Give its medicinal use and dose.
Stillingia—What is its synonym? Whence is it derived? What is the official description? What does it contain?
What is the dose? What is its official preparation?
Pyrethrum—What is its synonym? Whence is it derived? What is the official description?
What does it contain? What is the dose? What is the official preparation?
Xanthoxylum—What is its synonym? Whence is it derived? What is the official description?
What are the distinguishing characteristics of the Northern and Southern prickly ash?
What are its constituents, and to what does it owe its virtues?
What is the dose? What is the official preparation?
Sabal—What is its synonym? Give the official definition and description. What are its constituents?
Give its medicinal uses and dose?

Cimicifuga—What are its synonyms? What is its definition? What is the official description?

What does it contain? What is the dose? What are the official preparations?

Apocynum—What is the synonym? Whence is it derived? What is the official description?

What does it contain? What is a good solvent? What is the dose?

Lactucarium—What is it? Give the official description. What does it contain?

What is the chemical composition of the bitter resinous principle?

What are the properties of lactucic acid?

What are the properties of lactucopicrin?

What are the properties of lactucerin?

Which of these principles is in the largest proportion?

What is the dose? What are its official preparations?

CHAPTER LVII

RESINS, OLEORESINS, GUM RESINS, AND BALSAMS

What are resins, and how are they characterized? (See page 859.) What are they chemically?

What are natural oleoresins? What are gum resins? What are balsams?

Terebinthina—What is its English title? What is its definition?

What does it contain? Give the description, odor, taste, and chemical reaction.

For what is it used in pharmacy? What is the dose?

Oil of turpentine—What is the Latin name?

What is its chemical composition? What is its specific gravity?

Describe odor, taste and solubility.

Give the tests for identity. How may the following impurities be detected?—viz.: Petroleum, paraffin oils or rosin; kerosene or rosin oil; petroleum benzin or similar hydrocarbons.

For what is it used medicinally?

What are its official preparations?

Rectified oil of turpentine—What is the Latin official title? How is oil of turpentine rectified? Give the details of the process.

Give description, specific gravity and test for identity. For what is it used internally? Give the dose. Name the official preparation.

Terebene—Give the Latin title. How is this substance made?

Give the description, odor, taste, specific gravity, solubility, and tests for identity.

How may the following impurities be detected?—viz.: Acids; unaltered oil of turpentine; more than traces of resinous substances.

For what is it used medicinally? Give the dose.

Terpin hydrate—Give the Latin title and chemical formula in symbols. What is this substance chemically? How may it be made?

Give description, odor, taste, chemical reaction, solubility, and tests for identity.

For what is it used medicinally? Give the dose.

What are its officinal preparations?

Rosin—What are its synonyms? Whence obtained? Give the official description.

Of what does rosin consist?

What change takes place in it when treated with diluted alcohol?

What is its specific gravity?

Describe odor, taste, solubility.

Give melting point and acid number.

For what is it used? What are its official preparations?

Canada turpentine—Give Latin official name. What are its synonyms?

What is it? What does it contain?

Describe appearance, odor, taste, solubility and tests for identity.

For what purposes is it used?

Mastic—What is the Latin name? Whence is it derived? Give the official description.

What does it contain? For what purposes is it used?

Asafetida—What is the Latin official name? What is its definition? Give the official description.
What does it contain?
What does this volatile oil contain.
What does the resin yield by treatment with potassium hydroxide?
What does it yield by dry distillation?
What is the best solvent for its valuable principles?
Will water extract its virtues? How? What is the dose?
What are its official preparations.
Myrrh—Whence is it obtained? Give the official description.
What does it contain? What are its active principles?
What is its best solvent? For what can the gum left after macerating myrrh in alcohol be used? Mention the official preparations in which it is an ingredient.
What is the dose? What is its official preparation?
Elastica—What is the English title? What is the synonym? Give the official definition. For what is rubber used pharmaceutically?
How is "soft rubber" obtained? How is "hard rubber" obtained?
Give description, odor, taste, solubility, and test for identity.
Guaiac—What is the Latin name? What was the Latin title official in the U. S. P. 1890? How is this resin prepared?
Give the official definition and description for this resin. What should be the color of the powder? What change occurs if it is exposed to the air?
Give the solubility in alcohol, acid number, and amount of ash.
What effect does tincture of ferric chloride have upon an alcoholic solution?
How may an impurity of rosin be detected?
Of what does it consist? What are the best solvents for guaiac?
Why is a solution of guaiac colored blue by oxidizing agents?
What is the dose? What are the official preparations?
Balsam of tolu—What is the Latin name? Whence is it obtained?
What does it contain?
Give the description, odor, taste, and solubility. How may the following impurities be detected?—viz.: Resin; rosin and copaiba; limit of acidity; limit of saponifiable substances.
What are its medicinal properties? What are its official preparations?
Balsam of Peru—What is the Latin name? Whence is it obtained?
What does it contain?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity and specific gravity.
How may the following impurities be detected?—viz.: Fixed oils; rosin; turpentine, storax, fatty oils, etc.; copaiba. Describe the quantitative test.
For what purposes is it used?
Benzoin—What is the Latin name? Whence is it obtained?
Give the description and characteristics of Siam Benzoin. Of Sumatra Benzoin.
Give the solubility, chemical reaction and amount of ash.
What does it contain? What is its best solvent?
What is the dose? What are the official preparations?
Storax—What is the Latin name? Whence is it obtained?
What does it contain? Give description, odor, taste, solubility and tests for identity. Into what preparations does it enter?
What are its medicinal properties? For what is it used?
Benzoic acid—Give formula in symbols, molecular weight, and Latin name.
Where is it found, and how may it be obtained?
How is it prepared artificially from urine? What is the rationale of the process?
How is this acid sometimes treated to disguise its odor?
How is it made from naphthalene? What is the rationale of the process?
How is it made from toluene?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Readily carbonizable organic matters; more than traces of chlorine; cinnamic acid. For what is it used medicinally? What is the dose?
Benzosulphinide—Give Latin title, the other English title, synonyms; chemical formula in symbols and chemical name. What is it chemically? How is it made?

Give description, odor, taste, solubility and tests for detecting the following impurities: Inorganic impurities; carbohydrates; glucose; milk-sugar; benzoic or salicylic acids. For what is it used? Give the dose.
What are eclectic resinoids, and how are they usually prepared?
Are they the active principles of the drugs from which they are prepared?

CHAPTER LVIII

FIXED OILS, FATS, AND SOAPS

Fixed oils and fats—(See page 871.) Whence are they obtained?
What are their general properties; solubilities, color, odor, taste, consistence, etc.?
What is their specific gravity?
What change takes place upon exposure to air?
How may oils which have become rancid often be purified?
What are fixed oils and fats, chemically?
In most cases, of what do they consist?
What are these proximate principles sometimes termed?
To what is the consistence of fixed oils and fats due?
Why is almond oil liquid and tallow solid at ordinary temperatures?
Chemically considered, what is olein? What is its formula in symbols?
How may it be obtained?
What are the physical properties of olein?
How does palmitic acid occur?
Chemically, what is palmitin?
Stearin—Where is it found, and how is it made?
How may it be obtained pure? Describe odor, taste, and chemical reaction.
What is its melting point?
Of what does it consist, and how has it been formed synthetically?
Margarin—What has the substance long known under this name been shown to be?
How has margaric acid been obtained?
Stearic acid—What is the formula in symbols?
Give description, melting point, and solubility. For what is it used?
Palmitic acid—What is the formula in symbols?
What is its form? Its melting point?
Oleic acid—What is the formula in symbols?
Give description, solubility, odor, and taste.
At what temperature does it crystallize?
Sweet almond—What is the Latin name? What does it contain?
How does the fixed oil form an emulsion by simple trituration of the almond with water? What is its official preparation?
Expressed oil of almond—What is the Latin name?
Whence and how is this oil obtained?
How much oil does sweet almond yield?
How much oil does bitter almond yield?
How may a colorless oil be obtained?
What is its specific gravity? Describe appearance, odor, taste, solubility, and tests for identity. Of what does it principally consist?
At what temperature does it congeal?
How may it be distinguished from most other fixed oils?
What is its saponification value?
What is its iodine value? How is this figure obtained?
What is its synonym? Into which official preparations does it enter?
For what is it used?
Olive oil—Whence is it obtained?
Is commercial olive oil believed to be usually pure?
Can its purity be ascertained easily? What is its specific gravity?
Describe appearance, odor, taste, solubility, and tests for identity.

How may the following impurities be detected?—viz.: Appreciable quantities of cottonseed oil and most other seed oils; more than about 5 per cent. of cotton seed oil; cotton seed oil; sesame oil. Give its saponification value and iodine value.

What are its uses?

Cotton seed oil—Whence is it obtained, and where is it made?

How much oil does cotton seed contain? What is its specific gravity?

Describe appearance, odor, taste, solubility, and tests for identity.

At what temperature does it begin to congeal?

Give its saponification value and iodine value.

For what is it used?

Linseed oil—What is the Latin name? What is its synonym?

How is it prepared?

Of what does it consist?

To what does it owe its drying property? What is its specific gravity?

Describe appearance, odor, taste, chemical reaction, and solubility.

At how low a temperature does it remain liquid?

How may the following impurities be detected?—viz.: Non-drying oils; mineral oils and rosin oils; rosin or rosin oils. Give its saponification value and iodine value.

What is the dose?

Pumpkin seed—What is the Latin official name? Whence is it derived? What is the official description?

What are its constituents?

For what is it used, and in what form?

How is the fixed oil obtained?

Castor oil—Whence is it derived?

In what four ways has castor oil been obtained?

Which method produces the best oil?

What principles does castor oil contain?

To what is the purgative action due? How is this shown? What is the saponification value and the iodine value?

What is the specific gravity?

Describe appearance, odor, taste, solubility, tests for identity, and test for the absence of foreign oils.

What is the dose?

Croton oil—What is the Latin official name? Whence is it derived?

How is it prepared? What is the specific gravity?

Describe appearance, odor, taste, chemical reaction, solubility, tests for identity, and the absence of other non-drying oils.

What is its saponification value and iodine value?

What effect does it produce when applied to the skin?

Have the active principles been isolated?

What acids have been detected as having been formed by the decomposition of the fatty substances present?

What is the chemical composition of crotonol?

What is the dose?

Oil of theobroma—What is the Latin name? What is its synonym?

Whence is it derived? How is it made? What is the yield of oil?

Describe appearance, odor, taste, and chemical reaction. What are its melting point, solubility, and specific gravity?

Give the test for identity. How may the following impurities be detected?—viz. Wax, stearin, tallow, etc. Give the saponification value and iodine value.

What are its chemical constituents?

For what is it used?

Lycopodium—What is lycopodium? Give the official description.

What does it contain? What are its uses?

Oleic acid—What is the Latin name?

Give the formula in symbols and molecular weight.

How is it obtained?

What is "red oil"? What is the specific gravity?

Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Fixed oils; notable quantities of palmitic or stearic acid?

What are its uses? Why is it especially useful?

Stearic acid—Give the Latin title, chemical formula in symbols, and molecular weight.

From what source is it obtained? For what is it used officially?

Give the description, odor, taste, solubility, and tests for identity and impurity.

Glycerin—By what other English name is it known? What is its percentage of absolute glycerin.

What is the chemical composition of absolute glycerin?

How is glycerin obtained?

Explain the reaction which takes place in making lead plaster.

What is Tilghman's process for making it?

Explain the reaction which takes place in making glycerin by this process from stearin.

Chemically, to what class does glycerin belong, and what is it sometimes called?

What is its atomicity?

Describe appearance, odor, taste, chemical reaction, and solubility. What is the specific gravity? Give tests for identity.

How may the following impurities be detected?—viz.: Mineral impurities; sugars; readily carbonizable impurities; butyric acid; sulphuric acid; oxalic acid; calcium salts; chlorides; acrolein; heavy metals; arsenic.

What are its uses?

Spirit of glyceryl trinitrate—What is the Latin official title? By what other English title is it known? How is it made? For what is it used? What are its synonyms?

What is the percentage strength of the official solution? For what is it used medicinally? Give the dose.

Soap—What is the Latin name? What is its synonym?

What is its definition?

How is it made? What is grain soap?

How may it be purified?

How is toilet soap made?

What is the difference between hard soaps and soft soaps?

What change takes place when fats and oils undergo saponification?

What is the difference between soluble and insoluble soaps?

What are the two official soluble soaps?

What insoluble soaps are employed in pharmacy?

Describe its appearance, odor, taste, chemical reaction, and solubility.

How may the following impurities be detected?—viz.: An undue amount of water; animal fat; metallic impurities; sodium carbonate; silica and other accidental impurities; limit of alkalinity.

What are its medicinal properties?

What are its uses? What are its official preparations?

Soft soap—What is the Latin official name? What was its name in the U. S. P. 1880 in Latin?—in English?

How is it made officially?

How may a soft soap, green in color, be made?

Describe its appearance, odor, taste, chemical reaction, and solubility.

How may the following impurities be detected?—viz.: Limit of free alkali?

For what is it used? What is its official preparation?

Liquid petrolatum—Give the Latin official title.

What is it chemically and how obtained?

Give description, odor, taste, specific gravity, solubility, and test for identity.

How may acid impurities be detected?

What are some of its synonyms? How is it used medicinally and in what official preparations?

Petrolatum—What is petrolatum? What were the Latin and English titles of the two kinds of petrolatum in the U. S. P. 1890, which this replaces?

What is its synonym?

How is it prepared?

Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Fixed oils or fats of vegetable or animal origin, or rosin.

What is its use? By what names is it known commercially?

White petrolatum—What is the Latin title?

Give the official description. In what official preparations is it used?
What is paraffin? How is it obtained? What is its specific gravity?
Describe appearance, odor, taste, chemical reaction, and solubility. Give the tests for identity. How may an impurity of stearic acid be detected?
Can it be mixed readily with wax, resin, stearin, etc.?
Does it make a smooth mixture?
Petroleum benzin—Give the Latin name, and synonym. What is petroleum benzin?
What is its specific gravity?
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
Give the test for the difference from and absence of benzene.
For what is it used?
Is it identical with benzene?
Purified petroleum benzin—Describe the process by which this substance is purified. Give odor, test for identity and tests for the following impurities: heavy hydrocarbons; pyrogenous products and sulphur compounds. For what is it used?

CHAPTER LIX

DRUGS CONTAINING GLUCOSIDES OR NEUTRAL PRINCIPLES, WITH THEIR PREPARATIONS

What are glucosides? (See page 889.)
If salicin is boiled with sulphuric acid, what does it yield?
Explain the reaction which takes place.
How may glucosides be split into glucose and the derived product?
How do these principles act?
How are glucosides usually found?
Gentian—What is the Latin name? Whence is it derived?
How is it officially described?
What does gentian contain?
Into what does the glucoside gentiopicrin split when heated with dilute acids?
What effect is produced by ferric salts upon preparations of gentian?
To what is this reaction due?
If treated with ferric hydroxide, will the preparation still become discolored?
What are the medicinal properties of gentian?
Give the dose. What preparations of it are official?
Calumba—What was its synonym?
Whence is it derived? Give the official description. To what does it owe its virtues?
What other constituents are present?
For what is it used? What are the official preparations?
Quassia—What is its synonym? Give the official definition and description. What are the differences between the Jamaica and Surinam quassia?
What are its constituents?
To what does it owe its bitterness?
What is the formula in symbols of quassin?
What are its properties? What are the official preparations?
Chirata—Whence is it derived? Give the official description.
What principles does it contain? Give their formulas in symbols.
What are its uses? What is the official preparation?
Salicin—What is the Latin name? Give formula in symbols and molecular weight. What is salicin?
How is it made? Describe appearance, odor, taste, chemical reaction, and solubility.
Give tests for identity. How may the absence of alkaloids be determined?
For what is it used medicinally?
What is the dose?
Taraxacum—What is its synonym? Whence is it derived?
When should it be gathered? Give the official description. What are its constituents?

To what does it owe its bitterness? For what is it used medicinally? Give the dose.
What are the official preparations?
Lappa—What is its synonym? Whence is it derived? Describe this root.
What does it contain? What are its properties?
Mention the official preparation.
Scilla—What is its definition? Give the official description. What principles does squill contain?
What liquids are suitable for extracting its active principles? What are its properties?
What are the official preparations?
Digitalis—What is its synonym? What is its definition? Give the official description.
What is digitalin?
Into what is digitoxin converted by the action of diluted acids and heat?
What are its medicinal properties? Give the dose. What are its official preparations?
What does it contain? What is a good solvent? What is the dose?
Convallaria—What is the synonym? Give the official definition and description.
What principles does this drug contain? For what is it used medicinally?
Give the dose. What preparation is official?
Strophanthus—Give the official definition and description. What effect does concentrated sulphuric acid have upon the crushed or cut seeds?
What principles does it contain? For what is it used medicinally?
Give the dose. What preparation is official?
Strophanthin—Give Latin title and official definition. How may it be prepared?
Give description, taste, chemical reaction, solubility, and tests for identity.
What is the dose and medicinal use?
Cusso—What is the synonym? What is its definition and description?
What does it contain? For what is it used? What is its official preparation?
Santonica—What is its synonym? What is its definition and description?
How much santonin does it contain? What else is in it? What is the dose?
Santonin—What is the Latin name? Give formula in symbols and molecular weight. What is santonin?
How may it be made? Does it combine with alkalies?
What action do acids have upon these solutions?
Why should not the soluble compounds of santonin be used in medicine?
Give the description, odor, taste, chemical reaction, solubility, and tests for identity.
How may the following impurities be detected?—viz.: Sugar and other readily carbonizable organic impurities; alkaloids.
For what is it used medicinally? What is the dose?
Ergot—What is the Latin name? What are its synonyms? What is its definition and official description?
What precautions should be taken in storing it? How long may it be kept, before becoming unfit for use?
What are the constituents of ergot?
To which of these principles does it owe its activity?
What is a good solvent? For what is it used?
What is the dose of ergot? Of sclerotic acid?
What are its official preparations?
Cotton root bark—Give the official Latin title. What was the Latin title in the U. S. P. 1890? Give the official definition and description.
What are its constituents? What is its medicinal use and the dose?
Quillaja—What is its synonym? Whence is it derived?
Give a description of this drug.
Where does it come from? What glucoside does it contain?
Into what does this split upon heating with dilute acid?
What are the properties of saponin?
What else does it contain? What are its uses?
Give the dose. Name the official preparations.
Sarsaparilla—Whence is it derived? How is it officially described?
What glucoside does it contain?
Into what does this glucoside split when boiled with dilute acids?
What are its other constituents?
What are good solvents? What are its properties?

What are its official preparations?
Senega—Whence is it derived? How is it officially described?
What does it contain? What are good solvents?
Why are preparations of senega apt to gelatinize?
How may this be obviated?
What are its properties? In what preparation is it used?
What are its official preparations?
Senna—Whence is it derived? What is the difference between Alexandria and India senna? What does it contain?
Upon what principles does its cathartic action chiefly depend?
What was formerly believed to be the chief purgative principle?
Under the influence of dilute acids and heat, into what does cathartic acid split?
Are the purgative principles soluble in strong alcohol?
What portions are soluble?
What advantage is taken of this fact in the official fluidextract?
What are good solvents for the purgative principles?
What is the dose of senna given in infusion?
What are its official preparations?
Tamarind—What is the Latin name? What is tamarind? How is it officially described?
What is its medicinal property?
In what official preparation is it used?
Where does the copper which is sometimes present come from?
Cassia fistula—What is its synonym? Give its official definition and description.
How much pulp does cassia fistula yield?
What does it contain? In what preparation is it used?
What is its medicinal property?
Fig—What is the Latin official name? What is its definition and description?
What do figs contain? What are their properties?
Into what official preparation do they enter?
Prune—What is the Latin official name? Give the official definition and description. What does it contain?
What is its property? In what preparation is it used?
Rhubarb—What is the Latin official name? Whence is it derived? How is it officially described?
What effect do alkalies have upon powdered rhubarb?
Name the principles which are present in rhubarb. Which of these are resins?
To what are the astringent properties of rhubarb due?
What other ingredient is present?
Upon what do the medicinal properties of rhubarb depend? What is the dose?
What are the official preparations?
Chrysarobin—What is the Latin name? What is chrysarobin?
Give the description, odor, taste, specific gravity, solubilities and tests for identity. What are the objections to its use?
What are its properties and uses? What is its official preparation?
Gamboge—What is the Latin name? Whence is it obtained? How is it officially described?
What does it contain?
What effect have alkaline solutions upon the resin? What is its medicinal action?
In which official preparation is it an ingredient?
What is the dose?
Jalap—Whence is it derived?
What percentage of total resin should be present? How much of this should be soluble in ether?
How is it officially described?
What glucoside does it contain? What other constituents?
Upon what does the value of jalap depend?
How may its efficiency be tested? Describe the details of this assay. For what is it used medicinally? What is the dose?
What are the official preparations?
Scammony—What is the Latin name? What is scammony? How is it officially described? What percentage of scammony should be soluble in ether?
What resin does it contain, and how much?
With what other principle is this identical? For what is it used medicinally?

What is the dose?
What is its official preparation?
Podophyllum—What are its synonyms? Whence is it derived? How is it officially described?
What does it contain? What is a good solvent? What is the use and dose?
What are the official preparations?
Leptandra—What is its synonym? Whence is it derived? How is it officially described?
What does it contain? What is the active principle?
Is this identical with the eclectic preparation leptandrin?
What are the properties of true leptandrin?
For what is leptandra used medicinally? What is the dose? What are the official preparations?
Rhamnus Purshiana—What is the English title?
Give the official description, and definition.
Why should this bark be at least one year old before being used?
For what is it used medicinally? Give the dose.
What are the official preparations?
What are the constituents?
Frangula—What is the synonym? Give the official description and definition.
Whence is it derived?
What two glucosides does it contain? What other constituents?
What are its properties when fresh? and when old?
What is the dose? What is the official preparation?
Euonymus—What is its synonym? Whence is it derived? How is it officially described?
What does it contain? What is the dose? What is its official preparation?
Aloes—Name the two varieties of aloes, which were official in the U. S. P. 1890 but now included under this title. What is aloes? Give the several sources.
What does aloes contain?
What variety of aloin is present in Socotrine aloes?
How may this be distinguished from barbaloin and from nataloin?
What other principle is present in aloes and aloin? Name other cathartic drugs containing this principle. How do they produce this cathartic action?
Give official description, odor, taste, and tests for identity. How may the presence of gum, dextrin, and inorganic impurities be detected?
What is the dose? What are the official preparations?
Purified aloes—What is the Latin name? How is it prepared?
What impurities are removed by this process?
What are the official preparations?
Aloin—Whence is it derived? How is it prepared?
Give the official description, odor, taste, chemical reaction, solubility, and tests for identity.
What are its medicinal properties?
Colocynth—What is its synonym? What is its definition? How is it officially described? What glucosides does it contain?
Into what does this glucoside split under the action of diluted acids?
Are the seeds valuable? What is the dose? What are the official preparations?
Elaterin—Give Latin name, symbol, and atomic weight. What is elaterin?
How may it be prepared? What is elaterium, and how is it obtained?
What is the yield of elaterium from the cucumber?
How is commercial elaterium usually made? Describe appearance, odor, taste, chemical reaction, and solubility.
Give tests for identity. How may the absence of alkaloids be determined?
For what is it used medicinally? What is the dose?
What is the official preparation?
Nutgall—What is the Latin name? What are nutgalls? How are they officially described?
What do they contain? What is the dose? What are its official preparations?
Tannic acid—What is the Latin official name? Give formula in symbols and molecular weight. What are the synonyms? How may it be prepared?
Describe rationale of process.
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity. How may the following impurities be detected?—viz.: Gum or dextrin; resinous substances.

What is the dose? What form of liquid preparation is valuable? What are its official preparations?

Gallic acid—What is the Latin official name? Give formula in symbols and molecular weight. What was the formerly official process for preparing it?

Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity. How may the absence of tannic acid be determined?

What is the dose?

Pyrogallol—Give the chemical formula in symbols, and synonym. What is this substance chemically? How may it be obtained?

Give the official description, odor, taste, chemical reaction, solubility, and tests for identity.

What is its use in medicine? What is its use in the arts?

Gambir—What drug of the U. S. P. 1890 does this replace? What is its synonym?

What is the official definition? Give the official description. Why was the similar, U. S. P. 1890, drug replaced by gambir?

What peculiar tannin is present? Give its characteristics. What other principles are present?

Why do its liquid preparations frequently gelatinize? What is the dose?

What are its official preparations?

Kino—What is it? Describe its appearance and characteristics. What does it contain?

Why do its liquid preparations frequently gelatinize? What is its medicinal use?

What is the dose?

What is its official preparation?

Hæmatoxylon—What is its synonym? Whence is it derived? How is it officially described?

What does it contain?

What effect do alkalies have upon hematoxylin?

What are its medicinal properties? What is the dose?

What is its official preparation?

Krameria—What is its synonym? Whence is it derived?

Describe the difference between the several official varieties of krameria.

What does it contain? What is the dose?

What are its official preparations?

White oak—What is the Latin title? Give the official definition and description.

What does it contain? What is its chief use?

For what is it used medicinally? Give the dose. Name the official preparation.

Red rose—What is the Latin official name? Whence is it derived? What is the official description?

What does it contain?

What effect does sulphuric acid have upon the coloring matter?

For what is the infusion used?

What are its medicinal properties? What are its official preparations?

Oil of rose—Whence is it obtained?

What effect does cold have upon it? What is its principal use?

What range should its saponification value have?

Give the description, odor, taste, specific gravity, solubility, and tests for identity.

Describe the assay.

Rhus glabra—Whence is it derived? How is it officially described?

Rubus—What is its synonym? Whence is it derived? How is it officially described?

To what does it owe its virtues? What is the dose?

What are its official preparations?

Geranium—What is its synonym? How is it defined and how described? What does it contain?

What is its medicinal use?

What is the dose? What are its official preparations?

Hamamelis bark—What is its synonym? What is its Latin title? What is hamamelis bark? How is it officially described? For what is it used medicinally?

What does is contain?

What is the dose? What is its official preparation?

Hamamelis leaves—What is the Latin title? What was the Latin title in the U. S. P. 1890? What is its synonym? How is it defined and described?

For what is it used medicinally? Give the official preparation.

Chimaphila—What is its synonym? What is its source? How is it officially described? What does it contain?

What is the dose? What is its official preparation?

Uva ursi—What is its synonym? Whence is it derived?

What does it contain? What is the dose? What is its official preparation?

Salvia—What is its synonym? Whence is it derived?

CHAPTER LX

ALKALOIDS

What relation, with reference to their activity and value, do alkaloids hold towards other organic compounds? (See page 921.)

What are alkaloids, chemically? Where are they found?

What one element is common to all? What is their action towards litmus paper?

How are they affected by acids? By alkalies?

Give other general characteristics and distinctive features.

Name several reagents which will precipitate most alkaloids.

According to the adopted nomenclature, what is the last syllable of the names of alkaloids? What of the names of neutral principles?

Opium—What is opium? How and where is it obtained?

How much morphine should opium in its normal moist condition yield when assayed by the official process? How is it officially described?

Powdered opium—What is the Latin name?

Of what degree of fineness is powdered opium, and at what temperature should it be dried? How much morphine should it contain?

How may powdered opium of higher percentage of morphine be brought to the proper strength?

Granulated opium—At what temperature should it be dried? What percentage of morphine should it contain?

Describe, in detail, the process for assaying the several kinds of opium.

Deodorized opium—What kind of opium is directed to be used?

How is it prepared?

If opium having a higher percentage of morphine is used in this process, how may the proper quantity to be used be ascertained?

To what does opium owe its value?

How many alkaloids have been proved to exist in opium?

What acids are found combined with these alkaloids?

What other principles are also present?

Which of these alkaloids and their salts are official in the U. S. Pharmacopœia.

Mention the official preparations made from opium. From granulated opium. From powdered opium. From tincture of deodorized opium. From extract of opium.

Morphine—What is the Latin official name?

Give formula in symbols and molecular weight.

Which was the first alkaloid discovered? When and by whom was it discovered?

Explain the objects and the steps in the process for preparing morphine.

Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Strychnine or acetanilide; meconic acid or meconates; other alkaloids; ammonium salts.

In what form is it usually used in medicine? Dive the use and dose.

Morphine acetate—What is the Latin official name?

Give formula in symbols and molecular weight.

Why should free acetic acid be present? How is it prepared?

What happens if too much heat is used in evaporating the solution?

Is this salt a very permanent one? What change sometimes takes place?

How may its solubility be increased?

Describe odor, taste, chemical reaction, and solubility. Give tests and dose.

Morphine hydrochloride—What is the Latin title? What were the Latin and English titles in the U. S. P. 1890?

Give formula in symbols and molecular weight. How may it be prepared?
Is this salt more stable than morphine acetate?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests and dose.
Morphine sulphate—What is the Latin title?
Give formula in symbols and molecular weight.
How is it prepared?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
What is the dose? What is the official preparation?
How strong was the solution formerly official?
What is the strength of Magendie's solution?
Codeine—Give the Latin name, formula in symbols, and molecular weight.
How may it be prepared?
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the presence of morphine be detected? For what is it used medicinally?
Give the dose.
Codeine phosphate—What is the Latin title? How may it be prepared?
Give description, odor, taste, chemical reaction, solubility, tests for identity and test for morphine. What is the dose?
Codeine sulphate—What is the Latin title? How may it be prepared?
Give description, odor, taste, chemical reaction, solubility, tests for identity, and tests for morphine.
Apomorphine hydrochloride—What were the official Latin and English titles in the U. S. P. 1890? How is it prepared? Give rationale of process.
Describe appearance, odor, taste, chemical reaction, and solubility. Give tests for identity and absence of impurities. For what is it used in medicine?
What is the expectorant dose? The emetic dose?
Cinchona—What is the Latin name? What is its synonym?
Whence is it derived? What percentage of total anhydrous, cinchona alkaloids and of anhydrous, ether soluble alkaloids should be present? How is it officially described?
Red chichona—What is the Latin name? What is its synonym?
Whence is it derived? What percentage of anhydrous, cinchona alkaloids should it contain?
Upon what does the value of cinchona bark depend?
How may the value be ascertained?
Give the process of the U. S. Pharmacopœia for its assay: first, for ascertaining the total anhydrous cinchona alkaloids; secondly, for ascertaining the amount of ether soluble alkaloids.
How many alkaloids have been discovered in cinchona bark?
Have all of these been found in any one variety of bark?
Do they all exist naturally in the bark?
Which are the most important alkaloids?
What acids are found in cinchona bark? What other principles are found?
How are the artificial alkaloids chiefly produced?
Why is it difficult to preserve the galenical preparations of cinchona?
How may this difficulty be in a measure obviated?
What are the official preparations?
Quinine—Give Latin name, formula in symbols, and molecular weight.
How is it usually made?
Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Cinchonine and cinchonidine; limit of readily carbonizable organic impurities; excess of water; ammonium salts;.other cinchona alkaloids.
For what is it used?
Quinine sulphate—What is the Latin name? Give formula in symbols and molecular weight.
Give the process.
How many quinine sulphates have been obtained?
Which of these are official in the U. S. Pharmacopœia?
What is the difference in chemical composition between quinine sulphate (U. S. Pharmacopœia) and quinine bisulphate?

What is the difference in chemical composition between quinine bisulphate and the acid sulphate?

Quinine sulphate—Give description, odor, taste, chemical reaction, solubility, and tests for identity.

How may the following impurities be detected?—viz.: Ammonium sulphate and inorganic salts; limit of readily carbonizable organic impurities; morphine; more than 16.18 per cent. of water. Describe in detail the test for the presence of other cinchona alkaloids.

What is the dose? How is it best given in the liquid form?

Quinine bisulphate—What is the Latin official name?

Give formula in symbols and molecular weight. How is it made?

Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Limit of carbonizable organic impurities; other cinchona alkaloids.

What advantage has this salt over the sulphate for use in medicine?

How much weaker is it than the sulphate?

Quinine hydrochloride—What is the Latin name? What were the official Latin and English titles in the U. S. P. 1890?

Give formula in symbols and molecular weight. How may it be made?

Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Limit of readily carbonizable organic impurities; limit of sulphate; other cinchona alkaloids.

Why is this salt preferable to quinine sulphate for hypodermic use?

Quinine hydrobromide—What is the Latin official name? What were the official Latin and English titles in the U. S. P. 1890?

Give formula in symbols and molecular weight. How may it be made?

Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Limit of readily carbonizable organic impurities; limit of sulphate; other cinchona alkaloids.

Quinine salicylate—What is the official Latin title?

How may it be made? Give description, taste, chemical reaction, solubility and tests for identity.

How may the following impurities be detected?—viz.: Excessive moisture; other cinchona alkaloids.

What is its especial advantage in medicine? Give the dose.

Cinchonine sulphate—What is the Latin official name?

Give formula in symbols and molecular weight. How is it obtained?

Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Undue amount of moisture; limit of quinine or quinidine sulphates. What is the dose?

Cinchonidine sulphate—What is the Latin official name?

Give formula in symbols and molecular weight.

How is it obtained? Which barks contain most of it?

Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.

How may the following impurities be detected?—viz.: Limit of readily carbonizable organic impurities; undue amount of moisture; more than traces of quinine or quinidine sulphates; more than small quantities of cinchonine sulphate.

For what is it used medicinally? Give the dose.

Nux vomica—What is its definition?

What percentage of strychnine should it contain?

Describe the appearance and characteristics of nux vomica.

What other alkaloid is present? What are its characteristics? What other substances does it contain? Why is an acid menstruum used in extracting nux vomica for the extract?

Describe, in detail, the assay for nux vomica.

What is the dose? What are its official preparations?

Strychnine—Give the Latin name, formula in symbols, and molecular weight.

How may it be prepared?

Give description, odor, taste, chemical reaction, solubility, and tests.

How may the following impurity be detected?—viz.: Sugar and other readily carbonizable organic impurities; limit of brucine.
For what is it used medicinally? Give the dose.
Strychnine nitrate—Give the Latin name, and chemical formula in symbols.
How may it be prepared?
Give description, odor, taste, chemical reaction, solubility, and tests for identity.
How may a limit of brucine be determined?
Strychnine sulphate—Give formula in symbols and molecular weight.
How is it prepared? Give description, taste, chemical reaction, and solubility.
Give the tests for identity. How may a limit of brucine be determined?
Why is the sulphate more useful than the alkaloid? What is the dose?
Gelsemium—Give its definition and description. What does it contain?
What is the best solvent for its active principles? What is the dose?
What are the official preparations?
Physostigma—What is its synonym? Whence is it derived? Give the official description. What does it contain?
Describe, in detail, the assay for physostigma.
What is the dose? What are its official preparations?
What are the physical properties of physostigmine?
Physostigmine salicylate—What is its synonym? How may it be made?
Give description, taste, chemical reaction, solubility and tests for identity.
What advantages does this salt possess over the alkaloid? For what is it used medicinally? What is the dose?
Physostigmine sulphate—What is the Latin title and synonym? What are its disadvantages?
Give description, odor, taste, chemical reaction, solubility and tests for identity.
Give the dose.
Belladonna leaves—What is the definition and description?
What percentage of mydriatic alkaloid should be present?
Describe the assay for belladonna leaves.
Belladonna root—What is the definition and description?
What percentage of mydriatic alkaloids should be present?
To what does belladonna owe its activity?
What is the medicinal use and dose? What are its official preparations?
Atropine—Give the Latin name, formula in symbols, and molecular weight.
How may it be prepared?
Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.
What is the dose? Why is the sulphate preferred?
Atropine sulphate—How may it be prepared? What is the official definition and description? Give description, odor, taste, chemical reaction, and solubility.
Give tests for identity. What is the dose?
Homatropine hydrobromide—Give the Latin title and official definition. How may it be made?
Give description, odor, taste, chemical reaction, solubility, and tests for identity.
How may the following impurities be detected?—viz.: Most other alkaloids; atropine, hyoscyamine or hyoscine. For what is it used? Give the dose.
Scopola—Give official definition and description. What alkaloid does it contain?
How may it be assayed? What are its uses and official preparation?
Scopolamine hydrobromide—How is it defined? What alkaloids is it chemically identical with? For what is it used medicinally? Give the dose.
Hyoscyamus—What is its synonym? What is its definition and description.
What does it contain? What is the dose? What are the official preparations?
Hyoscine hydrobromide—Give the official Latin title. What were the Latin and English titles official in the U. S. P. 1890? How is it defined? How may it be prepared?
Give description, odor, taste, chemical reaction, solubility and tests for identity.
How may the presence of carbonizable impurities and morphine be detected?
For what is it used in medicine? Give the dose.
Hyoscyamine hydrobromide—Give the official Latin title. How is it defined?
Give description, odor, taste, chemical reaction, solubility, and tests for identity and purity.
For what is it used in medicine? Give the dose.
Hyoscyamine sulphate—What is the Latin official name?
Give formula in symbols and molecular weight. How is it prepared?

Give description, odor, taste, chemical reaction, and solubility. Give tests for identity and purity, and dose.
Stramonium—What was the official Latin title in the U. S. P. 1890?
What is the official definition and description? How may it be assayed?
What do the leaves contain?
What is the dose? What are the official preparations?
Pilocarpus—What is its synonym? Whence is it derived? What percentage of alkaloids should it contain? How is it described officially?
Give the marked differences between the two varieties of the drug. How may it be assayed?
What does it contain? Is it easily powdered? What is the dose? What is the official preparation?
Pilocarpine hydrochloride—Give the Latin name, formula in symbols, and molecular weight. How is it prepared?
Give description, odor, taste, chemical reaction, and solubility. Give tests, uses and dose.
Pilocarpine nitrate—Give the official Latin title. How may it be made?
Give description, odor, taste, chemical reaction, solubility, and tests for identity.
For what is it used medicinally? Give the dose.
Colchicum corm—What were the Latin and English titles in the U. S. P. 1890?
What percentage of colchicine should it contain? Whence is it derived? How is it officially described?
Colchicum seed—Whence is it derived? What percentage of colchicine should it contain?
What does the corm contain in addition to colchicine? What do the seeds contain besides colchicine?
Why are the seeds so tough? How may they be exhausted of their active principle?
What are the official preparations?
Colchicine—What is the Latin title? How may it be prepared?
Give description, odor, taste, chemical reaction, solubility, and test for identity.
For what is it used medicinally? Give the dose.
Veratrum—What is the Latin title? Give the Latin and English titles official in the U. S. P. 1890?
What are the synonyms? Give the official definition and description.
What does it contain? To what was it formerly supposed to owe its activity?
For what is it used medicinally?
What is the dose? What are the official preparations?
Veratrine—Whence is it obtained, and how is it prepared?
What are its properties and uses? Describe appearance, odor, taste, chemical reaction, solubility, and tests for identity. What are its uses in medicine?
What are its official preparations?
Sanguinaria—What is its synonym? What is its definition and description?
What does it contain? What is the dose? What are its official preparations?
Staphisagria—What is its synonym? Whence is it derived?
What does it contain? What are good solvents? For what is it used?
Aconite—Whence is it derived? What percentage of aconitine should be present?
What is the official definition and description? What does it contain?
How may aconitic acid be produced?
What is the best menstruum for preparations of aconite?
What are its properties and dose?
What are its official preparations?
Aconitine—What is the Latin title? How may it be prepared?
Give description, odor, taste, chemical reaction, solubility, and tests for identity.
Should the alkaloid itself be tasted? What is the dose of the official aconitine? What is amorphous aconitine?
For what is it used medicinally?
Hydrastis—What is its synonym? What is its definition? What percentage of hydrastine should it contain? Describe the rhizome. How may it be assayed?
What besides hydrastine does it contain?
What difference in appearance is there between the salts of hydrastine and those of berberine? What is its use and the dose? What are its official preparations?
Hydrastine—What is the Latin title? How may it be prepared?
Give description, taste, reaction solubility, and tests for identity.
What is its medicinal use and dose?

Hydrastinine hydrochloride—What is the Latin title? What is the official definition? How is this artificial alkaloid prepared?
Give description, odor, taste, chemical reaction, solubility, and tests for identity.
For what is it used medicinally? Give the dose.
Berberis—What is its synonym? Give official definition and description.
What does it contain? For what is it used? Give the dose.
What preparation is official?
Pomegranate—What is the Latin official name? Whence is it derived? Describe the stem bark; the root bark.
What does it contain? Which of the alkaloids is solid and crystallizable?
Which of the alkaloids are liquid? For what is it used in medicine? What is the dose?
Pelletierine tannate—What is the Latin title? What is this described as being?
How may it be prepared?
Give description, odor, taste, chemical reaction, solubility, and tests for identity.
For what is it used medicinally? Give the dose.
Pareira—What is its synonym? Whence is it derived? How is it officially described?
What does it contain?
With what is this alkaloid identical?
What is the dose? What is its official preparation?
Ipecac—Whence is it derived? What percentage of alkaloid should it contain?
Describe Rio ipecac; Carthagena ipecac. How is it assayed? What does it contain?
What is its use and the dose? What are its official preparations?
How may the apothegmatic matter which is dissolved by hydro-alcoholic liquids be separated?
Coca—What is its synonym? Whence is it derived? What percentage of ether-soluble alkaloids should it contain? Describe Huanuco coca; Truxillo coca?
How may it be assayed?
What does it contain?
What is the dose? What are its uses?
Cocaine—What is the Latin title? How may it be prepared?
Give description, odor, taste, solubility and tests for identity. For what is the alkaloidal cocaine preferred? What is its medicinal use? Give the dose.
Cocaine hydrochloride—What is the Latin title? How may it be prepared?
Give description, odor, taste, reaction, solubility, and tests for identity and purity. For what is it used medicinally? Give the dose.
Guarana—What is it, and whence is it derived? What percentage of alkaloid should it contain? How is it officially described? How may it be assayed?
What does it contain?
What is its use and the dose?
What is its official preparation?
Caffeine—What is the Latin name? What is the synonym?
Give formula in symbols and molecular weight. Whence is it obtained?
How is it prepared?
Give description, odor, taste, chemical reaction, and solubility. Give tests for identity.
How may the presence of organic impurities and other alkaloids be detected?
What is its use and the dose?
Citrated caffeine—What is the Latin title and synonym? How may it be prepared? Is it a definite chemical salt?
Give description, odor, taste, chemical reaction, solubility and test for tartaric acid. For what is it used? Give the dose.
Effervescent citrated caffeine—What is the Latin title? How is it prepared?
What is the dose?
Conium—What is its synonym? What is its definition? What percentage of coniine should it contain? How is it officially described?
Give the details of the assay.
What does it contain?
What are the peculiarities of coniine?
In what is coniine soluble?
What are the properties and dose of conium?
What is its official preparation?
Spigelia—What is the synonym? What is the official definition and description?

What does it contain? What is its medicinal use? Give the dose.
What preparation is official?
Scoparius—What is its synonym? Give the official definition and description.
What does it contain? What is its medicinal use and dose?
Sparteine sulphate—What is its source? How may it be prepared?
Give description, odor, taste, chemical reaction, solubility, and tests for identity and purity. For what is it used in medicine? Give the dose.
Lobelia—What is its definition and description? What does it contain?
What is its use and dose? What are its official preparations?

CHAPTER LXI

PRODUCTS FROM ANIMAL SUBSTANCES

Where are protein compounds found? (See page 1000.)
What are their constituents?
What are their physical properties?
What are ptomaines? What are leucomaines? What are toxalbumins?
From what classes are the animal products which are of interest in pharmacy derived?
Lard—What is the Latin name? Whence is it obtained?
How is it prepared?
What is the process, used largely in France, of purifying lard?
Give description, odor, taste, chemical reaction, solubility, specific gravity and test for identity.
How may the following impurities be detected?—viz.: Alkalies; chlorides; limit of free fatty acids; more than about 5 per cent. of cotton seed fats; cotton seed oil and certain other fats.
Of what does lard consist?
To what is its consistence due?
For what is lard used in pharmacy?
Benzoinated lard—What is the Latin official name?
How is it prepared? What temperature should be used?
If the weather is warm what addition is permitted?
Does the method of adding tincture of benzoin to lard and mixing make as good a product as the official method? Why? In what official preparation is it used?
Lard oil—What is the Latin official name? How is it prepared?
What is its usual adulteration?
Is this admixture particularly injurious?
Give description, odor, taste, specific gravity, solubility, and tests for identity.
How may the following impurities be detected?—viz.: More than 5 per cent. of cotton seed oil; mineral oils; cotton seed oil and certain other fats. What are its saponification and iodine numbers? For what is it used?
Wool-fat—What is the Latin title? Give definition? What is a common name?
How is it obtained? What is "suint"? Of what does it consist?
Give description, odor, taste, chemical reaction, tests for identity and impurities.
For what is it used?
Hydrous wool-fat—What is its Latin title? How much water may it contain?
Give description, odor, chemical reaction, solubility, and tests for identity.
For what is it used? What is its special advantage?
Prepared suet—What is the Latin official name? Whence is it obtained, and how prepared?
Give description, odor, taste, specific gravity, and solubility. Give tests for identity.
For what is it used?
Gelatin—What is gelatin? What is impure gelatin called? How is it obtained and purified? What is "shred gelatin"?
Give description, odor, taste, solubility and tests for identity.
For what is it used in pharmacy? Give the official preparation.
What is pepsin, and whence obtained?
How much coagulated egg albumen should it be capable of digesting?

Describe Prof. Scheffer's process for making it.
How is purified pepsin or scaly pepsin prepared? What is granular pepsin?
Give description, odor, taste, specific gravity, and solubility. Give tests for identity.
How may it be assayed? Give the details.
What is the dose?
Pancreatin—What is the official definition? Of what does it consist?
How many times its own weight of starch should it render soluble in water?
How is it prepared?
What effect does it have upon the following: albuminoids; starch; fats? What effect do acids have upon it?
Give description, odor, taste, solubility, and tests for identity. Describe the assay.
For what is it used in medicine? Give the dose.
Desiccated suprarenal glands—What is the Latin title? What is its source?
How may it be prepared? Name the active, alkaloidal principles which it contains.
Give description, odor, solubility and tests for identity. For what is it used?
Give the dose.
Desiccated thyroid glands—What is the Latin title? What is the source?
How may it be prepared? What is the active principle?
Give description, odor, solubility and tests for identity. For what is it used in medicine? Give the dose.
Diphtheria antitoxin—Give the Latin and other English title. What is this substance? At what temperature should it be kept?
How is it obtained; give the process in detail? How is its strength determined?
What is the Government standard?
Give description, odor, specific gravity and tests for identity.
For what is it used? Give the immunizing dose? What is meant by this? What is the curative dose?
Musk—What is the Latin official name? Whence is it obtained? How is it officially described?
What does it contain? What is the dose? What is its official preparation?
Lactic acid—How much absolute acid does it contain?
How may it be made?
Give description, odor, taste, specific gravity, and solubility. Give tests for identity.
How may the following impurities be detected?—viz.: Limit of chloride; sulphate; sarcolactic acid; heavy metals; sugars; butyric and other fatty acids; glycerin; more than traces of organic impurities. For what is it used?
What is the dose?
Sugar of milk—What is the Latin name?
Give formula in symbols and molecular weight. Whence is it obtained?
How is it prepared?
Give description, odor, taste, specific gravity, and solubility. Give tests for identity.
How may the presence of cane sugar, heavy metals or starch be detected?
What are its uses? Why is it specially useful in pharmacy?
Oxgall—What is the Latin official name? What is the official definition? What are its constituents?
Describe appearance, odor, taste, chemical reaction, specific gravity and test for identity.
For what is it used?
Purified oxgall—What is the Latin official name? How is it prepared?
Why is alcohol added in purifying it?
Describe appearance, odor, taste, and chemical reaction.
What is the official test for its identity? For what is it used medicinally?
Spermaceti—What is the Latin official name? Whence is it obtained?
Give description and specific gravity.
Describe odor, taste, chemical reaction, solubility, test for identity and presence of stearic acid as an impurity.
How is it made?
What is its composition? For what is it used?
What class of official preparations does it enter?
Cod liver oil—What is the Latin official name? What is its synonym? Whence is it obtained?
How is it best prepared?

How is the light oil of commerce prepared?
What are its constituents? Give description and specific gravity.
Describe odor, taste, chemical reaction, and solubility. Give tests for identity.
How may free fatty acids be detected? What is its saponification and iodine value?
What is its use and dose? Name its official preparation.
Cantharides—What is the Latin name? What are its synonyms?
Give the official definition and description.
To what do cantharides owe their blistering properties?
Describe the physical properties of cantharidin.
What is cantharidin believed to be, chemically?
Does this acid form salts? How may they be obtained?
What is the most satisfactory test of cantharidin?
What are the medicinal properties of cantharides?
Name its official preparations.
Cochineal—What is the Latin name? What is its definition and description?
What does it contain?
To what does it owe its red color?
For what is it used?
Yellow wax—What is the Latin official name? Whence is it obtained?
What is wax? How is it obtained commercially?
What are the constituents of beeswax?
Which of these is soluble in alcohol?
Give description, odor, taste, chemical reaction, solubility, specific gravity, tests for identity and saponification value.
How may the following impurities be detected?—viz.: Fats or fatty acids; Japan wax; rosin; soap; paraffin; ceresin.
White wax—What is the Latin title?
How is white wax made? What is its specific gravity?
Describe appearance, odor, taste, and tests for identity.
What is its principal use in pharmacy?

CHAPTER LXII

PHARMACEUTICAL TESTING

Why is a knowledge of chemical testing now demanded by the pharmacist? (See page 1020.)
What is meant by synthesis?
What is meant by analysis?
Upon what are the principles of analysis based?
What are meant by reagents, test-solutions and volumetric solutions?
What two kinds of analysis are in use?
What is meant by qualitative analysis?
What is meant by quantitative analysis?
What two kinds of quantitative analysis are in use, and what is the difference between them?
What is the legitimate and proper meaning of a normal solution?
What are double-normal, half-normal, tenth-normal, fiftieth-normal and hundredth-normal volumetric solutions?
In what other ways has the term normal solution been applied?
What is meant by proximate analysis?
What is meant by ultimate analysis?
What system is used by the U. S. Pharmacopœia in analytical operations requiring definite weights or measures?
What is the use of graduated flasks?
What is the use of graduated jars? Of graduated pipettes?
What is a burette, and how is it used?
For test-solutions that are decomposed by organic substances, can a rubber tube be used?
What can be used in its place?
What is Erdmann's float? What is its use?
How may pipettes sometimes be used instead of burettes?
What is the best form of reagent bottle?

CHAPTER LXIII—LXIV

DISPENSING—PRESCRIPTIONS

What consideration must guide the pharmacist in selecting the location of a drug store? (See page 1060.)

What are the advantages of a corner store? What the disadvantages?

What should be the shape of the room? How may the space be best apportioned in such a room?

Name the general rules which should govern the window display.

What kind of wood is best suited for wall fixtures? Why?

Describe a convenient arrangement for the dispensing counter.

In the arrangement of the drug store, how should solid substances which are subject to injury from exposure to light be kept?

How should odorous drugs, such as valerian, be kept?

How should volatile oils be kept?

How should corrosive or deliquescent salts be kept?

How should poisons, alkaloids, and powerful substances be kept?

Describe a "salt mouthed" bottle, a "tincture bottle", a "syrup bottle", an "oil bottle". What are the advantages of a "recessed" label?

How may a glass label be fastened to the bottle?

How may a prescription counter be arranged?

Describe Holbe's poison closet. How may a mortar be held tightly when in use?

Describe the arrangement of a laboratory. Also of a cellar.

What general principles should guide the prospective drug clerk in starting business? What should be his appearance and general conduct?

How may he keep up stock? What rules should be followed when waiting on customers? In what way should he recommend goods?

What rules should govern the prescription department?

By what general rules should the clerk be governed in charging goods?

What should govern the sending out of goods?

With what precautions should poisons be sold?

What should be remembered about the soda counter?

What is the definition of the word "prescription"? (See page 1086.)

From what Latin word is it derived?

What are the advantages of using Latin in writing prescriptions?

What is meant by "the superscription" of a prescription, and of what does it consist?

What is used in French prescriptions?

Is it desirable to have the name of the patient written on the prescription? Why?

What is meant by the inscription?

Of what parts should a model compound prescription be composed?

Give the meanings of these various parts.

How does the physician usually ascertain the quantities desired of the various ingredients in writing a prescription?

Give the various characters used in Latin prescriptions, and write out their names in full in Latin.

What sort of numerals are used, and what position do they occupy in reference to the ingredients?

What is meant by "the subscription" to a prescription?

What is meant by "the signa" to a prescription?

What is the use of having the name of the physician attached to a prescription?

How should unusual doses in prescriptions be marked or designated?

What would be understood by the following abbreviations occurring in prescriptions?—Acid. hydroc.; aconit.; ammon.; aq. chlor.; calc. chlor.; chlor.; emp. lyt.; ext. col.; hyd. chlor.; hydr.; mist. ammon.; potass. hyd.; sod. hypo.; sod. sulph.; sulph.; zinc. phos.

Translate the following prescriptions, and also the accompanying directions:

Recipe Liquoris Ammonii Acetatis, drachmas tres cum semisse;
Vini Antimonii, drachmas duas;
Tincturæ Cardamomi Compositæ, drachmas tres;
Aquæ Menthæ Piperitæ, uncias quatuor.

Fiat mistura, cujus unciæ duæ omni horæ quadrante calefactæ sumendæ, durante frigore.

Recipe Rosæ Gallicæ, unciam dimidiam;
Aquæ ferventis, uncias octo.
Stent per horam; colaturæ adde Succi Limonum, Sacchari, ana, quantum sufficit, ad gratam acerbitatem dulcedinemque.

Recipe Extracti Colocynthidis Compositi, drachmam unam;
Pulveris Scammonii, scrupulum unum;
Pulveris Cambogiæ, grana quinque.
Misce.—Fiant pilulæ viginti, quarum duæ deglutiantur horâ decubitus; diluculò, ut infra.
Recipe Infusi Sennæ, unciam unam.

Recipe Potassii et Sodii Tartratis, sesquidrachmam;
Cretæ Præparatæ, semidrachmam.
Misce.—Fiat pulvis in jusculo tenuissimo sumendus.

Recipe Ammonnii Carbonatis, grana sex;
Syrupi Aurantii, drachmas duas;
Aquæ, drachmas decem.
Misce.—Fiat haustus, cui, tempore capiendi, adde Succi Limonis recentis cochleare medium unum, et in effervescentiâ sumatur.

Recipe Tincturæ Opii, semidrachmam;
Spiritûs Chloroformi, drachmam;
Misturæ Cretæ.
Aquæ Menthæ Piperitæ, ana, uncias tres.
Misce.—Fiat mistura, cujus sumantur cochlearia duo magna post unamquamque sedem mollem, phialâ prius concussâ.

Recipe Misturæ Ammoniaci, uncias sex;
Tincturæ Opii, drachmam.
Misce.—Capiat cochlearia duo magna statim; iterentur post horam, si tussis accreverit.

Recipe Extracti Belladonnæ Fluidi, drachmam cum semisse;
Lini Farinæ, uncias duodecim;
Aquæ bullientis, quantum sufficit ut fiat cataplasma admovendum calidè loco affecto.

Recipe Cetrariæ, unciam;
Aquæ frigidæ, octarium.
Coque ad uncias duodenas; stet ut geletur, et utatur æger gelatinâ ad libitum.

℞ Magnes. Carb., ʒi;
Pulv. Rhei, gr. xv;
Aq. Anisi, f℥iss.
M.—Fiat julep.[1] cujus unum cochl.[2] minim.[3] infant.[4] lacten.[5] detur, secundis horis: phialâ agitata.

℞ Sp. Ammon. Arom., fʒi;
Tinct. Asafœt., f℥ss;
Syrupi, fʒiii;
Aq. Cinnam., f℥i.
M.—Exhibe cochl. parv. ter quaterve de die, vel sæpius, urgente convuls.[6] vel spasm.[7]

℞ Tinct. Hyoscyami, f ʒiss;
Pot. Acet., ʒiv;
Syr., fʒii;
Aq. Menth. Vir., ad f℥vi.
Ft. mist. cujus sumant.[8] cochl.[9] ii vel iii minim.[10] bis terve in die, vel ut opus sit

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[1] Julepum. [2] Cochleare. [3] Minimum. [4] Infantulo. [5] Lactenti. [6] Convulsione. [7] Spasmo.
[8] Sumantur. [9] Cochlearia. [10] Minima.

℞ Tinct. Opii, fʒss;
Mist. Cret., f℥iii.
M.—Cap. cochl. ij magn.[1] omni quadrante horæ, donec leniat.[2] dolor.

℞ Pulv. Ipecac., ʒiss;
Pot. Bitart., ʒi;
Aq. fervent. f℥iiss.
Macera per horam integr.[3] dein cola et adjice syr., fʒss.
M.—Detur ℥ss vel cochl.[4] ampl.[5] omni semihora, donec vomit.[6] proritav.[7]

℞ Plumbi Acet., gr. iv;
Syrup., fʒij;
Aq. Menth., fʒii.
M.—Cap. cochl. ampl.[8] mane quotidie; repetat.[9] dosis ad iii vices, et deinde cap.[10] æger haust.[11] aliq.[12] purgant.[13]

℞ Mist. Ammon.,[14] f℥vi;
Cap. æger cochl. mag. bis in die ex poculo jusc.[15] bov.[16]

℞ Morph. Acet., gr. ¼;
P. Colch.,[17] gr. iii.
Ft. pil. 4tis[18] horis s.[19]
Mitte vi fol.[20] arg.[21] inv.[22]

℞ Sodii Bicarb., ʒiii;
Ammon. Bicarb., ℈ii;
Pot. Nit., ʒss;
Syr. Aurant., f℥ss;
Ac. Hydrocyan. dil., gtt. xx;
Aquæ, ad ℥viij.
M.—Capiat ℥iss t. in d. cum pulv. i seq.[23] m.[24] stat.[25] effervesce.[26]

℞ Ac. Tart., ℈i;
Mitte chart. vi.

℞ Ol. Morrhuæ, f℥viij.
Sum.[27] coch. min. (ad. ampl.[28] augend.[29]) bis die c.[30] mist. sequent.[31] coch. ampl.[32]

℞ Acid. Phosph. dil., f℥ss;
Tinct. Nuc. Vom., fʒii;
Tinct. Calumb.,
Syr. Zingib., aa f℥i;
Aq. Cinnam., q. s. ut ft. f℥viii.
M.—Ft. mist.

What are meant by gravimetric prescriptions?
What are the supposed advantages of this method?
What are meant by volumetric prescriptions?
What are the advantages of this method?
What relation does the cubic centimetre bear to the gramme?
Write prescriptions according to each of these methods.
What general rules are to be observed by the clerk when receiving a prescription or order?
What procedure may be of assistance in reading the prescription before compounding it? Give rules to be followed in compounding the prescription.
What is meant by double checking?
Under what circumstances may additions or alterations be made in the prescription?
Name several methods of numbering prescriptions, giving advantages of each.

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[1] Magna. [2] Leniatur. [3] Integram. [4] Cochleare. [5] Amplum. [6] Vomitum. [7] Proritaverit. [8] Amplum. [9] Repeatur. [10] Capiat. [11] Haustum. [12] Aliquem. [13] Purgantem. [14] Ammoniaci. [15] Jusculi. [16] Bovini. [17] Colchici. [18] Quartis. [19] Sumenda. [20] Folio. [21] Argenteo. [22] Involve. [23] Sequenti. [24] Mane. [25] Statu. [26] Effervescentiæ. [27] Sumatur. [28] Amplum. [29] Augendum. [30] Cum. [31] Sequentis. [32] Amplo.

What is the value of a date attached to a prescription?
Why should the price always be placed upon the prescription?
What is a "cipher"? Give an illustration.
Name the advantages and disadvantages of a prescription book for filing prescriptions.
Describe Lawrences' prescription box. Nesbitt's prescription file. Anderson's prescription file. Naulty's prescription file.
Why are labels to be attached to all packages sent from the drug store?
What rules should govern the selection of the style of labels?
How should poisonous substances be labeled?
How may labels be pasted on bottles satisfactorily?
What are the advantages and disadvantages of gummed labels?
How may labels be preserved and arranged?

CHAPTER LXV

EXTEMPORANEOUS LIQUID PREPARATIONS

In compounding prescriptions, as a general rule, should heat be used in making solutions of solid substances? Why? (See page 1150.)
When may mixtures which contain more solid material than can be dissolved be filtered before being dispensed?
Give an example.
Give an example where such a mixture should not be filtered.
Is the apothecary justified in using solvents not directed in a prescription, for the purpose of effecting complete solution of the ingredients?
Is the order to be followed in mixing the ingredients of a prescription of any special importance? Why?
Where a difference results from a variation in the order of mixing the ingredients, what rule should be adopted to secure uniform results?
What are mixtures, properly so called?
Is this definition adhered to in extemporaneous pharmacy?
What are emulsions?
What are natural emulsions?
From what are manufactured emulsions usually made?
How are gum-resin emulsions made?
Should powdered gum resins be used in making these? Why?
What is meant by seed emulsions?
What is the object sought by the pharmacist in making emulsions?
What is the English method of making emulsions?
What is meant by "cracking" an emulsion?
How may a cracked emulsion be restored?
What is the Continental method?
What are the most satisfactory proportions of the ingredients to be used?
How are casein emulsions formed?
How is saccharated casein prepared?
What are chondrus emulsions?
How is chondrus prepared for use as an emulsifying agent?
Explain the use of quillaja as an emulsifier.
When it becomes necessary to add alcoholic liquids to emulsions, what precautions are necessary to make a nice, smooth emulsion?
How may emulsions of volatile oils be rendered more stable?
How may the sink at the dispensing counter be made most convenient?
What is a "poison bottle"?
When should amber glass bottles be used in prescription work?
How should liquids be poured from the shelf bottle into a graduate?
How may liquids be dropped from the shelf bottle?
What are the advantages of a hard-rubber-base graduate?
What precautions should be taken in preparing a cork for use?
Describe the Lochman's cork press. What are its advantages?
How may bottles be capped? Why should they be capped?

CHAPTER LXVI

INCOMPATIBILITY

What four conditions may produce incompatibility in pharmaceutical mixtures? (See page 1163.)

Into what three classes may incompatibility be conveniently divided?

What is meant by chemical incompatibility?

Precipitation—Give an illustration showing an intentional production of a precipitate. How should such a prescription be dispensed?

Give an illustration in which a precipitate is not desired. How should such a prescription be dispensed?

Give an illustration of a precipitate resulting from the mixing of salts which, of themselves, are soluble but form an insoluble salt.

Mention a number of substances which will produce such precipitates.

Illustrate the production of an insoluble precipitate through the reduction of a salt.

Under what circumstances will an insoluble hydroxide be formed in a prescription?

Enumerate the conditions which will cause the precipitation of alkaloidal substances.

Give an illustration of the precipitation of a weak, insoluble acid.

Liberation of a gas—Under what conditions is the evolution of a gas, in a prescription, desirable?

What is the possible danger when a gas is liberated in a tightly stoppered bottle?

Give an illustration of a prescription in which carbon-dioxide is liberated unintentionally.

To what is the liberation of carbon dioxide due in a mixture containing phenol, sodium bicarbonate, sodium borate, glycerin and water?

Under what conditions may ammonia gas be liberated?

Give an illustration of an explosion due to a reducing agent.

How do strong acids act upon alcoholic liquids?

What is the result at times when tannin-like substances are mixed with spirit of nitrous ether?

What substances, when decomposed, liberate disagreeable odors?

What substances will decompose solution of hydrogen dioxide, liberating oxygen?

Change in color—Give an illustration of decolorization which indicates that the preparation no longer possesses its original medicinal value.

Cite an instance in which a colorless compound is formed, of value equal to the original colored substance.

To what cause may the production of an inky color usually be attributed?

Give illustrations of some surprising changes in color caused by acids or alkalies acting upon organic substances.

Mention some of the color changes which may result with combinations of the following synthetics:. Acetanilide; antipyrine; resorcinol; phenyl salicylate.

Mention other changes in color resulting from chemical action.

Production of heat—Enumerate instances in which this phenomenon may occur.

Immiscible liquids formed by chemical reaction—Cite instances illustrating this incompatibility. What is meant by physical incompatibility?

In instances where the active constituents separate how may the skill of the dispenser overcome the difficulty? Mention specific cases.

If the separated matter is proven to be inert what should be the remedy?

Give illustrations of the separation of a precipitate due to a difference in menstrua.

Of a precipitate due to a difference in solvents.

When substances, prescribed together, are immiscible, what general rules should govern the dispenser?

When substances are not completely soluble what shall determine his course?

Give instances in which gelatinization may occur.

Under what circumstances may volatile oils separate from solution?

Incompatibility in solid preparations—Enumerate instances in which a chemical change produces an insoluble substance.

What combinations of solid substances will produce the evolution of a gas?

Mention changes of color which may occur in various solid preparations, as powders, ointments and capsules.

Enumerate substances which may cause explosions when rubbed with reducing agents.

Under what conditions do powders sometimes become moist or turn to a liquid, due to chemical action?

When may this same result be due to a physical change simply?

Mention a number of substances which liquefy when rubbed together.

How may such difficulties be remedied?

If the resulting combination, as prescribed, is unfitted in consistence for dispensing, what rule should the compounder follow?

Mention substances, prescribed for dispensing in the form of solids, which are immiscible.

What may sometimes remedy this difficulty?

What is meant by therapeutical incompatibility? Give examples.

CHAPTER LXVII

SOLID EXTEMPORANEOUS PREPARATIONS

What kind of substances should not be administered in powders? (See page 1184).

Compound acetanilide powder—Give the Latin official title. Name the ingredients.

What percentage of acetanilide does it contain?

How is it made? For what is it used medicinally? Give the dose.

Aromatic powder—What is the Latin title? What are the ingedients? For what is it used?

Compound chalk powder—Give the Latin official name. How is it prepared? For what is it used?

Compound effervescing powder—Give the Latin official name.

Give the synonym. What are the ingredients?

Compound powder of glycyrrhiza—Give the Latin official name. What is the synonym?

What are the ingredients? For what is it used medicinally?

Powder of ipecac and opium—Give the Latin official name.

Give the synonyms. What are its ingredients and their proportions? For what is it used medicinally?

Compound powder of jalap—Give the Latin official name. Give the synonym.

What are the ingredients? For what is it used medicinally?

Compound powder of morphine—Give the Latin official name.

Give the synonym. What are the ingredients?

What is the proportion of morphine sulphate? For what is it used medicinally?

Compound powder of rhubarb—Give the Latin official name.

What are the ingredients? By what synonym is it known? For what is it used medicinally?

Give the general formula for triturations.

What trituration is official?

Give its formula. What is its medicinal value?

What color of paper should be used for wrapping packages? How should the package be wrapped?

Describe a seidlitz powder measure. Is such a measure accurate?

Describe a covered prescription sieve.

How may powders of uniform size and weight be divided without having to weigh each powder?

How can powder papers be folded so as to present a uniform appearance?

Describe Michael's powder divider. Weills's powder divider.

What is a cachet, or, as sometimes called, "cachet de pain"?

How are cachets used?

How is wafer-sheet prepared?

How is it used for taking powders?

How may bottles be utilized for sealing cachets?

Describe the cachet apparatus sold by J. M. Grosvenor and Co.

Describe Johann Schmidt's "Saccelli amylacei" and 'dryseal" cachet apparatus.

What are tablet triturates? How are they made?

What are troches, and how are they used?

Describe Hahn's pestle-cap.
For what purpose is it used?
How is the mass prepared for making troches?
How are troches cut?
What contrivances are used to give them uniformity?
Give the English official names of the following varieties of troches and the quantity of the medicinal ingredient contained in one of each:
Trochisci acidi tannici.
Trochisci ammonii chloridi.
Trochisci cubebæ.
Trochisci gambir.
Trochisci glycyrrhizæ et opii.
Trochisci krameriæ.
Trochisci potassii chloratis.
Trochisci cantonini.
Trochisci sodii bicarbonatis.
What are confections?
By what other names are these preparations known?
What is the basis of confections?
How many confections are official?
Name them.
How is confection of rose prepared?
How is confection of senna prepared?
How many pill masses are official?
How is mass of ferrous carbonate prepared? What is its synonym?
What preparation of iron does the finished mass contain?
What chemical reaction takes place between ingredients of the mass?
Mass of mercury—Give the Latin official name. Give the synonym.
How is it prepared? What proportion does the mercury bear to the mass?
How long should the ingredients be triturated? How may the presence of mercurous oxide or mercuric acid be detected?
Describe Day's pill mass mixer.
Describe Day's pill mass roller.
What are pills?
Of what two parts does a pill mass consist?
What are the essential requirements of a pill mass?
Give the names of some of the more ordinary excipients.
Give the formula for making a convenient, general excipient.
How may pill masses be conveniently divided into pills?
How is a pill tile used in making pills?
Describe a "pill machine".
Describe Michael's pill cutter.
Describe the Diamond pill cutter.
When should dusting powder be used in making pills? What kind of powder may be used? How may pills be "finished"?
Describe Colton's modern pill plant.
Give the formulas for the following pills, official in the U. S. Pharmacopœia:
Pilulæ aloes.
Pilulæ aloes et ferri.
Pilulæ aloes et mastiches. What is the synonym?
Pilulæ aloes et myrrhæ.
Pilulæ asafœtidæ.
Pilulæ catharticæ compositæ.
Pilulæ catharticæ vegetabiles.
Pilulæ ferri compositæ. What are the synonyms?
Pilulæ ferri iodidi.
Pilulæ laxativæ compositæ.
Pilulæ opii.
Pilulæ phosphori.
Pilulæ podophylii, belladonnæ et capsici.
Pilulæ rhei compositæ.
With what substance are pills coated?
Describe the sugar coating of pills. Chocolate coating.
Describe the earliest methods for gelatin coating. How was this improved by Allaire?

Describe Maynard's pill coater.
Describe Franciscus' pill coater.
Describe Palethorpe's pill coater.
Describe Patch's pill coater.
How is the vacuum used in pill coating?
How may pills be coated with salol or keratin?
What are such pills called?
What property do they possess?
What is "pearl" coating? How may pills be coated with gold or silver?
How are compressed pills or troches made?
What are the advantages of compressed pills?
What treatment is required by powders before they can be compressed?
What is meant by "granulating" the powder before compressing?
What substances are used as lubricants?
What varieties of gelatin capsules are made?
How are they made?
How are empty capsules filled?
Describe Raymond's capsule filler.
Describe Parke, Davis Company's capsule filler
Describe Ihrig's capsule filler.
What are "pearls" or "globules"?
Describe how these are made. What are their advantages?
What are suppositories?
What is ordinarily the best base for suppositories?
How are gelatin suppositories made?
Give the formula for glycerinated gelatin. How is it made?
How are suppositories of glycerin made?
What is the usual size of suppositories?
In what different ways are suppositories made?
How are rolled suppositories made?
How are moulded suppositories made?
What varieties of moulds are used in making them?
What is the greatest objection to individual moulds?
What are the advantages of divided moulds?
What is the best form of divided mould?
Wherein do hinged moulds differ from divided moulds?
How are compressed suppositories made?
Describe Archibald's suppository machine.
Describe Whitall, Tatum Company's suppository machine.
Describe the "Rapid fire" suppository machine.
Describe Colton's power suppository machine.
What is a suppositer, and for what is it used?
How are capsules used for suppositories?
Of what are urethral suppositories or bougies preferably made, and why?
How should suppositories be dispensed?

CHAPTER LXVIII

SOLID EXTEMPORANEOUS PREPARATIONS USED EXTERNALLY

What are cerates? (See page 1256.) Why are they so called?
How are cerates made?
How many cerates are official?
Give the formulas and official process for the following cerates, viz.:
Cerate—Give the Latin official name. What is the synonym?
Camphor cerate—Give the Latin official name.
Cantharides cerate—Give the Latin official name. Give the synonym.
Cerate of lead subacetate—Give the Latin official name. Give the synonym.
Rosin cerate—Give the Latin official name. Give the synonym.
Compound rosin cerate—Give the Latin official name. What is the synonym?
What are the ingredients in rosin cerate? In compound rosin cerate?
What are ointments? In what different ways are ointments made?

In making ointments by fusion, what precaution is necessary?
How may mechanical impurities be separated?
How are ointments made by incorporation?
What official ointment is made by chemical reaction?
What three maxims should be observed in making or dispensing ointments?
Give the formulas and modes of making the following ointments, viz.:
Ointment—Give the Latin official name.
Ointment of boric acid—Give the Latin official name.
Ointment of tannic acid—Give the Latin official name.
Ointment of rose water—Give the Latin official name.
Belladonna ointment—Give the Latin official name.
Chrysarobin ointment—Give the Latin official name.
Diachylon ointment—Give the Latin official name.
Nutgall ointment—Give the Latin official name.
Mercurial ointment—Give the Latin official name.
What percentage of metallic mercury should mercurial ointment contain? How may it be assayed?
Ointment of ammoniated mercury—What is the Latin official name?
Blue ointment—What is the Latin official name? What percentage of mercury should it contain?
Ointment of mercuric nitrate—Give the Latin official name. Give the synonym.
Ointment of yellow mercuric oxide—Give the Latin official name.
Ointment of red mercuric oxide—Give the Latin official name. What is the synonym?
Iodine ointment—Give the Latin official name.
Iodoform ointment—Give the Latin official name.
Ointment of phenol—What is the Latin official title? What were the official Latin and English titles in the U. S. P. 1890?
Ointment of potassium iodide—Give the Latin official name.
Stramonium ointment—Give the Latin official name.
Sulphur ointment—Give the Latin name.
Veratrine ointment—Give the Latin official name.
Ointment of zinc oxide—Give the Latin official name.
Ointment of zinc stearate—Give the Latin official name.
How may cerates and ointments be preserved from rancidity?
What kinds of jars are the best receptacles for ointments?
What is the best-shaped jar for dispensing ointments?
How are collapsible tubes used for ointments?
What sort of wooden boxes are best for ointments?
How may a neat finish be given to ointments in boxes?
What are plasters?
What is the basis of most of the official plasters?
How may spread plasters be softened?
How many plasters are official?
Give the formulas and modes of making the following plasters, viz.:
Adhesive plaster—Give the Latin official name.
Belladonna plaster—Give the Latin official name.
What percentage of mydriatic alkaloid should be present? How may it be assayed?
Capsicum plaster—Give the Latin official name.
Mercurial plaster—Give the Latin official name.
Opium plaster—Give the Latin official name.
Lead plaster—Give the Latin official name. Give the synonym.
Soap plaster—Give the Latin official name.
Upon what substances are plasters usually spread?
What is the method of proceeding in spreading a plaster upon leather?
What advantage has a plaster-iron over a spatula for spreading plasters?
What advantage has a spatula over a plaster-iron?
How are blisters spread?
What is a good material upon which to spread them?
What are chartæ or papers?
How many are official?
How is mustard paper prepared?
How is mustard paper used?
How much mustard does each square inch contain?
Before applying mustard paper to the skin how should it be treated?
Why should warm water be used and not hot water?

INDEX

HEAVY BLACK FIGURES INDICATE PAGES UPON WHICH WORKING PROCESSES WILL BE FOUND

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