This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

nders' Question Compends

ESSENTIALS OF PHARMACY

PROF. L. E. SAYRE

JUST ISSUED.

Professor of Surgery in Rush Medical College, Chicago, and in the Chicago Polyclinic.

PRICE, $2.00.
Send post-paid on receipt of price.

This the latest work of its eminent author, hims one of the contributors to the "American Text-Book Surgery," will prove of exceptional value to the advan student who has adopted that work as his text-book. I not only the syllabus of an unrivalled course of Surg *Practice,* but an [illegible] t to the la *work.*

Form 44—20m—Oct. 3, '93

IN PREPARATION.

A Manual of Surgery,

GENERAL AND OPERATIVE.

BY

JOHN CHALMERS DACOSTA, M.D.,

Demonstrator of Surgery, Jefferson Medical College; Chief Assistant, Surgical Out-Patient Department, Jefferson Medical College Hospital; Surgical Registrar, Philadelphia Hospital.

A new Manual of the Principles and Practice of Surgery, intended to meet the growing demand by students and others for a medium-sized work which will embody all the newer methods of procedure so fully detailed in the larger text-books, but written in a concise, brief style.

Considerable space will be devoted to Surgical Bacteriology, Asepsis, and Antisepsis, with full details of the various methods of disinfecting instruments, the hands, etc., as well as the preparation of the various drugs and materials used.

The illustrations are mostly new, the long and close connection of the author with the Jefferson Medical College Hospital having given him unusual opportunities for obtaining original and thoroughly representative plates.

The book will be of a handy and convenient size of about 400 pages, printed on fine paper, and well and substantially bound.

PRICE:—CLOTH, $1.00; INTERLEAVED, FOR TAKING NOTES, $1.2

Saunders' Question-Compenc

Arranged in the form of Questions and Answers.

☞ THE LATEST, CHEAPEST AND BEST ILLUSTRATED SERIES OF COMPENDS. ☜

☞ *New York Medical Record*, AUGUST 23d, 1890:—
"Where the work of preparing Students' Manuals is to end we cannot but the Saunders series, in our opinion, bears off the palm at present."

University Medical Magazine:—"Best of their class that have yet appeared.

Southern California Practitioner:—
"Mr. Saunders' series of Compends are the best ever published in this country.

No. 1.—ESSENTIALS OF PHYSIOLOGY. Third edition. Finely illustr Revised and greatly enlarged by H. A. HARE, M.D. (Price, $1.00, net

No. 2.—ESSENTIALS OF SURGERY. With Appendix on Antiseptics. edition. 90 illustrations. By EDWARD MARTIN, M.D.

No. 3.—ESSENTIALS OF ANATOMY. Based on GRAY. Fourth edition illustrations. By CHARLES B. NANCREDE, M.D.

No. 4.—ESSENTIALS OF MEDICAL CHEMISTRY, ORGANIC AND I GANIC. Fourth Revised edition. With an Appendix By LAWR WOLFF, M.D.

No. 5.—ESSENTIALS OF OBSTETRICS. Third edition. Revised and gr enlarged. 75 illustrations. By W. EASTERLY ASHTON, M.D.

No. 6.—ESSENTIALS OF PATHOLOGY AND MORBID ANATOMY. S thousand. 46 illustrations. By C. E. ARMAND SEMPLE, M.D.

No. 7.—ESSENTIALS OF MATERIA MEDICA. Therapeutic and Perscrip Writing. Second edition. Sixth thousand. By HENRY MORRIS, M.D

Nos. 8 and 9.—ESSENTIALS OF PRACTICE OF MEDICINE. By H MORRIS, M.D. And an Appendix on URINE EXAMINATION. Illustrated. LAWRENCE WOLFF, M.D. Third edition, enlarged by some 300 Esse Formulæ, selected from eminent authorities, by WM. M. POWELL, M.D. (Do number, price, $2.00.)

No. 10.—ESSENTIALS OF GYNÆCOLOGY. With 58 illustrations. Sec edition. By EDWIN B. CRAGIN, M.D.

No. 11.—ESSENTIALS OF DISEASES OF THE SKIN. Second edition. illustrations. By HENRY W. STELWAGON, M.D.

No. 12.—ESSENTIALS OF MINOR SURGERY BANDAGING AND VE REAL DISEASES. Second edition, revised and enlarged. 80 illustra By EDWARD MARTIN, M.D.

No. 13.—ESSENTIALS OF LEGAL MEDICINE, TOXICOLOGY AND GIENE. 130 illustrations. By C. E. ARMAND SEMPLE, M.D

No. 14.—ESSENTIALS OF DISEASES OF THE EYE, NOSE AND THRO 118 illustrations. By EDWARD JACKSON, M.D., and E. BALDWIN GLEA M.D.

No. 15.—ESSENTIALS OF DISEASES OF CHILDREN. By WILLIAM M. ELL, M.D.

No. 16.—ESSENTIALS OF EXAMINATION OF URINE. Colored " SCALE," and numerous illustrations. By LAWRENCE WOLFF, M.D. (75 cents.)

No. 17—ESSENTIALS OF DIAGNOSIS. BY S. SOLIS-COHEN M.D. and GOHNER, M.D. 55 illustrations (some of which are colored), and a f piece. (Price, $1.50, net,)

No. 18—ESSENTIALS OF PRACTICE OF PHARMACY. By L. E. SAYR

No. 20.—ESSENTIALS OF BACTERIOLOGY. Second edition, revised. 81 il tions (some colored) and 5 plates. By M. V. BALL, M.D.

No. 21.—ESSENTIALS OF NERVOUS DISEASES AND INSANITY. Second e revised. 48 original illustrations. By JOHN C. SHAW, M.D.

No. 22.—ESSENTIALS OF MEDICAL PHYSICS. Second edition, revised. 15 trations. By FRED J. BROCKWAY, M.D. (Price, $1.00, net.)

No. 23.—ESSENTIALS OF MEDICAL ELECTRICITY. 65 illustrations. By D. STEWART, M.D., and EDWARD S. LAWRENCE, M.D.

☞ **Sent post-paid on receipt of price.** ☜

SAUNDERS' QUESTION-COMPENDS, No. 18.

ESSENTIALS OF PRACTICE OF PHARMACY.

ARRANGED IN THE FORM OF

QUESTIONS AND ANSWERS.

PREPARED ESPECIALLY FOR

PHARMACEUTICAL STUDENTS.

(SECOND EDITION, REVISED.)

BY

LUCIUS E. SAYRE, Ph. G.,
PROFESSOR OF PHARMACY AND MATERIA MEDICA, OF THE SCHOOL OF PHARMACY OF THE UNIVERSITY OF KANSAS.

PHILADELPHIA:
W. B. SAUNDERS,
925 Walnut Street.
1894.

PRESS OF
W. B. SAUNDERS,
PHILA.

PREFACE TO SECOND EDITION.

(REVISED.)

THE present edition contains a complete revision of the text of the former book, and this text is made to correspond with the United States Pharmacopœia of 1890. There have been also numerous additions made, notably: An Outline of Drug and Plant Analysis, Structural Formulæ of Organic Carbon Compounds used in Medicine, Pharmaceutical Testing of Inorganic Chemicals, and Problems in Allegation and Specific Gravity. For these problems and answers I am indebted to Mr. S. R. Boyce, Assistant in Pharmacy in the School of Pharmacy of the University of Kansas. His use of the book in the class-room has convinced him of the importance of this addition in meeting the practical needs of the student.

L. E. S.

PREFACE.

This little volume has been written at the request of a few friends who claim some knowledge of my method of presenting pharmaceutical topics, in a tangible form, to the students as Quiz-master. Facing a class with a set of questions made to suit the hour, is a very different thing from writing a compend embracing a series of questions in proper sequence and logical order, such as will comprehend the subject in hand. If this little work fails to accomplish this object, the author feels inclined to say to his disappointed friends that herein lies the cause.

The motto of the student is, in these days of intense activity, get all you can in the shortest time. The author suggests here the old proverb:

> "Get what you can, and what you get, hold,
> 'Tis the stone which will turn your lead into gold."

One of the objects of this book is to assist the student in holding the instruction he receives in the study of pharmacy. On the other hand, it is to open up and map out the subject to the young student in a way that is comprehensible and easily followed. In doing this the Pharmacopœia has been strictly adhered to, and only when felt driven to do so, has the author turned aside from this standard. He believes in making the Pharmacopœia the central figure in pharmaceutical study. If the student familiarizes himself with that book, he becomes capable of branching into directions of scientific study for which he finds ample help in text-books.

The author has followed a classification which differs in a measure from the leading text-book—"Remington's Practice" —not because he thinks it better, but more particularly to give the student variety. It will be observed that a classification somewhat consistent with the chemistry of the carbon compounds is made in the organic part of the work. The student cannot too early become familiar with such classifications.

The author is indebted to various writers, whose works have been consulted, notably, Remington, Parrish, Potter, Attfield, Watt and others. An article by Joseph W. England, in the *Journal of Pharmacy* for January, 1890, has materially aided him in the part relating to incompatibility. He desires especially to thank Prof. Oscar Oldberg, who so kindly put at the writer's disposal any part of his valuable writings.

L. E. S.
University of Kansas.

CONTENTS.

ESSENTIALS OF PHARMACY.

INTRODUCTORY.

PHYSICS.

Metrology.

WEIGHT measures the attraction of the earth upon a body.

VOLUME is the space occupied by a certain amount of matter.

SPECIFIC WEIGHT is the relation of the weight of a body to its bulk—the relative weight of equal bulks of different bodies.

SPECIFIC VOLUME is the relation of the volume of a body to its weight—the relative volume of equal weights of different bodies.

STANDARDS OF WEIGHTS AND MEASURES.—These are dependent upon linear measure; best illustrated by the decimal system of weights and measures. In that system the *meter* is the standard unit of linear measure. This meter is the ten-millionth part of the distance from the equator to the poles, which is the basis of the whole system. The cube upon the one-tenth of the meter (decimeter) is the standard unit of fluid measure, the *liter;* the *gram*, which is the standard unit of weight, is the weight of *one cubic centimeter* (the cube upon the one hundredth part of the meter) of pure water. (See below.)

The English and American *inch* (based upon the length of a pendulum vibrating seconds, in vacuum) is the basis of the Avoirdupois and Troy weight; the weight of one cubic inch of pure water (at 62° F. under the pressure of one atmosphere) is declared to be 252.458 grains. The *Avoirdupois pound* is equal to 7000 of such grains; and the *Troy pound* is equal to 5760 grains.

Systems of Weights and Measures employed in Pharmacy.

TROY OR APOTHECARIES' WEIGHT is used largely in dispensing, while the wine or Apothecaries' measure is employed for liquids (except in compounding, when the Pharmacopœia directs, in most cases, liquids to be weighed).* The table of this system is as follows:

20 grains (grs.), = 1 scruple (℈j).
3 scruples, = 1 drachm (ʒj).
8 drachms, = 1 ounce (℥j), or 480 grains.
12 ounces, = 1 pound, or 5760 grains.

AVOIRDUPOIS WEIGHT.

$27\frac{11}{32}$ grains, = 1 drachm (1 dr.).
16 drachms, = 1 ounce (1 oz.).
16 ounces, = 1 pound, or 7000 grs. (1 ℔.).

---

* The Committee of Revision of the Pharmacopœia for 1890–1900 has been instructed as follows: "To direct solids to be weighed and liquids to be measured, except in such cases as they find it advisable to use weights only, and that the metric system be employed for this purpose."

WINE OR APOTHECARIES' MEASURE ("*American*").

60 minims (♏), = 1 fluid drachm (fʒj).
8 fluid drachms, = 1 fluid ounce (f℥j).
16 fluid ounces, = 1 pint (Oj).
8 pints, = 1 gallon (Cong. j).

THE MEASURE RECOGNIZED BY THE BRITISH PHARMACOPŒIA is known as *Imperial measure;* the table is as follows:

60 minims, = 1 fluid drachm.
8 fluid drachms, = 1 fluid ounce.
20 fluid ounces, = 1 pint.
8 pints, = 1 gallon (10 lbs. Avoir.).

The MINIM is a variable expression of fluid measure. The *minim of American fluid measure* of water at its greatest density weighs about 0.95 grain, being the 480th part of the American fluid ounce of 455.7 grains of water. The *British minim* being the 480th part of the British fluid ounce of 437½ grains of water, weighs about 0.91 grain.

The American fluid ounce of water weighs 455.7 grains, and is $\frac{1}{16}$ of the American pint of 7291.1 grains of water.

The British fluid ounce of water weighs 437½ grains, and therefore corresponds with their weight standard (avoirdupois) ounce. It is $\frac{1}{20}$ of the British Imperial pint.

The American fluid drachm of water weighs 56.96 grains, being $\frac{1}{8}$ of the American fluid ounce of 455.7 grains of water.

The British fluid drachm of water weighs 54.68 grains, being $\frac{1}{8}$ of the British fluid ounce of 437½ grains of water.

The Metric System.

The units in the metric system are as follows:—

THE METER (unit of length = 39.37 inches).
" GRAM (" " weight = 15.432 grains)
" LITER (" " fluid measure = 33.814 U. S. fluid ounces).

The names of the subdivisions of these units are expressed by prefixing the Latin numerals, milli, centi, and deci, and the names of the multiples by prefixing the Greek numerals, deka, hecto, and kilo, to the unit. These prefixes, arranged in numerical relation, furnish a table as follows:—

Decimal System.		Written.
10 Milli- (.001)	= 1 Centi-	.01
10 Centi-	= 1 Deci-	.1
10 Deci-	= 1 Unit	1.
10 Units	= 1 Deka	10.
10 Deka-	= 1 Hecto-	100.
10 Hecto-	= 1 Kilo-	1000.

If the student will supply or insert a unit (Gram, Liter or Meter) after each one of the above prefixes (milli, centi, etc.) he will have practically a complete table of the metric system.

The cubic centimeter and the gram.

Fluid measure in the metric system is usually stated, in dispensing, in *cubic centimeters* (abbreviated c.c). The intimate connection between the cubic centimeter and gram is interesting: this connection will be seen at once, as one c.c. of distilled water (at 4° C.) weighs one gram. Hence the cubic centimeter is sometimes called a "fluid gram" (fluigram).

Approximate equivalents in other systems.

The following are given as some of the principal equivalents for the student to commit to memory:—

I. LINEAR MEASURE.

1 Meter (1.) = 39.37 inches (3 ft. 3 inches and ⅜ inch).
1 Centimeter (.01) = two-fifths inch.
5 Centimeters (.05) = two inches.
25 Millimeters (.025) = one inch.

II. LIQUID MEASURE.

1 Liter = 33.8 fl. oz. (2 pts., 1 fl. oz., 6 fl. dr., 30 m.).
1 c.c. = 16.23 minims (15.43 grains).

III. WEIGHT.

1 Gram (1.) = 15.43 grains.
1 Milligram (.001) = $\frac{1}{64}$ grain.
8 " (.008) = $\frac{1}{8}$ grain.
64 " (.064) = 1 grain.
1 Kilogram (1000.) = about two lbs. avoirdupois (2.205 lbs.)
(about 2 lbs. 8 oz. Troy)

IV. APOTHECARIES' INTO METRIC.

1 fl. oz. = 29.57 c.c.
1 fl. dr. = 3.7 c.c.
1 Troy oz. = 31.103 grams.
1 Av. oz. = 28.350 grams.

(Remember that the $\frac{1}{8}$ grain and 8 milligrams are about equal; from this data milligrams may be converted into grains and vice versa.)

Computation of equivalents.—(*Approximate, see Oldberg, Weights and Measures*).

To convert c.c. into minims or grams into grains.—Multiply by 16.

To convert c.c. into fluid drachms or grams into drachms.—Divide by 4.

To convert grams into Troy ounces or c.c. into fluid ounces.—Divide by 32.

To convert multiples or subdivisions of any metric unit, first convert the multiple or subdivision into the unit or the fractions of the unit and use the above rules, *e. g.*:—

CONVERT 482 MG. INTO GRAINS.—First convert 482 mg. into gms., which is done by simply pointing off three places; 482 mg. then = .482 gm. Applying the above rule, we have .482 gm. × 16 = 7.712 grs.; again—

CONVERT 8 MG. INTO GRAINS.—8 mg. = .008 gm.; multiplying by 16 we have .128 gr. or $\frac{1}{8}$ gr.

To convert minims into c.c. or grains into grams.—Divide by 16.

To convert fl. dr. into c.c. or drachms into grains.

Multiply by 4.

To convert Troy oz. into grams, or fl. oz. into c.c.
Multiply by 32.

Approximate equivalents of domestic measures.

A tablespoonful, = ʒ v or 20 c.c. (usually stated f℥ss).
A dessertspoonful, = ʒ ijss or 10 c.c. (usually stated fʒ ij).
A teaspoonful, = ♏lxxx or 5 c.c. (usually stated fʒj).

The drop varies in size according to the liquid and mode of dropping. An ordinary eye pipette delivers drops of water about one-half minim (.03 c.c).

Scales and Balances.

SCALES is a term applied to the more common weighing instruments in general.

BALANCES are delicate weighing instruments which indicate at least 1 mg. ($\frac{1}{64}$ gr.), having *knife edges* (usually of nickel or agate) on which the *beams* and *hangers* are equipoised. They are also provided with *rests* to keep them in a state of repose, and *riders* placed on notches on the beam, by which minute differences of weight are determined. Such a balance should be kept in a glass case, to prevent the influences of draughts of air, weather, heat, dust, etc. They should be perfectly true by the spirit level, and on a solid foundation. Delicate balances are usually supplied with cases having set screws on the bottom for leveling. The pans are generally of metal and movable; these should be reversed daily.

Watch crystals are useful for weighing certain corrosive chemicals. Glass or horn pans also are used. *In a properly constructed balance* the arms are of equal length, weight and form, and the pans with their appendages must be equal. The relative positions of the center of gravity and the fulcrum influence materially the character of the instrument. If the center of gravity be too far below the fulcrum, the vibrations will be rapid and of short duration, and a considerable weight will be required to turn the lever. By elevating the center of gravity, the vibrations will become slower. *In balances intended for heavy loads* the center of gravity is therefore lower than in delicate instruments. Every balance requires to be examined from time to time, no matter how frequently or rarely used.

Specific gravity. (For Problems, see pages 29–33.)

The Pharmacopœia refers to sp. gr. in the following words: "The specific gravity of liquids should be ascertained, if accuracy is required, by means of a specific gravity bottle of suitable capacity at a definite temperature. The specific gravity of alcohol, or of any mixture of alcohol and water may, however, also be ascertained by means of an accurate hydrometer, preferably that prescribed by the U. S. Government for the use of the internal revenue and custom house officers. Whenever specific gravity is mentioned in the Pharmacopœia without reference to temperature, it is to be understood to refer to a temperature of 15° C. (59° F.)."

Pycnometers or specific gravity bottles.

A specific gravity bottle is a bottle having a glass stopper with a capillary opening through it, and of a size to contain accurately 1000 grains (sometimes 500 or 100 grs.) of distilled water at standard temperature. Such a bottle is accompanied with a weight which exactly counterpoises it. In using, the bottle is carefully filled with the liquid to be examined, then dried externally, and then placed on the scales and weighed. The increased or decreased amount of the weight of the liquid divided by 1000 will give its specific gravity.

Care of specific gravity bottles.

The bottle should be wiped dry to remove adhering moisture or dust; and handled as little as possible while containing the liquid under operation, to prevent change of temperature. Specific gravity bottles of fair accuracy may be made by the student himself. Select a small, well-stoppered bottle, clean, weigh, and make a note of the exact counterpoise, for future reference; then the quantity by weight of pure water at the standard temperature that this bottle is capable of holding, is ascertained, and also noted. The latter weight will be the divisor; the dividend will be the weight of any liquid of which the specific gravity is wanted.

Hydrostatic Balance.

The hydrostatic balance is an accurate balance so arranged that one of the pans is suspended with a shorter stirrup and to the bottom of the pan is attached a hook from which a substance may be suspended by means of a horse hair or piece of thread. The substance is first weighed in the usual manner, the weight is carefully noted as the weight of the substance in air. Then the substance is weighed suspended in water and the weight again noted. The latter weight will show a decrease of the weight in the air; by dividing the weight of the substance by the loss of the weight in water we have the specific gravity of the substance.

Scheme for conversion of Solid Ounces to Fluid, and vice versâ:

$$\left.\begin{array}{lll}\text{Troy} & \times\ 1.05 & = \\ \text{Gm.} & \times\ .0338 & = \\ \text{Avoir.} & \times\ .96 & = \end{array}\right\} \text{f℥j} \left\{\begin{array}{ll} \times\ 1.04 & = \text{Avoir.} \\ \times\ 29.57 & = \text{Gm.} \\ \times\ .95 & = \text{Troy.}\end{array}\right.$$

Thermometry.

Method of constructing and graduating a thermometer.

A glass tube of uniform bore, having a bulb at one end, is heated over a flame to form a partial vacuum; while heated it is inverted in mercury; on cooling the mercury rises in the bulb, owing to the contraction of the volume of air. The tube is then heated until the mercury overflows, when the tube is quickly sealed by a blowpipe. In graduating, the thermometer is inserted in pounded ice and the lowest point to which the mercury column falls will be the freezing point.

The thermometer is then put in boiling water and the point to which the mercury rises will be the boiling point. For intermediate temperatures intermediate marks are made.

There are three different thermometric scales in use, namely: *Fahrenheit, Centigrade, and Reaumur.*

COMPARISON OF THE DIFFERENT SCALES.

	F.	C.	R.
Boiling point	212°	100°	80°
Freezing	32°	0°	0°
Difference.	180°	100°	80°

In order to change the expression of a temperature from one scale to another the following formulæ are useful:

$$*C = \frac{F - 32,}{1.8} \quad F = 1.8\,C + 32 \quad R = (F - 32)\,\tfrac{4}{9}$$

$$C = \tfrac{5}{4}\,R. \quad F = \tfrac{9}{4}\,R + 32 \quad R = \tfrac{4}{5}\,C.$$

* C = Centigrade. F = Fahrenheit. R = Reaumur.

Therefore it is evident that, for example, to reduce Fahrenheit to Centigrade it is first necessary to subtract 32 and then divide by 1.8. The remaining formulæ to be worked as indicated.

Microscopy.

A simple microscope consists of but one double convex lens to be held near to the object, or of two or more lenses that can be used singly or all at the same time. When thus used in combination, the two or three simple lenses are not only placed close to each other, but close to the object, the combination acting as though it were a simple lens of much greater magnifying power. In the compound microscope the lenses near the eye magnify the *image* produced by the lower glasses. By separating the lenses of a simple microscope so that the upper shall magnify the image produced by the lower, one has a simple form of a *compound microscope.*

THE ESSENTIAL PARTS OF A COMPOUND MICROSCOPE.

The eyepiece = The lens next the eye.
The objective = The lens next the object.

Magnification.

To compute the magnification given by a microscope it is necessary to multiply together the separate magnification due to the eyepiece and objective. Practically manufacturers use the following formula (not entirely accurate for calculating the magnification*): Divide 100 by the product of what are called the focal length of objective and eyepiece expressed in inches. For example: Two-inch eyepiece and $\frac{1}{5}$ objective. To find the magnifying power: Applying the above rule, $2 \times \frac{1}{5} = \frac{2}{5}$; $100 \div \frac{2}{5} = 250$ diam., the magnifying power. The manufacturers send with their instruments cards referring to the magnifications of the lenses, of which the following is an abstract:—

TUBE OF STANDARD LENGTH (10 INCHES.)

OBJECTIVE.	1 INCH.	$\frac{1}{2}$ INCH.	$\frac{1}{5}$ INCH.	$\frac{1}{16}$ INCH.
Eyepiece . . .				
2 inch (A. . .	46	92	275	800
1 inch (C). . .	80	165	485	1500
$\frac{1}{2}$ inch (E). . .	160	330	970	3000

It will be seen from the above that the eyepieces are sometimes lettered instead of numbered.

The Microscope and the Pharmacopœia.—Generally in descriptions of crude drugs it is sufficient to indicate the distinctive

---

* See paper by W. LeConte Stephens, *American Journal of Science,* vol. XL, July, 1890.

characteristics that are visible to the naked eye, "and, when necessary, such as are visible under an ordinary good pocket lens magnifying about ten diameters." Ex.—Unguentum Hydrargyri, Amylum, Aloe, Lycopodium, etc. For expert work the compound microscope is invariably called into requisition. *The microscopical unit of measurement* is the 1000th of a mm., known as the *micromillimeter* (mkm).

Alligation in Pharmacy.

Alligation is the process of mixing substances of different values to produce a mixture of given mean value.

1 *Problem.*—Given 2 ℔s. of a certain powder at 7 per cent., 3 ℔s. of another powder at 8 per cent., 5 ℔s. of another at 16 per cent. and 6 ℔s. of another at 18 per cent.; to find the average per cent.

SOLUTION.

$$\begin{array}{rcrcr}
.07 & \times & 2 & = & 14 \\
.08 & \times & 3 & = & 24 \\
.16 & \times & 5 & = & 80 \\
.18 & \times & 6 & = & 1.08 \\
 & & \overline{} & & \overline{} \\
 & & 16 &) & \underline{226} \\
 & & & & 14\tfrac{1}{8}\text{ per cent.}
\end{array}$$

Rule.—Multiply the percentage of each kind by the number of it. Add the products. Divide the sum of the products by the sum of the numbers.

2 *Problem.*—Given 4 ℔s. of powder at 7 per cent., to be mixed with three other kinds at 8 per cent, 16 per cent and 18 per cent., so that the mixture shall average 14 per cent. To find the amounts of the 8, 16 and 18 per cents. that must be used.

SOLUTION.

By the Linking Method

$$\text{Average } 14\left\{\begin{array}{l} \left[\begin{array}{l} 7 \\ \left.\begin{array}{l} 8 \\ 16 \end{array}\right] \end{array}\right. \\ \left.\begin{array}{l} \\ 18 \end{array}\right\rfloor \end{array}\right. \begin{array}{r} \ldots\ldots\ldots\ 2 \\ \ldots\ldots\ldots\ 4 \\ \ldots\ldots\ldots\ 7 \\ \ldots\ldots\ldots\ \underline{6} \\ 19 \end{array}$$

The rates then are for the 1st—$\frac{2}{19}$,	The first, $\frac{2}{19}$ consists of 4 lbs.
2d—$\frac{4}{19}$,	The second, $\frac{4}{19}$ " 8 lbs.
3d—$\frac{7}{19}$,	The third, $\frac{7}{19}$ " 14 lbs.
4th—$\frac{6}{19}$.	The fourth, $\frac{6}{19}$ " 12 lbs.

Explanation.—The 7 per cent. and 16 per cent. kinds when used in certain quantities will give an average of 14 per cent. That is 7 per cent. put into a 14 per cent. average gains 7 per cent. The 16 per cent. put into a 14 per cent. average loses 2 per cent. In a similar manner the 8 per cent. gains 6 per cent. and the 18 per cent. loses 4 per cent.

Therefore, for the average of the 7 and 16 the difference between 14 and 16 gives the proportional part of the 7 per cent. kind, and the difference between 7 and 14 gives the proportional part of the 16 per cent. kind. In the same manner for the 8 and 18. The sum of the parts is equal to 19.

Then, by proportion, find the amounts of the other kinds. Thus:—

$\frac{2}{19} : \frac{4}{19} :: 4$ lbs. : No. lbs of the second = 8 lbs.
$\frac{2}{19} : \frac{7}{19} :: 4$ lbs. : No. lbs of the third = 14 lbs.
$\frac{2}{19} : \frac{6}{19} :: 4$ lbs. : No. lbs. of the fourth = 12 lbs.

Rule.—Find the proportional parts according to the above explanation. Then, by proportion, find the amount of each kind.

3. If the problem be to find the ratio of the ingredients to be used, in order to make a certain definite amount, then the method of solution as given in No. 2 is to be used.

Suppose the mixture to contain 19 lbs., as in No. 2, then $\frac{2}{19}$, $\frac{4}{19}$, $\frac{7}{19}$, $\frac{6}{19}$, of 19 lbs. will be the results required.

PROBLEMS IN ALLIGATION AND SPECIFIC GRAVITY.

In alligation.

(1) How shall samples of powdered opium be mixed (the opium being 6, 8, 10, 15, and 17 per cent. of morphine respectively) to make a mixture containing 12 per cent. of the alkaloid?

(2) How shall one mix 150 lbs. of jalap, containing 14 per cent. resin, with lots containing 9 and 11 per cent. to make an average of 12½ per cent.?

(3) How many pounds of 14 per cent. can be made from 9 pounds of 16 per cent. by diluting with sugar of milk?

(4) How much glycerine shall I mix with water to make 25 pounds of solution having a specific gravity of 1.16?

(5) Wishing to make 150 gallons of 50 per cent. alcohol, how shall one mix lots containing 60, 65, 35, and 20 per cent. respectively?*

(6) How shall I make a solution of KOH, sp. gr. 1.036, from solutions having the sp. gr. of 1.2, 1.25, and 1.4? Use water as 1.

---

* **Rules** of the U. S. P. 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 pure 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 any deficiency in the V volumes by adding more water.

Example.—An alcohol of 30 per cent. by volume is to be made from an alcohol of 94 per cent. by volume.—Take 30 volumes of the 94 per cent. alcohol, and add enough pure water to produce 94 volumes.

II. BY WEIGHT.—Designate the weight-percentage of the stronger alcohol by W, and that of the weaker by w.

Rule.—Mix w parts by weight of the stronger alcohol with pure water to make W parts by weight of product.

Example.—An alcohol of 50 per cent. by weight is to be made from an alcohol of 91 per cent. by weight.—Take 50 parts by weight of the 91 per cent. alcohol, and add enough pure water to produce 91 parts by weight.

(7) How many gallons of official ammonia can be made from 35 gallons of 28 per cent. ammonia? In this example water must be figured at 0 (zero).

(8) How many ounces of scammony containing 80 per cent. resin can be made from 54 ounces, assaying 57 per cent., by mixing with lots containing 85, 90, and 92 per cent. of resin?

(9) How much water will be required to make 5 lbs. of solution of soda, sp. gr. 1.12, from a solution having the sp. gr. of 1.40?

(10) How shall one make 240 gallons of bay rum containing 60 per cent. of alcohol from lots containing 70, 62, 58, and 50 per cent.?

(11) How much 96 per cent. sulphuric acid must be mixed with 20 ounces at 15 per cent., and 30 ounces at 45 per cent., to make 60 per cent. acid?

(12) How much hydrochloric acid, sp. gr. 1.16, 1.12, and 1.10, must be mixed to make 1000 ounces, sp. gr. 1.15?

(13) I have 7 kilogrammes of 60 per cent. and 9 kilos of 80 per cent. alcohol. How shall these be mixed—all into 60 per cent.—and how much will the mixture make? Water is used for dilution of course.

(14) How shall one make 250 gallons of dilute alcohol from official alcohol?

(15) If tincture of capsicum is made from 19 parts by weight of official alcohol to 1 of water, what is the per cent. of absolute alcohol in the menstruum?

(16) How shall I make 32 ounces of salt bath, sp. gr. 1.15, from solutions having sp. gr. of 1.30, 1.27, and 1.20?

Problems in specific gravity.

Rule.—Divide the weight of the substance in air by the weight of an equal bulk of distilled water.

This rule is very simple, is easily comprehended, but to apply it in every case is difficult. In practice the operator is often puzzled to know how he shall best determine the weight of an equal bulk of water. There are certain physical facts the student must remember: (1) Fluids buoy up solids with a force equal to the weight of the fluid displaced by the solid. (2) Floating bodies displace their weight of liquid. (3) Immersed bodies displace their bulk of liquid. For example: A piece of cork is placed upon water. It first displaces its own weight of water, and then floats partially immersed. In order to find its equivalent of water for the purpose of taking its specific gravity, we must attach a sinker, previously weighed under water, and note (weigh) the force with which the cork lifts on the sinker. This buoyancy added to the weight of the cork in air equals the weight of an equal bulk of water. All this procedure is followed, as stated, simply in order *to find out the weight of an equal bulk of water.*

The method of taking specific gravity of solids may be concisely stated as follows:

$$\text{Sp. gr. of solid} = \frac{\text{weight of given substance in air.}}{\text{loss of weight in water.}}$$

Loss of weight in water = weight of an equal bulk of water.

Rule 2.—Divide the weight of the substance in air by the loss of weight in water.

Problem (1). A piece of copper weighs 360 grs.; in water it weighs 320 grs. What is its specific gravity?

(2) A silver chain weighs 848 grs.; in water 768 grs. What is its sp. gr.?

(3) A piece of phosphorus weighs 45¾ grs.; in water 24¾ grs. What is its sp. gr.?

(4) A graduated cylinder contains 30 Cc. of water. When a solid weighing 15 Gm. is dropped into it the water-level is raised to 40 Cc. What is the sp. gr. of the solid?

(5) If 105 grs. of powdered silver be placed in a bottle of 300-gr. water capacity and the bottle filled with water, the combined weight of its contents is 395 grs. What is the sp. gr. of the silver?

(For substances soluble in water use any other suitable liquid—any liquid in which the substance is not soluble. After the operation is completed, make correction by multiplying the result by the sp. gr. of the liquid used.)

(6) A solid soluble in water weighs 680 grs. ; in ether (sp. gr..750) it weighs 540 grs. What is its sp. gr.?

(7) A piece of alum weighs 124 grs.; in oil of turpentine (sp. gr. .870) it weighs 62 grs. What is its sp. gr.?

(8) 450 grs. of sodium chloride weighs 375 grs. in alcohol (sp. gr. .820). What is the sp. gr. of the salt?

(When necessary to use a sinker, the buoyancy added to the weight of the substance in air equals the weight of the water displaced.)

(9) A piece of cork weighs 154 grs.; its sinker, in water, weighs 921 grs.; the cork and sinker together under water weigh 425. What is the sp. gr. of the cork?

(10) A sample of wax weighs 300 grs. When attached to a piece of copper counterpoised in water the two lose 7 grs. What is the sp. gr. of the wax?

(11) One cubic inch of cork weighs 60.6 grs. What is its sp. gr.?

(12) A piece of potassium weighs in air 200 grs.; a lead sinker weighs in petroleum (sp. gr. .750) 350 grs.; their combined weight is 347.6. What is the sp. gr. of the potassium?

(13) A cylinder weighs in air 80 grs., in water 61 grs., and in solution of calcium chloride 52 grs. What is the sp. gr. of the solution?

(14) A glass rod weighs in air 100 grs., in water 91 grs., and in sulphuric acid 84.44 grs. What is the sp. gr. of the acid?

(15) A glass stopper weighs in air 200 grs.; in water 180 grs.; in glycerin 175 grs. What is the sp. gr.?

(16) Equal volumes of benzol (sp. gr. .850) and glycerin weigh 34 and 45 Gms. respectively. What is the sp. gr. of the glycerin?

(17) A powder soluble in water weighs in air 255 grs.; when placed in a bottle of 600 grs. water-capacity, and the bottle filled with alcohol (sp. gr. .820), the whole contents weigh 700 grs. What is the sp. gr. of the powder?

(18) How many kilograms in 10 liters of ether (sp. gr. .725)?

(19) How many grams in 8 fluidounces of hydrochloric acid (sp. gr. 1.16)?

(20) How many Troy ounces in two pints of ether (sp. gr. .750)?

SPECIFIC VOLUME

is the reverse of specific gravity; hence the volumes of equal weights are to each other inversely as the specific gravity, and the weights of equal volumes are to each other as the specific gravity:

$$\begin{aligned} 1 \div \text{sp. gr.} &= \text{sp. vol.} \\ 1 \div \text{sp. vol.} &= \text{sp. gr.} \\ \text{Sp. gr.} \times \text{sp. vol.} &= 1, \text{ etc.} \end{aligned}$$

From the above principles find the specific volume of U. S. P.: H_2SO_4, HCl, and HNO_3, syrup, glycerin, chloroform, etc.

If the sp. gr. of sulphuric acid is twice that of olive oil, and a liter of olive oil weighs 917 grams, what is the weight of 500 Cc. of sulphuric acid? *Ans.* 917 grams.

(For further details and problems see Remington's "Practice of Pharmacy.")

ANSWERS TO PROBLEMS IN SPECIFIC GRAVITY.

No. 1	9.	No. 11	.236
" 2	10.6	" 12	.741
" 3	2.17	" 13	1.473
" 4	1.5	" 14	1.728
" 5	10.5	" 15	1.25
" 6	3.63	" 16	1.125
" 7	1.74	" 17	4.448
" 8	4.92	" 18	7.25 K.
" 9	.237	" 19	274 Gms.
" 10	.977	" 20	22.78 Troy oz.

Pharmaceutical Processes and Manipulations.

How may the processes used in pharmacy be subdivided?

PHYSICAL PROCESSES.—Desiccation (Exsiccation); Comminution; sifting, etc.

Processes of Extraction (mainly of fibrous and organic material).—Maceration; Expression; Infusion; Digestion; Decoction; *Percolation.*

Vaporization.—Evaporation; Distillation; (Sublimation).

Straining and other Processes of Separation.—Colation; Filtration; Clarification; (Decantation); Decolorization; Deodorization.

CHEMICAL PROCESSES (mainly of inorganic and crystalline material).—Solution; Diffusion; Dialysis; Precipitation; Elutriation; Levigation; Porphyrization; Crystallization; Decantation; Granulation.

Processes Requiring High Heat.—Sublimation; Ignition; Calcination; Deflagration; Reduction; Oxidation.

What effect has drying upon vegetable drugs?

Vegetables in drying lose water and volatile oils. Some of their constituents may undergo oxidation, such as resins, oils, glucosides, alkaloids, etc.

If not carefully dried, what changes are vegetables likely to undergo?

Crude vegetable drugs, if kept moist, are liable to be affected by fermentation, mouldiness, and slow decay.

What is meant by the term desiccation?

It is a process of expelling moisture from solid substances. In the case of vegetable drugs it is accomplished at a temperature not likely to change important constituents (usually about 120° F.; opium is directed to be dried for powdering at a temperature not exceeding 185° F.). Between 70° to 90° F. fermentation and mouldiness is most rapid.

How are fleshy or succulent drugs best prepared to facilitate desiccation?

They should be cut with a sharp knife, in thin slices, transversely to the direction of cellular and fibrous tissues, thereby opening the cells and ducts and exposing the greatest surface to evaporation. Ex.—Squill, Colchicum, Calumbo, etc.

What effect has desiccation upon crystalline substances?

Crystalline substances are merely deprived of water of crystallization. (See Exsiccation, *Index*.) Usually a high temperature is used, and the process is known as exsiccation.

What loss in weight is sustained in the desiccation of medicinal substances?

Drugs lose in drying from 1 to 20 per cent. (Opium loses from 9 to 20 per cent. in drying and powdering). Vegetables contain from 30 to 80 per cent. moisture (Stramonium leaves have about 98 per cent. of moisture). Crystalline substances in the processes of exsiccation lose nearly all the water of crystallization. (Sulphate of iron loses 39 per cent. The official sodii carbonas exsiccatus is made by driving off 50 per cent. of moisture from the crystallized sodii carbonas.)

Comminution.

What are the varieties of comminution?

Comminution includes cutting, bruising, rasping or grating, grinding, trituration, etc.

What circumstances determine the degree of comminution to which a substance should be subjected preparatory to future extraction?

Soft, spongy material expands in the solvent and becomes permeable in coarse powder, while woody structures resist solvent action comparatively, and require for the removal of active matter a fine powder. Comminution should be most perfect when an insoluble drug is to be administered in suspension.

What classes of substances are most necessarily ground in steel mills and what belong exclusively to stone mills?

Steel mills are advantageous for tough and fibrous material; stone mills for friable substances and for salts and mineral substances.

For what operations and what substances are metallic, wedgewood and stone mortars used?

For contusing, bruising and triturating in comparatively small quantities. For trituration, shallow mortars of wedgewood ware or porcelain are best adapted. Crystalline salts should never be triturated in a metallic mortar. Fibrous substances should always be comminuted in metallic mortars.

What materials are reduced by rasping or grating?

Hard and woody substances, as guaiac, are made into fine chips with a saw and rasp. Rhubarb is divided into fine pieces by the use of a fine saw. Nutmeg is reduced with the least loss of fragrant oil by grating.

How are the coarser pulverized substances separated from the finer?

By means of sieves (composed of fine wire, horse-hair, muslin or bolting-cloth), by means of suspension in water (elutriation), and by settling from the air.

What grades of fineness have powders of the U. S. Pharmacopœia, and how are these grades expressed?

The fineness of powders is expressed in the Pharmacopœia by descriptive words, and by terms expressing the number of meshes to the linear inch in the sieve through which they should pass. These different forms of expression correspond to each other as follows:—

Coarse powder, = No. 20 powder.
Moderately coarse, = No. 40 "
Moderately fine, = No. 50 "
Fine, = No. 60 "
Very fine, = No. 80 " or more.

What is a granular powder?

A powder made uniform by rejecting all the particles which pass through a No. 30 sieve and all that fall through a No. 20.

How is the process of Elutriation conducted?

The article to be powdered is ground in a mortar with a large quantity of water, and this is poured off into a precipitating jar and allowed to stand until the coarse particles subside; the liquid is decanted (poured off) and allowed to stand until the finely suspended (very fine) powder subsides. The decantation and collection of powder are continued until the finest powder is reached and the liquid is clear.

What is trochiscation?

The paste (magma) resulting from elutriation is sometimes made into cones; this operation is called trochiscation. Prepared chalk is thus made.

What do we learn from this process of elutriation?

First, that the power of water to hold particles in suspension is inversely proportional to the size of the particles; second, that all materials deposited in water are assorted according to size.

How are impalpable powders made?

Impalpable powders are secured in the process of grinding by mill stones; the finest particles are carried to a certain height by a motion given to the air, and deposit themselves on shelves within the inclosure.

Extraction,—

MACERATION, EXPRESSION, PERCOLATION, DIGESTION, INFUSION AND DECOCTION.

What is maceration; why and how is it employed in pharmacy?

Maceration is the soaking of a substance at ordinary temperature in a liquid (menstruum). It is employed in pharmacy to extract the soluble and active principles contained in drugs; it is also employed to prepare vegetable substances for percolation, in which case a comparatively small quantity of liquid is used to thoroughly soften and expand the cells of the comminuted drug. The process is conducted by placing the comminuted drug in wide-mouthed bottles or jars, adding the required menstruum, setting aside and agitating occasionally, from 2 to 16 days, when the liquid is poured off and the residue expressed.

What materials are most suitably extracted by maceration?

Non-fibrous substances which yield viscid solutions; for example, Aloes (see Tr. Aloes and Tr. Aloes et Myrrhæ). These should be coarsely comminuted for maceration.

Why is not maceration used more generally in making tinctures?

Because it leaves a small quantity of finished tincture in the residue.

How may this objection in many cases be overcome?

By observing the directions of the U. S. P., which states that, when dregs of a tincture or similar preparation have macerated 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, 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.

How is the term menstruum used in pharmacy?

It is used to denote the liquid capable of dissolving out the soluble principles of vegetable organic drugs. (A liquid capable of completely dissolving inorganic and crystalline substances is termed a solvent.)

What is expression and how employed in pharmacy?

It is the forcible expression or squeezing out of a juice or liquid from moist substances. It is largely employed in pharmacy to separate liquids from marc or drugs (the residue left after straining). The different kinds of presses used are, hydraulic, screw, filter, roller, spiral twist and lever.

What is digestion?

Digestion is maceration above the normal temperature, yet below the boiling point of the liquid.

What is infusion?

Infusion is accomplished by macerating a coarsely comminuted substance with either cold or hot water for about two hours, in a suitable vessel tightly covered. The strained (not expressed) liquid is made up to a certain bulk, in the general official process, by passing water through the strainer; this constitutes an infusion. Two official infusions, however, are made by percolation. (See page 66.)

What is decoction?

Decoction is allied to digestion; the drug, however, is boiled for a time, the liquid cooled, strained, and in the general officinal process made up to a certain bulk, as in the case of infusion.

What is percolation?

Percolation is a process of extraction in which a menstruum is passed through a porous and properly comminuted solid.

It is employed almost exclusively for exhausting vegetable substances. (Percolation of inorganic material is known as *lixiviation.*)

Explain the process theoretically.

The solid body being comminuted according to its nature, and packed in a suitable vessel (percolator), the liquid is poured upon it, and, as it gradually descends, each particle comes in contact with a succession of different particles of the solid and becomes more and more strongly impregnated with the soluble matter, till it escapes from the bottom. The solid particles are brought in contact with a continued succession of fresh portions of the solvent, and part with some of their soluble matter to each till exhaustion is completed, or till the supply of the liquid ceases. The Pharmacopœia states that, 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 destitute of color, odor, and taste, other than that possessed by the menstruum itself.

What are the practical details of the process?

The details for conducting percolation perfectly are given in the preliminary notice of the U. S. P., which are as follows:

The Percolator, its Dimensions and Fittings.—The percolator most suitable for the quantities contemplated by the Pharmacopœia should be nearly cylindrical, or slightly conical, with a funnel-shaped termination at the smaller end. 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 its outer edge. The glass tube, which must not protrude above the inner surface of the cork, should extend from one and one-eighth to one and one-half inch (3 to 4 centimeters) 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 it in position.

The dimensions of such a percolator, conveniently holding five hundred grammes of powdered material, are preferably the following: Length of body, fourteen inches (36 centimeters); length of neck, two inches (5 centimeters); internal diameter at top, four inches (10 centimeters); internal diameter at beginning of funnel-shaped end, two and one-half inches (6.5 centimeters); internal diameter of the neck, one-half inch (12 millimeters), gradually reduced at the end to two-fifths of an inch (10 millimeters). It is best constructed of glass, but unless so directed, may be constructed of a different material.

The Preparation of the Percolator and Material for Percolation.—The percolator is prepared for percolation by gently pressing a small tuft of cotton into the space of the neck above the cork, and a small layer of clean and dry sand is then poured upon the surface of the cotton to hold it in place.

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 it is 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 it 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 are accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube and has reached, in this, the height corresponding to its level in the percolator, which is now closely covered to prevent evaporation, and the apparatus allowed to stand at rest for the time specified in the formula.

The Manipulation of Percolation.—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 recipient, the rapidity of percolation may be increased or lessened as may be desirable, observing, however, that the rate of percolation, unless the quantity of material taken in operation is largely in excess of the pharmacopœial quantities, shall not exceed the limit of ten to thirty drops in a minute. 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.

What is repercolation?

It is the process of percolating successive portions of powdered drug in such a manner as to make a fluid extract without evaporation. For example: Divide thirty-two parts of powdered drug into four portions of eight parts each. No. 1 is moistened, packed, macerated, and percolated until exhausted. Reserve the first six parts, and use the remainder to macerate No. 2, which, percolate and reserve eight parts; repeat the process with No. 3 and No. 4, reserving eight parts of percolate from each. Mix the reserved portions, thereby making thirty parts total. The weaker percolate of the fourth portion is reserved for subsequent operations, when from each eight parts of drugs eight parts of percolate are obtained. (Dr. Squibb's process.)

It has been proven that the first twelve ounces of percolate contains from seventy to seventy-eight per cent. of the total extract obtainable from sixteen Troy ounces of drug. This process is sometimes called fractional percolation.

Why is percolation sometimes called displacement?

Because of the theory that successive portions of solvent *displace* the portions which preceded them. This is practically only partially the case.

What kinds of materials require fine comminution for percolation, and what require coarse?

Woody materials may be finely powdered; fleshy and easily permeable tissues may be coarsely comminuted.

Why is the powder moistened and afterwards sieved?

As stated under maceration, the cells are softened and expanded. Sifting, after maceration, is necessary to break up the agglutinated lumps and render the powder uniform in character.

Can any powder be percolated successfully without previously macerating?

Substances containing volatile oil and resin, such as ginger (and when the menstruum is light and volatile, as alcohol or ether), are better percolated by first packing the dry powder in a percolator.

What is circulatory displacement?

The substance to be extracted or dissolved is tied in a bag and suspended in the upper part of the menstruum. The heavy extractive matter falls through the liquid to the bottom of the vessel, the lighter menstruum circulating displaces the heavier liquid until the material is exhausted.

From common utensils what may be extemporized as a percolator?

An ordinary funnel or a conical chimney of a lamp makes a very good percolator for small quantities.

Why should the general shape of a percolator be tall and narrow?

Because it is desirable that the menstruum should traverse a long column of powder.

Vaporization.

What pharmaceutical operations does vaporization include?

It includes the three operations—evaporation, distillation and sublimation.

Which of these are commonly used in the treatment of organic material?

Evaporation and distillation. (Sublimation is largely employed in the treatment of inorganic material.)

What apparatus is required for conducting the first named operation?

Evaporating dishes.

Mention some of the principles involved in these processes.

The quantity of vapor that will form in a confined space is constant for the temperature, and when an atmosphere is saturated, vaporization ceases unless some circumstances concur to remove a portion of the vapor by condensation.

Rapidity of evaporation is influenced by the state of saturation of the air in contact, being inversely as the quantity of vapor existing in it, when the liquid does not boil.

The boiling points of homogeneous liquids are uniform, provided the pressure is the same; but, if solid matter is in solution, the temperature rises until saturation is attained. Liquids in vaporizing render a large amount of heat latent, which, on condensation, becomes again sensible.

The boiling point rises owing to pressure when a liquid is heated in a tight vessel.

The boiling point is affected by the cohesion and depth of the liquid, and by the nature of the material and surface of the vessel.

Evaporation below boiling is in ratio to the extent of surface exposed to the air.

Evaporation by boiling is in ratio to the extent of surface of the vessel exposed to heat.

What are the various modes of evaporation?

Spontaneous evaporation in vacuo; over lime or sulphuric acid, at the common temperature (processes chiefly used in analytical operations.)

Spontaneous evaporation in the open air, in shallow vessels or on a revolving cylinder.

Evaporation by heat, artificially applied, varying from 100° to 212° F.

Evaporation in vacuo with steam heat, so as to boil at a low temperature.

What precaution is necessary in evaporating certain liquids?

Solutions of aromatics require a gentle heat, the same may be said of fluids and solid extracts, but solutions of saline substances may be evaporated to boiling.

What is distillation?

Distillation essentially consists of the conversion of a liquid into its vapor, by the aid of heat, and the recondensation of that vapor into the liquid state by the application of cold. It differs from evaporation merely in its object, which is the volatile liquid, while evaporation rejects this and secures the residue.

What apparatus is required to conduct this operation?

It requires for its conduction peculiar forms of apparatus, consisting of a boiler (called a retort), a condensing surface, and a vapor-tight communication between the two.

What is a retort?

A plain retort is a flask having a neck so curved that it inclines downward when the body of the flask rests upon a stove or other support and ready for distillation. The neck so bent becomes the exit tube of the apparatus. A *tubulated* retort is provided with an opening at the top, into which is fitted a glass stopper. This convenience allows the apparatus to be refilled with a continuous supply while in operation.

What is a condenser?

A condenser is usually composed of a glass tube surrounded by and fitted to a somewhat shorter and much larger tube. Into the lower end of this second tube there is an opening for receiving a cool stream of water, and at the other end and opposite side there is an opening for the exit of the water warmed in transit; the longer interior tube is thus chilled, and, receiving the steam, condenses the same along its interior wall. A Leibig's condenser answers to the above description.

What is a receiver?

A flask the neck of which tapers to fit the exit tube of the retort. When the receiver has an opening at the top it is called *tubulated;* if opened at the bottom and tapering, for the purpose of measuring the distillate, it is called *quilled.*

What is a still?

These are modified forms of the old "Alembic" retort. The exit tube is usually connected with a spiral coil of pipe immersed in water to condense its vapors. Remington's Pharmaceutical Still and others have improved condensers, which make condensation more rapid and perfect than the old way.

What is fractional distillation?

Fractional distillation consists in collecting in different vessels distillates which come over between certain given temperatures.

What is destructive distillation?

Destructive distillation takes place when dry organic substances placed in a retort are heated to redness, so as to destroy existing compounds.

What are the distinctive characters of products of distillation?

They are free from sediment and entirely volatile.

What is sublimation?

Sublimation differs from distillation from the fact that the product is always solid and generally crystalline. Its object is either to purify volatile solids from fixed impurities or, as a means of obtaining volatile substances in process of manufacture. It is usually conducted on a large scale.

What apparatus is used in conducting this process?

Retorts and hoods of various patterns. On a large scale, the vapor resulting from sublimation is frequently conducted and condensed in large chambers especially arranged for the purpose.

What kind of preparations are made by this process?

There are organic and inorganic products made by sublimation, such as benzoic acid, camphor, arsenious acid, carbonate and chloride of ammonia; calomel, iodine and sulphur.

What is the characteristic quality of all products of sublimation?

They should be entirely volatile, some at ordinary temperatures, others only at higher heat.

Other Processes of Separation.

Colation, Filtration, Clarification, Decantation.

What is meant by colation or straining, and what materials are used for this purpose in pharmacy?

It is a kind of filtration, used for separating insoluble impurities and foreign ingredients. Coarse linen is sometimes employed, especially when pressure is exerted. Clearer products are obtained by using several thicknesses of flannel, with the nap on the inside, without pressure. Muslin, felt, gauze and bolting cloth are also used.

What is the nature and object of filtration?

Filtration consists in passing a liquid through a porous medium, with the object of separating suspended and insoluble substances from dissolved matter. The liquid passing through the medium (filter) is called the filtrate.

The filtrate is supposed to be generally rendered transparent.

How may filtration be expedited?

By the use of different kinds of filtering media; by arrangements for keeping the filter constantly full; by increasing the pressure of the liquid upon the filtering medium and by maintaining an increased temperature.

How is paper pulp best prepared?

By beating filter paper in a mortar with water or with liquor potassæ, washing the product with water and drying.

Of what other substances are filters made?

Sand, asbestos, ground glass, charcoal, porous stone, etc.

How can the pressure of the atmosphere be increased upon the liquid?

By producing a partial vacuum below the filter and its supports (*e. g.*, a funnel); this can be done by a vacuum pump or other device, such as a column of water falling through a tube, etc., (filter pumps of the catalogues).

What is clarification?

This process is employed when the impurities to be separated are deposited, on account of their greater specific gravity, or by being rendered heavier on the application of heat or dilution with water, or when, by the addition of a foreign substance, they are aggregated together and separated as a coagulum. (See also Liq. Guttæ Percha.)

What foreign substances are employed in clarification?

Albumin (added to the liquid and heat applied) produces a scum, which, in rising, carries up with it the enveloped particles.

Gelatin (added to cloudy solutions containing tannin) produces a heavy precipitate, carrying with it the impurities.

Milk (added to some wines) produces a coagulum which envelopes and separates impurities. Paper pulp agitated with the liquid and strained retains suspended matters.

How is clarification effected by fermentation?

Natural juices of plants become clarified by virtue of the alcohol developed in fermentation, the insoluble substances being deposited.

What is decantation, and how is the process conducted?

It is the separation of a fluid from a solid which has deposited in a vessel. It may be accomplished either by simply tilting the vessel or by the use of a syphon. In the former case a glass guiding rod is used to prevent dribbling of the liquid and to convey away the liquid decanted into any receptacle without loss. The rod is held in a vertical position, against the rim of the vessel, or in advance of the flowing stream of liquid to be decanted. Care is taken in the operation not to disturb the deposit.

What is a siphon, and explain its action?

A bent tube, having one arm shorter than the other; when filled with a liquid and the short arm immersed below the surface of a fluid, and the discharging orifice placed in a lower position than the former, a flow takes place. Atmospheric pressure forces the liquid up the shorter arm, while the excess of weight of the liquid in the longer arm causes a continuous flow.

What rules should be observed in making siphons of great length?

No part of the tube should be higher above the liquid than the point to which that liquid will rise by atmospheric pressure—that is, thirty-three feet for water, thirty inches for mercury, etc.

What is an economical way of making a siphon?

Join two pieces of glass, of unequal length, by means of a piece of India-rubber tubing, just large enough to admit the tube with application of some force. This permits a motion which would break one made entirely of glass.

How are immiscible liquids separated from each other?

If two immiscible liquids (*e.g.*, ether and water) are allowed to stand in a suitable vessel,—separator, or a separating funnel (a funnel with a stop-cock), the lower liquid may be drawn off without disturbing the upper one. If separation is effected in an ordinary bottle, the upper layer is usually removed by means of a pipette or syringe.

For the separation of what liquids is the Florentine Receiver used?

It is used to separate volatile oils obtained by distillation of aromatic substances with water.

How does decoloration act as a separating process, and how is this process conducted?

Insoluble compounds are formed of coloring matter when solutions of them are brought in contact with porous charcoal.

Therefore by passing (filtering) a colored liquid through animal charcoal the color is removed from the liquid.

What is deodorization and how performed?

It is the process of depriving of odor by means of animal or vegetable charcoal.

To what class of substances are the two preceding processes applied?

Tinctures, oils, saccharine solutions, fatty bodies. Such preparations as deodorized opium and deodorized iodine are made by entirely different processes.

What effect has animal charcoal upon solutions of alkaloids, bitter and astringent, and what pharmaceutical importance is attached?

Charcoal absorbs such proximate principles, hence care should be used in removing coloring from vegetable solutions, that their medicinal quality is not impaired.

CHEMICAL PROCESSES.

(Treatment of mainly inorganic crystalline material.)

What are solutions? Define the process of solution.

Simple solutions are solutions generally of mineral salts of definite strength. Solution is the union of a liquid (the solvent) with another liquid, a solid or a gas, the combination being inseparable without the use of evaporation, distillation, or chemical means. The union not so intimate, however, as to cause change in color, odor or taste, unless chemical combination, as well as solution takes place. (From a simple solution the solid substances dissolved can be reclaimed, unchanged, by evaporation of the liquid.)

What kind of a solution results when a change of color, odor, or taste, etc., is produced?

A chemical solution.

What solvents are used in making solutions?

Water, alcohol, ether, chloroform, etc.

How is solution aided?

Solutions of solids are generally aided by comminution.

Mention other circumstances which influence solubility and solution.

Heat usually increases the solvent power of liquids, and causes currents and consequent agitation, thus favoring the process of solution; though, as a rule, heat favors solubility, some exceptions to the rule exist, as acetate and citrate of lime. Rapid solution, when not accompanied by chemical reaction, always causes a reduction of temperature, owing to the law that bodies in passing from the solid to the liquid state have their capacity for caloric increased. When dehydrated salts are dissolved there is an increase of temperature. When a gas is to be dissolved in a liquid, cold favors its solution by increasing the specific gravity of the gas, and by counteracting the sensible heat resulting from its condensation.

What effect has the presence of one salt upon the solubility of another salt?

In some cases increasing and in other cases decreasing it. A saturated solution of one salt may be a solvent for another salt—a quality of great value in the removal of impurities from certain salts.

When a salt is said to be soluble, what solvent is meant?

Water.

What is meant by a saturated solution?

A solution is said to be saturated when the substance dissolved ceases to be liquefied by the solvent at common temperatures. Therefore, the real strength of saturated solutions is dependent upon temperature.

What is meant by supersaturated solution, and how is it effected?

When the solvent retains in solution more of the soluble matter than it could under the existing circumstances dissolve, it is said to be supersaturated. It is often effected by heating the solvent to a proper degree and dissolving the substance in it to saturation, then a slow reduction of temperature (without agitating the vessel) will make an over-saturated solution, but a little agitation will start crystallization and throw out the salt in excess of solution.

What is meant by dialysis?

A separation of a crystalloid from a colloid by osmosis.

What is meant by the term crystalloid and colloid?

Those substances which diffuse most rapidly are called crystalloids (crystalline chemical subtances), those which diffuse slowly are called colloids (gelatinous substances).

What is meant by the term osmosis, and how is it effected?

A simple dialyser may be made by stretching over the bottom of a sieve frame a piece of parchment or fine membrane. If into the vessel thus made is placed a solution and the whole floated on distilled water, then there is water on one side of the membrane (septum) and the solution on the other; these liquids flow through the membrane at different rates; this is called osmosis. (If the flow of the water into the solution preponderates, it is called endosmosis; if the flow of the solution, it is called exosmosis. The diffusate is found in the distilled water.)

Precipitation.

What is meant by the term precipitation?

When finely divided crystals or amorphous powders are separated from solutions by chemical (or physical) agents, this is termed precipitation. For example; when a solution of carbonate of sodium is added to a solution of chloride of calcium, a precipitate of carbonate of calcium is produced. Light will precipitate solutions of silver and heat will precipitate lime water. The agent producing the precipitation is called the precipitant. The liquid remaining is called the supernatant liquid.

By what terms are the physical characters of precipitates described?

By the terms flocculent, gelatinous, curdy, granular, and crystalline.

What is meant by the term magma?

It is applied to the moist precipitate as it is collected in a filter before it is dried.

By what means may the character of a precipitate be modified?

Hot dense solutions produce heavy precipitates, cold and diluted solutions produce light precipitates.

By what other process can very finely divided products be obtained?

By Elutriation (see *Index*); Levigation (see *Index*).

Crystallization.

What is the usual mode by which a soluble salt is obtained in crystalline form?

Soluble salts are usually crystallized from a saturated solution by slowly evaporating the solvent.

What other modes are used?

Fusion (example, sulphur), sublimation (ex., benzoic acid), precipitation (ex., mercuric iodide).

What is meant by the terms water of crystallization and efflorescence?

Water of crystallization is well defined as solid water in a combined state. All water of crystallization is expelled at high temperatures (see Exsiccation); but some crystalline substances have it so loosely held that it desiccates at low temperatures, leaving a fine powder behind; the crystal is then said to be *efflorescent.*

What is deliquescence?

Absorbing moisture from the air; such crystals are hygroscopic (carbonate of sodium is efflorescent, but carbonate of potassium is deliquescent).

What is exsiccation?

Driving off water of crystallization by strongly heating (ex., Alumen Exsiccatum).

AMORPHOUS.—A non-crystalline substance.

What is meant by the term mother liquor?

The liquid drained from crystals after they have ceased to form. It frequently contains much of the substance in solution.

What difference is there in the mode of washing precipitates and crystals?

Crystals are usually washed with the smallest effective quantity of cold water; precipitates, more copiously with warm water.

How is a crystal bounded?

By plane surfaces symmetrically arranged with reference to certain imaginary lines passing through its centre; these lines are called axes.

How are crystalline forms systematically arranged?

They are arranged differently by different authors. The following is one of the best systems of classification:—

Crystals are arranged in six systems, based upon the number and relations of axes, as follows:—

Isometric System.—Three equal axes crossing at right angles (ex., cube).

Tetragonal System.—Two axes equal, third unequal, all crossing at right angles (ex., square prism).

Orthorhombic System.—Three unequal axes, but intersections all at right angles (ex., rectangular prism).

Monoclinic System.—Three unequal axes, one intersection oblique (ex., oblique rectangular prism).

Triclinic System.—Unequal axes all crossing obliquely (ex., oblique rhomboidal prism).

Hexagonal System.—Three equal axes lying in one plane and intersecting at angles of 60°, and a fourth axis crossing each of the others at right angles and longer or shorter (ex., hexagonal prism).

By the truncation and bevelment of the angles and edges of these fundamental forms a vast variety of secondary forms are produced.

What is meant by cleavage?

The tendency to break or cleave along certain planes.

How may the form of a crystal be determined?

In two ways: First, by the regularity of its internal structure or molecular arrangement, as shown by cleavage and the polarization of transmitted light, and, second, by the regularity of external form which follows under favorable conditions, as a necessary consequence of symmetry in arrangement of the molecules.

(For the proper elucidation of the subject of crystallography see Dana's Text Book of Mineralogy.)

How may very large and perfect crystals be formed ?

From cold saturated solutions by slow evaporation ; small crystals are made from rapid cooling of supersaturated solutions.

What is granulation ?

The process of rapidly stirring a solution of a crystalline salt during evaporation until all the liquid is expelled. The residue is a granular powder composed of broken crystals.

Processes Requiring High Heat.

What inorganic substances are made by sublimation ?

Corrosive sublimate, calomel, chloride of ammonia, iodine, sulphur, etc.

What two kinds of sublimate are there ?

Powder sublimate and cake sublimate. (For process of Sublimation, see *Index.*)

What is ignition ?

Ignition is the process of strongly heating either an organic or inorganic substance, with access of air, the residue left being sought.

What is incineration ?

Incineration is a process similar to ignition ; it is applied to organic substances, with a view to burning the carbonaceous principles, converting them into carbon dioxide, which usually remains in the ash combined with an alkali present.

What is calcination or dehydration ?

It is the process of strongly heating inorganic crystalline substances, with a view to the removal of water, CO_2, or other volatile constituents, (ex., magnesia).

What is fusion ?

Fusion is the process of liquefying either organic or inorganic substances by heat, (ex., melting of wax).

What is torrefaction or roasting?

It is the process of heating organic substances to change their qualities, by modifying certain constituents without altering others, (ex., torrefied rhubarb).

What is deflagration?

Deflagration is a process of heating one inorganic substance with another capable of yielding oxygen (permanganates, chlorates, nitrates, etc.) which produces sudden combustion without explosion.

What is reduction?

A process of reducing inorganic substances to obtain a lower degree of combination, or the element itself, by the aid of some reducing agent (ex., reduced iron).

What is oxidation?

It is the process of heating with access of air, inorganic substances having a strong affinity for oxygen, which they absorb from the air or chemical compounds (ex., zinc oxide).

What is carbonization?

Carbonization is the process of heating organic substances without access of air, until volatile products are driven off and a charred residue remains, having a black color like charcoal (ex., charcoal).

PHARMACY.—PRACTICAL AND THEORETICAL.

Give briefly a history of the United States Pharmacopœia.

Previous to 1820 European pharmacopœias had been the principal authority in the U. S. A small volume of formulæ was printed in Boston in 1778; the text was Latin. It did not come into general use. The present U. S. P. grew out of a plan for a National Pharmacopœia submitted to the N. Y. Medical Society by Lyman Spalding in 1817. The material for the prospective work was to be contributed by various districts—northern, southern, central, and western—of the U. S. These divisions were to hold conventions for the collection and arrangement of material to constitute a pharmacopœia. At a general convention all were to be consolidated. From the union of the northern and central districts the work was finally accomplished, and in 1820 the pharmacopœia published. The work has been revised each decade since this time. The manner of calling together the conventions, and other details, for revision is fully described in the pharmacopœia itself.

What does the study of pharmacy include?

It largely embraces the study of the Pharmacopœia, the commentaries (dispensatories) upon it, and text-books relating to various branches of sciences necessary to its proper comprehension.

What is a pharmacopœia?

A pharmacopœia is considered an authoritative guide to the physician and pharmacist regarding the crude drugs and their preparations. It fixes the identity and the standard of quality, purity, and strength of all medicinal substances by means of appropriate titles, definitions, working formulæ and tests. In other countries the work is issued under governmental auspices, and therefore has a certain legal status. The U. S. P. has, like the others, a prestige and professional standing; its legal enforcement is more consistent with a republican form of government. It is revised every ten years by a convention of delegates representing the medical and pharmaceutical professions.

(A dispensatory is a commentary upon one or more pharmacopœias.)

What is meant by the terms official and officinal?

By official is meant recognized by the Pharmacopœia; by officinal, duly authorized: these two terms, however, are frequently used synonymously by pharmacists.

What may be said of the medicinal value of official and non-official drugs and preparations?

The medicinal value of any substance is not directly affirmed by a pharmacopœia, and the absence of mention of any drug or preparation in the Pharmacopœia should not be construed as casting any doubt as to the medicinal value of the same.

How many drugs and medicinal substances of the Pharmacopœia have no official preparations made from them?

There are about 50. (See page 134, those names of drugs in Italics.)

How may the value of official organic drugs be shown from a pharmaceutical standpoint?

The value of drugs from a pharmaceutical standpoint may be shown as follows: (1) Those entering in but one official preparation; (2) those entering into two official preparations, etc.

Give a list of drugs according to the above classification.

Organic Drugs.*

Contained in one preparation only. (Parts of plants.)

In the Form of Tincture.—Anisum (*Tr. Rhei Dulc.*), Arnicæ Flor., Bryonia, Calendula, Carum (*Co. Tr. Card.*), Cinchona Rub. (*Co. Tr. Cinch.*), Crocus, Elaterinum, Humulus, Kino, Limonis Cortex (*spirit*), Mentha Piperita (*spirit*), Pyrethrum, Santalum Rubrum (*Co. Tr. Lavend.*), Styrax (*Co. Tr. Benz.*), Sumbul (*Elaterin = Trituratio E.*)

Fluid Extract.—Apocynum, Aspidosperma, Asclepias, Belladonna Radix, Buchu, Castania, Calamus, Chimaphila, Cusso,

---

* For constituents, active principles, etc., see pages 134–142.

Cypripedium, Coca, Dulcamara, Eupatorium, Eucalyptus, Guarana, Gossypii Radix, Geranium, Grindelia, Hamamelis, Pareira, Pilocarpus, Rubus, Rumex, Rhus Glabra, Sabina, Scutellaria, Senega, Spigelia, Stillingia, Strophanthus, Triticum, Viburnum Opulus, Viburnum Prunifolium, Xanthoxylum.

Extract.—Colocynth, Euonymus, Hæmatoxylon, Juglans (*Ext. Colocy. enters: Co. Ext., Pil. Cath. Co. and P. Cath. Veg*).

Syrup.—Allium, Amygdala Amara, Rubus Idæus.

In Conf. Senna.—Cassia Fistula, Ol. Coriand., Ficus, Prunum.

Unclassified.—Aspidium (*Oleoresin*), Aurantii Flor. (*Water*), Chrysarobinum (*Ointment*), Cetraria (*Decoc.*), Fennel (*Co, Powd. Glycyrrh.*), Gossypium (*Pyroxylin*), Mentha Viridis (*Sp.*), Piper (*Oleoresin*), Sassafras Medulla (*Mucilage*), Sinapis Nigra (*Charta Sinapis*), Ulmus (*Mucilage*).

Not Recognized as Parts of Plants.—Amylum (*Glycerite*), Cambogia (*Co. Cath. Pills*), Copaiba (*Mass*), Kino (*Tr.*), Manna (*Inf. Senna Co.*), Mastiche (*Pil. Al. et Mas.*), Scammonium (*Co. Cath. Pills*), Terebinth. Canad. (*Collod. Flex*).

Various Essential Oils.—Anise, Carum, Gaultheria, Lavandula, Myristica, Pimenta, Sassafras, Sinapis.

Fixed Oils.—Amygdalæ Expressum (*Ung. Aquæ Rosæ*), Ol. Lini (*Liniment Calcis*).

Contained in two preparations. (**Parts of plants.**)

Aloe Socotrina (*Aloe Purif., Ext.*), Amygdala Dulcis (*Emuls., Syr.*), Aurantii Dulcis Cortex (*Syr., Tr.*), Belladonna Folia (*Alcoh. Ext., Tr.*), Calumba (*Fl. Ext., Tr.*), Chirata (*Fl. Ext., Tr.*), Conium (*Ext., Fl. Ext.*), Ergota (see page 62), Galla (*Tr., Oint.*), Gelsemium (*Fl. Ext., Tr.*), Iris (*Ext., Fl. Ext.*), Leptandra (*Ext., Fl. Ext.*), Lobelia (*Fl. Ex., Tr.*), Matico (*Fl. Ex., Tr.*), Nux Vom. [*Ext., Fl. Ext.* (*Tr.*)], Physostigma (*Ext., Tr.*), Sanguinaria (*Fl. Ext., Tr.*), Senega (*Fl. Ext., Co. Syr. Squill*), Taraxacum (*Ext., Fl. Ext.*), Uva Ursi (*Ext., Fl. Ext.*), Vanilla (*Troch. Iron, Tr.*), Veratrum Viride (*Fl. Ext., Tr.*).

Not Recognized as Parts of Plants.—Ammoniaci (*Emuls. Ammoniac., Emp. Amm. cum Hg.*), Catechu (*Troch., Co. Tr.*), Lupulin (*Fl. Ext., Oleoresin*), Pix Liquida (*Syr., Oint.*), Ol. Fœniculi (*Aqua, Co. Sp. Junip*), Ol. Gossypii (*Lin. Ammon., Lin. Camph.*), Ol. Juniperi, Ol. Rosmarin (*Soap Lin., Co. Tr. Lavand.*), Ol. Terebinthinæ, Ol. Limonis (*Sp. Aurant. Co., Sp. Limonis*), Ol. Mentha Viridis (*Sp., Aqua*).

Contained in three preparations. (Parts of Plants.)

Aconitum (*Ext., Fl. Ext., Tr.*). Althæa (*Syr., Mass Hg., Pil. Phosphori*), Capsicum (*Tr., Fl. Ext., Oleoresin*), Caryophyllus (*Co. Tr. Lavend., Ar. Tr. Rhei, Vin. Opii*), Cannabis Indica (*Tr., Ext., Fl. Ext.*), Cimicifuga (*Ext., Fl. Ext., Tr.*), Colchici Semen (*Tr., Fl. Ext., Wine*), Cubeba (*Fl. Ext., Oleores., Tr.*), Colchici Radix (*Ext., Fl. Ext., Wine*), Gentiana (*Co. Tr., Fl. Ext., Ext.*), Hydrastis (*Ext., Glycerit., Tr.*), Hyoscyami (*Fl. Ext., Ext., Tr.*), Jalap (*Ext., Co. Pulv., Resin*), Krameria (*Tr., Fl. Ext., Ext.*), Mezereum (*Fl. Ext., Fl. E. Sars. Co., Decoc. Sarsa. Co.*), Podophyllum (*Ext., Fl. Ext., Resin*), Prunus Virginiana (*Fl. Ext., Inf., Syr.*), Quassia (*Tr., Ext., Fl. Ext.*), Serpentaria (*Tr., Co. Tr. Cinch., Fl. Ext.*), Stramonii Semen (*Tr., Ext., Fl. Ext.*), Valeriana (*Ammon. Tr., Fl. Ext., Tr.*), Ergota (*Ext., Fl. Ext., Wine*).

Not Recognized as Parts of Plants.—Benzoinum (*Co. Tr., Tr., Adeps Benz.*), Guaiaci Resina (*Tr. Ammon., Tr., Co. Pil. Antim.*), Ol. Aurantii Corticis (*Comp. Spirit, Sp., Bay Rum*), Ol. Cinnamomi (*Water, Sp., Arom. Sulph. Acid*), Ol. Lavandulæ Flor. (*Co. Tr. Lav., Sp. Ammon. Arom., Ung. Diachylon*), Ol. Olivæ (*Enters 3 plasters 2 ointments and 1 cerate*), Ol. Ricini (*Collod. Flexile, Lin. Sinapis Co., Ung. Hyd. Ox. Rub.,* and *Pil. Ant. Co.*

Contained in four preparations. (Parts of plants.)

Aurantii Amari Cortex (*Fl. Ext., Tr., Co. Tr. Cinch., Co. Tr. Gent.*), Cinchona Flava (*Ext., Fl. Ext., Infus., Tr.*), Digitalis (*Ext., Fl. Ext., Inf., Tr.*), Ipecacuanhæ (*Fl. Ext., Troch., Pulv.*

Ip. et Opii, Troch. Morph. et Ipecac.), Rosa Gallica (*Fl. Ext., Honey, Confec. Rosa, Pil. Aloes et Mastic*), Sarsaparilla (*Co. Decoc., Fl. Ext., Co. Fl. Ext., Co. Syr.*), Scilla (*Vinegar, Fl. Ext., Tr., Co. Syr. Squill*).

Not Recognized as Parts of Plants.—Asafœtida (*Emuls., Pill., Tr., Pil. Al. et Asaf.*), Pix Burgundica (*Emplas., Emp. Picis cum Cantharid., Emp. Ferri, Emp. Opii*).

Contained in five preparations.

Cinnamomum (C. Cassia—*Tr. Card. Co., Tr. Catechu Co., Tr. Lavandul. Co.;* C. Zelanicum—*Pulv. Arom., Tr. Cinnamomi*), Myristica (*Pulv. Arom., Co. Tr. Lavand., Tr. Rhei. Arom., Troch. Cretæ, Troch. Sod. Bicarb.*), Myrrha (*Tr., Mist. Fe. Co., Pil. Al. et Myrrh, Tr. Al. et Myrrh., Pil. Rhei Co.*), Senna (*Conf., Fl. Ext., Co. Inf., Syr., Co. Pulv. Glycyrrh.*), Zingiber (*Fl. Ext., Oleores., Tr., Pulv. Arom., Pulv. Rhei Co.*), Resina (*Cerate, Emplas., Emp. Arnicæ, Emp. Capsici, Emp. Hydrarg.*).

Contained in seven preparations.

Cardamomum (*Tr., Co. Tr., Pulv. Arom., Ext. Colocy. Co., Tr. Gent. Co., Tr. Rhei, Tr. Rhei Dulc.*).

Contained in eight preparations.

Rheum (*Ext., Fl. Ext., Pill, Pil. Rhei Co., Pulv. Rhei Co., Tr., Tr. Rhei Arom., Tr. Rhei Dulc.*).

Contained in nine preparations.

Acacia (*Mucil., Emuls. Almond, Mist. Glycyrrh. Co., Pil. Iod. Iron, Pil. Phos. Co., Pulv. Cretæ Co., Troch. Cretæ, Troch. Cubeb, Troch. Glycyrrh. et Opii*), Camphora (*Aqua, Linim., Sp., Lin. Saponis, Tr. Opii Camph., Lin. Bellad., Lin. Sinapis Co., Lin. Chloroformi, Pulv. Morph. Co.*), Tragacanth (*Mucil., Troch. Acid. Tannic, Troch. Ammon. Chlor., Tro. Catechu, Tro. Ipecac, Tro. Krameria, Tro. Potass. Chlor., Tro. Santonini, Tro. Zingib.;* also in *Pil. Ferri Carb.*).

Contained in ten preparations.

Aloe Purificata (*Ext. Colocy. Co., Pill, Pil. Al. et Asafœtida, Pil. Al. et Ferri, Pil. Al. et Mastiches*, Pil. Al. et Myrrh, Pil.

Rhei Co., Tr. Aloes, Tr. Al. et. Myrrh, Tr. Benz. Co.), Opium (*Acetum, Ext., Opium Deodorat., Pill, Pulv. Ip. et Opii, Tr., Tr. Opii Camph., Tr. Opii Deod., Troch. Glycyrrh. et Opii, Vinum.*

Contained in eleven preparations.

Glycyrrhiza (*Fl. Ext., Pure Ext., Co. Pulv., Ammon. Glycyrrhizin, Co. Decoc. Sars., Co. Fl. Ext. Sarsap., Mass Hydrarg., Pil. Iod. Iron., Co. Powd. Morph., Co. Syr. Sarsap., Tr. Rhei Dulc.*).

Give a synopsis of official preparations.

Dry preparations (made by simple trituration):—Powders and Triturations.

NON-ALCOHOLIC:—

Waters; Solutions; Infusions; Decoctions; Syrups; Honeys; Mucilages; Mixtures; Glycerites, Vinegars and Emulsions.

ALCOHOLIC AND ETHEREAL:—

Wines; Tinctures; Elixirs; Spirits; Fluid Extracts and Oleoresins.

SOLIDS AND SEMI-SOLIDS:—

Extracts; (Resinoids); Resins; Masses; Pills; Troches and Confections.

UNCTUOUS AND OTHER PREPARATIONS FOR LOCAL APPLICATIONS.

Liniments; Collodions and Oleates; Ointments; Cerates; Suppositories; Plasters and Papers.

OFFICIAL PREPARATIONS (*Dry Powders*).

PULVERES, Powders (9 off.) consist of dry substances in a pulverized condition. The various ingredients are triturated until thoroughly mixed.

Name the official powders and percentage of ingredients.*

Pulvis Antimonialis—*James' Powder*—Ant. ox. 33, Ca.

---

* The figures immediately following the name of ingredient usually indicate the percentage of that ingredient in the preparation.

ppt. phos. 67). P. Aromaticus (Cin. 35, Ginger 35, Card. 15, Nutmeg 15). Creta Compositus (Chalk 30, Acac. 20, Sugar 50). Effervescens Compositus—*Seidlitz Powder*—(Sod. Bic. 31 Gm., Sal Roch. 93 Gm., Acid Tart. 27 Gm; 12 powders, blue and white wrappers.—Seidlitz Mix.[*] gr. 160, in blue paper; Acid Tart., gr. 35, in white). Glycyrrhiza Compositus (Sen. 18, Glycyrr. Pulvis 23.6, Ol. Fennel .4, Sulph. lot. 8, Sugar 50). Ipecacuanhæ et Opii—*Dover's Powder*—(Ip., Op. āā 10, Sacch. Lac. 80). Jalapæ Compositus (Jal. 35, Cr. Tart. 65). Morphinæ Compositus—*Tully's Powder*—(Morph. Sulph. 1,[†] Camph. 19, Glycyrr. 20, Ca. carb. ppt. 20). Rhei Compositus (Rhub. 25, Magn. 65, Ginger 10).

TRITURATIONES.

Triturations are mixtures of finely triturated medicinal substances and sugar of milk; strength, 10 per cent. of medicinal substance (Ex., Trituratio Elaterini).

Non-Alcoholic Preparations.

AQUÆ, Waters (18 off., including Distilled Water).

Volatile substances in aqueous solution. Prepared by solution in cold and in hot water; by filtration through impregnated powder, impregnated absorbent cotton[‡] and by distillation.

Name the official waters and their ingredients.

From Volatile Oils, etc.—Amygd. Amar. 0.1; Anise .2; Cinnamon .2; Fœniculi .2; Menth. Pip. .2; M. Vir. .2; Creosote 1; Camph. 0.8; Chloroform (saturated aqueous solution).

From Gases.—Ammon. 10; Ammon. Fort. 28; Chlori, saturated; Hydrogenii Dioxidi 3.

From Flowers.—Aurant. Flor., A. Fl. Fort, Rosæ, R. Fort.

---

[*] Seid. Mix. = Sal. Roch. 3, Sod. Bicarb. 1.

[†] 1.6 per cent.

[‡] 1880, Absorbent Cotton; 1890, Precip. Phos. lime (usual percentage being .4).

LIQUORES. Solutions (24 off).

Non-volatile, chiefly inorganic substances in aqueous solution, one as chloroformic solution of Gutta-percha (9 per cent., U. S. P., 1880).

Give their official names, ingredients and percentage.

They may be classified for study as follows:—

Arsenical.—Liq. Acidi Arsenosi; Arseni et Hydrargyri Iodidi (*Donovan's Solution*); Sodii Arsenatis; Potassii Arsenitis (*Fowler's Solution*), each containing 1 per cent. arsenic.

Alkaline and Earthy.—Liq. Calcis (saturated); Potassæ 5; Sodæ 5; Ammonii Acetatis (neutral);* Pot. Citratis (neutral sol.); Sodæ Chloratæ (Labarraque's Solution), 2.6 per cent. available Cl; Sodii Silicatis (nearly saturated); Magnes. Cit. (Effervescent Solution of Citrate of Magnesia).

Iron.—Liq. Ferri Acetatis 31; F. Chloridi 37.8; F. Cit. 43; F. Nitratis 6.2; F. Subsulphatis 43.7 (Monsel's Solution); F. Tersulphatis 28.7; F. et Amm. Acet.†

Lead, Mercury, and Zinc.—Liq. Plumbi Subacetatis Dilutus .75;‡ Plumbi Subacet. 25; Hydrargyri Nitratis 60; Liq. Zinci Chloridi (Burnett's Disinfecting Fluid) 50 (?).

Miscellaneous.—L. Iodi Compositus (I 5 KI 10) (Lugol's Solution).

INFUSA, Infusions (4 off., see also page 39).

Name the official infusions giving percentage of ingredients.

With Boiling Water.—Digitalis (Dig. 1.5, Alcohol 10, Aq. Cinnam. 15, Aq. Bulliens 50, Aq. 25); Sennæ Compositus —Black Draught—(Senna 6, Manna 12, Mag. Sulph. 12, Fennel 2).

Percolation.—Inf. Cinchonæ (Cinch. 6, Arom. Sulph. Acid); Pruni Virginianæ 4.

DECOCTA, Decoctions (see also page 39).

---

* Contains 5 parts Ammon. Carb., 100 parts Dil. Acet. Acid.

† Basham's Mixture: Tr. Ferri Chlor., Liq. Amm. Acet., etc.

‡ Contains 3 per cent. Liq. Plumbi Subacetatis.

Name the official decoctions, and percentage of ingredients.

Decoctum Cetrariæ 5; Sarsaparillæ Compositum (Sar. 10, Sas. 2, Guaiac Lig. 2, Glycyrr. 2, Mezereum 1).

Of what strength should an infusion or decoction be made whose strength is not indicated by the Pharmacopœia or by the physician?

Five per cent

SYRUPS (32 off.), Syrupus, Sugar 85, Dist. Water q. s. ft. 100).

Name the official syrups, and percentage of ingredients.

They may be classified as follows (*figures indicating percentages; solids by weight, liquids by volume*):—

Of Inorganic or Crystalline Substances.—Syrupus Calcis (Lime 6.5); Acidi Citrici (Cit. Acid .10, Sp. Lemon .10); Calcii Lactophosphatis (Ca. phos ppt. 2.5, Lac. Acid 6., Orange Flower 2.5, Phosphoric Acid 3.6); Ferri Iodidi (Iron 2.5, Iodine 8.3, Syrup and Distilled Water q. s. ft. 100); Ferri, Quininæ et Strychninæ Phosphatum (Fe. phos. 2, Quin. Sulph. 3, Strychnine, .02, Acid. Phos. 4.8); Hypophosphitum (Hypophosphites Ca 4.5, Na 1.5, K 1.5, Sugar 50, Spt. Lemon .5); Hypophosphitum cum Ferro (Fe. Lact. 1, K Cit. 1, Syr. Hypophosphites 98); Acidi Hydriodici (Absol. HI Acid 1).

Organic Substances.—(*a*) Made by the addition of Fluid Extract or Tincture to simple syrup or sugar and water.

Ipecacuanhæ 7.; Krameriæ 45; Lactucarii* 10; Rosæ 12.5; Rubi 25; Senegæ 20 (and Aq. Amm. .5); Zingiberis * 3.

(*b*) Others containing but one medicinal substance.

Acaciæ (Mucil. 25); Allii (Garlic 20, Dil. Acet. Acid q. s.); Scillæ (Acet. Scillæ 45); Althæa 5; Pruni Virginianæ 15 (and Glycerine 15); Rhei (F. E. 10, K_2CO_3 1, Sp. Cinn.

---

* Ca. Phos. Ppt. is used in making these syrups. *Tincture* (not Fl. Ext.) is used in Syrup of Lactucarium; Bals. Tolu and Alcohol in Syr. Tolu.

.4); Sennæ 25 (and Alcohol 15, Ol. Coriand. .5); Amygdalæ (Sweet 14, Bitter 4); Limonis (1880; L. Juice 40, Lemon Peel 2); Aurantii (Sweet Or. Peel 5); Aurantii Florum (Or. Fl. Water q. s.); Picis Liquidæ 7.5; Tolutanus* 1; Rubi Idæi (Sugar, with fermented and filtered raspberry juice).

(*c*) Complex or Compound Syrups.—Rhei Aromaticus (Arom. Tr. Rhei 15); Sarsaparillæ Compositus (Fluid Extracts of: Sarsap. 20, Glycyrrh. 1.5, Senna 1.5; Oils of: Sassaf. .01, Anise .01, Gaulth. .01); Scillæ Compositus* (Fluid Extracts: Sq. 8, Senega 8, Tart. Ant. .2, Ppt. Phos. Ca. 1).

MELLITÆ, Honeys (3 off.).

Name the official honeys, and percentage of ingredients.

Mel; Mel Despumatum; Mel Rosæ (Fl. Ext. Rose 12, Clarified Honey 88, by weight).

MUCILAGINES, Mucilages (4 off.).

Solutions of gums or mucilaginous principles.

Name the official mucilages, and percentage of ingredients.

Mucilago Acaciæ 34 + water; Sassafras Medullæ, 2; Tragacanthæ 6 (and Glycerine 18 + heat); Ulmi 6 (digest on water-bath one hour).

MISTURÆ, Mixtures (8 off. with the Emulsions).

Aqueous preparations holding in suspension insoluble matter. (This definition in a sense applies also to "Emulsum," see below.)

In extemporaneous pharmacy how is the term mixture used in its broad sense?

It is applied to every fluid compound intended for internal use, unless it have a distinctive title, as tincture, fluid extract, etc.

---

* Ca. Phos. Ppt. is used in making these syrups. *Tincture* (not Fl. Ext.) is used in Syrup of Lactucarium; Bals. Tolu and Alcohol in Syr. *Tolu.*

What are Emulsions? Name those official.

Milky mixtures of oil, resin, etc. with water. Emulsum Ammoniacum 4; E. Amygdalæ (Sweet Almonds 6, Acacia 1, Sugar 3); E. Assafœtida 4; E. Chloroformi (Chloroform 4, Ol. Amygdalæ Expressum 6, Tragacanth 1.5).

How were these preparations classified in the Pharmacopœia of 1880?

The emulsions were all placed under the head of mixtures, as Mistura Assafœtida, etc.

Mention the official mixtures of the U. S. P., 1890, and percentage of ingredients.

Cretæ—(Pulv. Cretæ Co. 20, Aq. Cin. 40, Aq. 40); Ferri, Composita—(Fe. Sulph. .6, Pot. Carb. .8, Myrrh 1.8, Sug. 1.8, Sp. Lav. 6, Aq. Rosæ q. s.); Glycyrrhizæ Co., "Brown Mixture" (Pure Extract Licorice 3, Syrup 5, Mucil. Acacia 10, Tr. Opii Camph. 12, Vin. Antimony 6, Sp. Æth. Nit. 3, Water q. s. ft. 100); Rhei et Sodæ (Sod. Bicarb. 3.5, Fl. Ext. Rhei 1.5, Fl. Ext. Ipecac. .3 Glycerin 35, Sp. Peppermint 3.5, Water q. s. ft. 100).

GLYCERITA, Glycerites (6 off.).

Name the glycerites, and percentage of ingredients.

Glyceritum Acidi Carbolici (Carb. Acid 2, Glycerin 8); Acidi Tannici (Tannic Acid 2, Glycerin 8); Amyli (Starch 1, Water 1, Glycerin 8); Boroglycerini (Boric Acid 31, Glycerine q. s. ft. 100 with prolonged heat at about 150° C.); Hydrastis (Hyd. 100, Glyc. 50, Alc. and Aq. q. s. 100); Vitelli (Vitelli 45, Glyc. 55).

ACETA, Vinegars (2 off.).

Made by treating certain drugs with a menstruum of diluted acetic acid.

Mention the official vinegars.

Acetum Opii, "Black Drop" (Opium 10, Nutmeg 3, Sugar 20, Diluted Acetic Acid q. s. ft. 100); Scillæ (squill 10, Diluted Acetic Acid q. s. ft. 100).

Alcoholic and Ethereal Preparations.

VINA, Wines (10 off.)

Differ from tinctures in that the *menstruum* is white *wine*, to which is added from 10 to 15 per cent. of alcohol.

Give the percentage of alcohol in the official simple wines.

Vinum Album (Dry White Wines, such as California Riesling, Ohio Catawba, etc.), 10–14; Vinum Rubrum (Dry Red Wine, such as Native Claret, Burgundy, etc.), 10–14.

Give the percentage of ingredients in the medicated wines.

Vinum Antimonii (Antim. et Pot. Tart. .4, Boiling Dist. Water 6.5, Alcohol 15, White Wine q. s. ft. 100); Colchici Rad. 40. (Colchici Seminis (Colch. 15, Alc. 15); Ergotæ (Ergot 15, Alc. 15); Ferri Amarum (Bitter Wine of Iron), Soluble Citrate of Iron and Quinine 5, Tincture Sweet Orange Peel 15, Syrup 30); Ferri Citratis (Citrate of Iron and Ammonia 4, Tincture of Sweet Orange Peel 15, Syrup 10); Ipecacuanha (Fl. Ext. 10, Alc. 10); Opii (Op. 10, Cassia 1, Cloves 1, Alc. 15).

TINCTURA, Tinctures (72 off.).

Alcoholic solutions of non-volatile substances (exception Tr. Iodi).

What is the general process for making tinctures?

They are prepared usually by percolating a drug with alcohol of different strengths. To some Glycerine is added.

Classify tinctures according to menstruum, and state the percentage of ingredients in each.

(*a*) *Alcohol.*—Asafœtidæ 20,* Aurantii Dulcis 20, Benzoini, 20, Bryoniæ 10, Calendulæ 20, Cannabis Indicæ 15, Cantharidis 5, Cimicifugæ 20, Cubebæ 20, Herbarium Recentium 50, Guaiaci 20, Iodi 7, Myrrhæ 20, Physostigmatis 15, Pyrethri 20, Tolutanæ 10, Veratri Viridis 40, Zingiberis 20.

(*b*) *Alcohol 95, Water 5.*—Capsici 5.

---

* The figures immediately following the drug indicate the percentage *of the drug in the tincture.*

(*c*) *A. 75, W. 25.*—Scillæ 15, Valerianæ 20.

(*d*) *A. 70, W. 30.*—Aconiti 35.

(*e*) *A. 35, W. 65.*—Quassia 10, Quillaja, 20.

(*f*) *A. 65, W. 35.*—Arnicæ Radicis 10, Chiratæ 10, Gelsemii 15, Serpentar. 10, Strophanthus 5, Sumbul 10, Vanillæ 10 (+ Sugar 20).

(*g*) *A. 60, W. 40.*—Aurantii Amari 20, Calumbæ 10, Colchici Seminis 15.

(*h*) *Diluted Alcohol.*—Aloes 10 (Licorice 20), Arnicæ Florum 20, Belladonnæ Foliorum 15, Cardamomi 10, Croci 10, Digitalis 15, Humuli 20, Hydrastis 20, Hyoscyami 15, Krameria 20, Lobelia 20, Matico 10, Stramonii Seminis 15, Musk 5.

Name and classify special tinctures which cannot well be included in the above classification.

(*a*) *Tinctures containing Glycerine.*—Cinchonæ 20 (A. 67.5, W. 25, G. 7.5), Cinnamomi 10 (A. 75, W. 20, G. 5), Gallæ 20 (A. 90, G. 10), Lactucarii 50 (A. 50, W. 20, G. 25, Dil. Alc. q. s.; first macerate and percolate the L. with Benzine), Rhei (R. 10, Card. 2, G. 10, A. 60, W. 30), Kino 10 (A. 65, W. 20, G. 15).

(*b*) *Assayed Alkaloidal Tinctures.*—Nucis Vomicæ (contains 2 per cent. of Ext., which cont. 15 per cent. of Alk.), A. 3, W. 1, Opii (Op. 10, Ppt. Phos. Calc. 5, Dil. Alc.; should assay 1.3 to 1.5 per cent. of crystallized Morphine), Opii Deodorati (Op. 10, A. 20, W. 80; first treat the aqueous liquid ext. with Ether; should assay same as tincture).

(*c*) *Compound Tinctures.*—Aloes et Myrrhæ (Al. 10, My. 10, Licorice 10; A. 75, W. 25), Benzoini Composita (Bz. 12, Aloes Purif. 2, Storax 8, Bals. Tolu 4, Alc.), Cardamomi Composita (Card. 2, Cinn. 2, Caraway 1, Cochineal .5, Glycer. 5, Dil. Alc.), Catechu Composita (Cat. 10, Cinn. 5, Dil. Alc.), Cinchona Composita (Red Cinch. 10, B. Or. Peel 8, Serpentar. 2; A. 85, W. 7.5, G. 7.5), Gentiana Composita (Gen. 10, B. Or. Peel 4, Card. 1; A. 60, W. 40), Ipecacuanha et Opii (Tr. Op. Deod. 100, evaporate to 80, add Fl. Ext. Ip. 10;

Dil. Alc. q. s.), Lavandula Composita (Oils of: Lav. 0.8, Rosemary 0.2; Cinnam. 2, Cloves 0.5, Nutmeg 1, Red Saunders 1; A. 70, W. 25, Dil. Alc. q. s.), Opii Camphorata (Op. 0.4, Camph. 0.4, Benz. Acid 0.4, Anis, 0.4, Glycerine 4.; Dil. Alc.), Rhei Aromatica (Rh. 20, Cinn. 4, Cloves 4, Nutmeg 2; A. 5, W. 4, G. 1), Rhei Dulcis (Rh. 10, Licor. 4, Anise 4, Card. 1; A. 5, W. 4. G. 1).

(*d*) *Containing Ammonia.*—Guaiaci Ammoniata 20; Valerianæ Ammoniata 20 (Mens. Sp. Ammon. Arom.).

(*e*) *Menstruum Acid.*—Sanguinariæ (San. 15, Acetic Acid 2, A. 60, W. 40).

(*f*) *Metallic.*—Ferri Chloridi (Liq. Fer. Chl. 25, A. 75).

ELIXIRIA, Elixirs (2 off.).

Sweet cordials containing medicinal ingredients: Elixir Aromaticum (Comp. Sp. Orange 1.2, Syrup 37.5, Precip. Phos. Ca. 1.5, Deod. Alc. and Dist. Aq. q. s. ft. 100). This preparation serves as a pleasant and palatable vehicle for medicinal substances. Elixir Phosphori (Sp. Phosphorus, 21, Ol. Anis. 0.2, Glycerin 55, Arom. Elix. q. s. to 100).

SPIRITUS, Spirits (25 off.).

Alcoholic solutions of volatile substances, either solid, liquid or gaseous.

Name the official spirits, and percentage of ingredient.

Aromatics.—Anisi (Ol. Anisi 10); Aurantii (Ol. Peel 5); Camphoræ 10; Chloroformi 6; Gaultheria (Ol. 5); Juniperi (Ol. 5); Juniperi Compositus (Oil of Juniper .4, Caraway .05 Fennel .05); Lavendulæ (Ol. Lav. 5); Limonis, *Essence of Lemon* (Ol. 5, Peel 5); Menthæ Piperitæ, *Essence of Peppermint* (Ol. Peppermint 10, Peppermint 1); Menthæ Viridis, *Ess. of Spearmint* (Ol. Spearmint 10, Spearmint 1); Myrciæ, *Bay Rum* (Oil of Myrcia 16, Ol. Or. Peel 1, Pimento 1, in 2000); Myristicæ, *Essence of Nutmeg* (Ol. Nutmeg 5); Amygdalæ Amaræ 1; Aurant. Co. (Oils of: Orange 20, Lem. 5, Coriand. 2, Anis .5); Cinnamomi 10; Glonoini (Nitroglycerin) 1; Phosphori. .12 (in Absol. Alc.).

Crude Alcohols.—Frumenti; Vini Gallici.

Ethereal.—Ætheris (Strong Ether 32.5); Ætheris Compositus (Strong Ether 32.5, Ethereal Oil 2.5); Ætheris Nitrosi (should yield not less than 11 times its own vol. of NO).

Containing Ammonia.—Ammoniæ (NH_3 10 per cent.); Ammoniæ Aromaticus (Amm. Carb. 3.4, Water of Amm. 9, Oils of Lemon 1, Lavender Flowers .1, Nutmeg .1).

EXTRACTA FLUIDA, Fluid extracts (88 off.).

Concentrated tinctures of vegetable drugs of definite strength. 100 grams of the drug are taken and the product is made up to 100 c.c., hence 1 c.c. represents 1 gram of the drug, or, approximately, 1 minim represents a grain. They are made by careful percolation, a fraction of which is evaporated, etc.

What is meant by reserved percolate?

In making Fl. Ex., the 1st 70 to 90 per cent. of the percolate obtained is called the "reserve percolate;" it contains most all the virtues of the drug; no heat is applied to it. It is reserved to be added to the concentrated second percolate.

What is meant by the second percolate?

After obtaining a reserve percolate the percolation of the drug is continued till exhausted; the liquid resulting from the latter is called second percolate.

How is concentration effected in making fluid extracts?

Concentration is effected by evaporating (at a low temperature on a water-bath) the second percolate to a soft extract. This is added to the reserved percolate and the whole made up to the required bulk by adding sufficient quantity of the menstruum.

What menstrua are more commonly used in making Fl. Ex.?

Alcohol, Diluted Alcohol, etc. (sometimes Glycerin is added).

Name and classify the fluid extracts according to the menstrua used in their manufacture.

(*a*) *Alcohol.*—Aromaticum, Buchu, Calami, Cannabis Indicæ, Capsici, Cimicifugæ, Cubebæ, Cusso, Gelsemii, Grindeliæ, Iridis (versic.), Lupulini, Mezerii, Sabinæ, Veratri Viridis, Xanthoxyli, Zingiberis.

(*b*) *A. 80, W. 20.*—Belladonnæ Radicis, Eriodictyi, Podophylli, Rhei, Serpentariæ.

(*c*) *A. 75, W. 25.*—Aconiti, Arnicæ Radicis, Calumbæ, Guaranæ, Eucalypti, Ipecacuanhæ, Leptandræ, Matico, Nucis Vomicæ, Scillæ, Stramonii Seminis, Valerianæ, Viburni Opuli, Viburni Prunifolii.

(*d*) *A. 66⅔, W. 33⅓.*—Aurantii Amari, Chiratæ, Colchici Radicis, Colchici Seminis, Digitalis, Hyoscyami, Menispermi, Phytolaccæ Radicis.

(*e*) *Containing Glycerine.*—Apocyni, A. 65, W. 25, G. 10 (finish with A. 65, W. 35), Aspidospermatis, A. 60, W. 30 (finish with A. 2, W. 1), Castaneæ (Concent. Aq. Decoc. 70, A. 20, G. 10), Cinchonæ, A. 80, G. 20 (finish with A. 80, W. 20), Gossypii Radicis, A. 75, G. 25 (finish with Alc.), Hamamelidis, A. 50, W. 80, G. 10 (finish with A. 50, W. 80), Hydrastis, A. 60, W. 30, G. 10 (finish with A. 20. W. 10), Pareiræ, A. 72, W. 18, G. 10 (finish with A. 40, W. 10), Pruni Virginianæ, W. 20, G. 10 (finish with A. 85, W. 15), Rubi, A. 60, W. 30, G. 10 (finish with A. 2, W. 1), Uvæ Ursi, A. 20, W. 50, G. 30 (finish with A. 20, W. 50), Dil. Alc. 90, G. 10 (Geranii, Rhois Glabræ, Krameriæ and Rosæ).

(*f*) *Diluted Alcohol.*—Asclepiadis, Chimaphilæ, Cocæ, Convallariæ, Cypripedii, Dulcamaræ, Eupatorii, Gentianæ, Scoparii, Lappæ, Lobeliæ, Pilocarpi, Rhamni Purshianæ, Rumicis, Scutellariæ, Sennæ, Spigeliæ, Stillingiæ, Taraxaci.

(*g*) *Menstruum weaker than Dil. Alc.*—Frangulæ, A. 50, W. 80, Sarsaparillæ, A 33⅓, W. 66⅔, Tritici (Boiling Water extractive 75, A. 25), Quassiæ, A. 30, W. 60.

(*h*) *Menstruum Containing Acid.*—Conii (Acet. Acid 2, Dil. Alc. 98; finish with Dil. Alc.), Ergotæ (Acet. Acid 2, Dil. Alc. 98; finish with Dil. Alc.), Nucis Vomicæ (Acet. Acid 5., A. 75, W. 25, to contain 1.5 per cent. of Alkaloid), Sanguinariæ (Acet. Acid 5, A. 75, W. 25).

(*i*) *Containing Ammonia.*—Glycyrrhizæ, Aq. Ammon. 5, A. 30, W. 65, Senega Aq. Ammon. 5, A. 75, W. 20 (finish with A. 75, W. 25).

(*k*) *Compound Fl. Ext.*—Sarsaparillæ Compositum (Sars. 75, Glycyr. 12, Sass. 10, Mezer. 3, A. 30, W. 60, G. 10.

What assayed fluid extract is official in U. S. P., 1890?

Fluid Extract of Nucis Vomicæ. The specific directions for assay are given in the U. S. P. under *Extractum Nucis Vomicæ.*

OLEO-RESINÆ, Oleoresin (6 off.).

Made by extracting drug by means of stronger ether and distilling off the ether; the semi-fluid residue constitutes the oleoresin (Aspidium, Capsicum, Cubeb, Lupulin, Pepper, Ginger).

SOLIDS AND SEMI-SOLIDS.

EXTRACTA, Extracts (32 off.).

Semi-solid and solid preparations resulting from the evaporation of solutions of vegetable principles.

Give an outline of the process by which they are made.

The drug is extracted about as in fluid extracts. The second percolate is evaporated until its weight is 10 per cent. of the drug used, then mixed with the reserved percolate and the whole evaporated to a soft extract (pilular consistence). The temperature in no case should rise above 50° C. (122° F.).

It is to be observed that in the present Pharmacopœia glycerin is not in the extracts as formerly. Two extracts (Nux Vomica and Opium) are *Assayed Extracts.*

What menstrua are used in making extracts?

About the same as in fluid extracts. There are a number of extracts, however, having water alone as the menstruum (see below).

Name and classify extracts according to the menstruum used in their manufacture.

(*a*) *Alcohol.*—Aconiti, Cannabis Indicæ, Cimicifugæ, Iridis, Jalapæ, Physostigmatis.

(*b*) *Diluted Alcohol.*—Colocynthidis, Juglandis, Stramonii Seminis, Arnicæ Radicis.

(*c*) *A. 80, W. 20.*—Podophylli, Rhei.

(*d*) *A. 75, W. 25.*—Leptandræ, Cinchonæ.

(*e*) *A. 66⅔, W. 33⅓.*—Belladonnæ Foliorum, Digitalis, Hyoscyami (finish with Dil. Alc.), Euonymus.

(*f*) *A. 20, W. 50.*—Uvæ Ursi.

(*g*) *Water.*—Aloes (Boiling W.), Gentianæ, Glycyrrhizæ Purum (+ Aq. Ammon. 15), Hæmatoxyli, Krameriæ, Quassiæ, Taraxaci (from root collected in autumn).

(*h*) *Containing Acetic Acid.*—Colchici Radicis (Acet. Acid 3.5, W. q. s.), Conii (Acet. Acid 2, Dil. Alc. q. s.), Ergotæ (by evaporating the Fl. Ext.).

(*i*) *Assayed Extracts.*—Nucis Vomicæ (Acet. Acid 5, A. 75, W. 25, Ext. diluted with Sugar of Milk to 15 per cent. of Alkaloid), Opii (Water q. s.; Ext. diluted with Sugar of Milk to 18 per cent. of Alkaloid).

What are the ingredients in extractum colocynthidis compositum?

Ext. Colocy. 16, Aloes 50, Card. 6, Resin Scam. 14, Soap 14.

What is an inspissated juice?

It is the expressed juice of the plant evaporated to a pilular consistence (ex., Ext. Taraxaci).

ABSTRACTA, Abstracts (not official).

An extract of the drug dried and so diluted with sugar of milk that its strength corresponds to twice that of the drug or fluid extract (½ grain represents the soluble principles of 1 grain of the drug). Not off. in U. S. P., 1890.

Give an outline of the process by which abstracts are prepared.

The drug is exhausted by percolation with alcohol; the concentrated percolate is mixed with sugar of milk and evaporated to dryness at 50° C. (122° F.); the product diluted with sugar of milk to the required weight (Nux Vomicæ and Ignatiæ have A. 8, W. 1 as a menstruum, and Aconite has 2 per cent. of Tartaric Acid in its menstruum). (Others off.: Bellad., Conium, Digital., Hyos., Jalap, Podophyl., Senega, Valerian). Off. in U. S. P., 1880.

In what official preparations are chemical substances added to aid in extraction of the drug and to make the soluble principles more permanent?

In many preparations of Alkaloidal drugs acid is used as part of the menstruum. Acetic Acid (2 per cent.) is used in making Ex. Conii Fld.; Aq. Ammon. (5 per cent.) in Ex. Glycyrrh. Fld.; (5 per cent.) in Syr. Senegæ; Acetic Acid (3.5 per cent.) in Ex. Colchici Radicis.

RESINÆ, Resins (4 off.). (*Resinoid* is a name frequently employed to denote (dried) precipitates resulting from the addition of concentrated alcoholic tinctures to water.)

Briefly state how the official resins are prepared.

Resinæ Copaibæ (residue from distilled Balsam Copaibæ); Jalapæ (concentrated tincture precipitated by water); Podophylli (concentrated tincture precipitated by water, acidulated with HCl); Scammonii (concentrated tincture, made by digesting Scam. in boiling Alc., precipitated by water).

MASSÆ, Pill Masses (3 off.), viz.:—

Massa Copaibæ = (Mg 0.6, Cop. 94); Massa Ferri Carbonatis = ($FeSO_4$ 100 parts, Na_2CO_3 100 parts, Honey 38, Sugar

25); Massa Hydrarg. = (Hg 33, Glycyrrh. 5, Altheæ 25, Glycerin 3, Honey of Rose 34).

PILULÆ, Pills (15 off.).

Pill masses divided and formed into convenient shape for administration. They should be made as small as possible, and a dose should not exceed 4 pills.

What general rule is desirable in making pill masses?

The material should be well powdered and mixed in order to obtain uniformity of composition, and then the excipient should be added.

What is an excipient, and what rule should be observed in the selection of excipients?

The object of an excipient is mainly to give adhesiveness and plasticity to the mass, without interfering with solubility. The nature of the excipient must vary according to the material to be brought to the massive condition.

Name some common excipients and briefly comment upon them.

Water should be used with powders of a gummy nature.

Syrup, Honey and Glucose should be used when only slight adhesiveness is required.

Glycerine differs from the above, in that it keeps the masses plastic, but is too hygroscopic to be used alone.

Mucilage Acacia, Glycerite of Starch, Tragacanth Paste (made with glycerine and water), etc., are excellent adhesive excipients for friable, non-adhesive powders and crystalloids.

How can camphor, resinous and oily substances be formed into pills?

By the use of special adhesive pastes, soap and skillful use of heat.

What excipients are useful with oxidizable substances?

Resin Cerate, Cocoa Butter, Petrolatum, etc.

Briefly describe how an official pill should be made and dispensed.

The mass is made into a cylindrical roll; it is then cut by a pill machine, or otherwise, into the requisite number of parts, each of which is rolled into a spherical form by rotary motion between the thumb and finger. Before dispensing, they are dusted with a suitable powder (lycopodium, rice-flower, altheæ, or powdered licorice root). A very good powder is composed of starch, rice-flower, āā ℥ss; sach. alb., ʒij; acacia, ʒj.

Mention the official pills in which water is used.

Aloes; Aloes et Asafœtida; Asafœtida; Opii; Rhei; Aloes et Mastiche; Catharticæ Compositæ; Rhei Compositus; Catharticæ Vegetabiles.

Mention those in which adhesive material is added.

Syrup, etc.: Aloes et Myrrhæ; Ferri Carbonatis (Blaud's Pills). Confection of Rose: Aloes et Ferri. Castor oil: Antimonii Comp.—Tolu-coated: Ferri Iodidi; Phosphori.

Give a formula for a gelatine coating solution.

Best French Gelatine, 2½ oz., av.; Aq. Dest., f℥vij. Macerate until gelatine softens. Solve by water-bath and add Powd. Boric Acid, ʒij; then slowly add mucilage acacia, ℥ij, and strain.

How are dried powders made into compressed pills?

Compressed Pills may be made extemporaneously by the use of any of the so-called compressed-pill machines. The simplest form consists of a cast-steel hollow cylinder, into the bottom of which is set a closely-fitting removable post. The powder is placed in the cylinder, and, by the use of a cylindrical plunger and strong mallet, the powder is compressed by a heavy blow. The lenticular pill thus formed is removed by removing the bottom post and striking a blow on the plunger sufficiently heavy to drive the pill through.

TROCHISCI, Troches (15 off.).

Lozenges of medicinal substances incorporated with sugar or extract of licorice, made by adding excipients to masses, divided and formed into flat, circular, oblong, etc., pieces, usually weighing from 10 to 20 grains.

How are troches prepared?

By incorporating the ingredients into a plastic mass, rolling into thin sheets, and cutting into proper shape with a lozenge-cutter.

Mention the official troches.

Trochisci Acidi Tannici; Ammonii Chloridi; Catechu; Cretæ; Cubebæ; Ferri; Glycyrrhizæ et Opii (.005, $\frac{1}{12}$ gr. about, of P. Op. in each); Ipecacuanhæ; Krameriæ (Rhatany); Menthæ Piperitæ; Morphinæ et Ipecacuanha ($\frac{1}{40}$ gr. Sulph. Morph. in each); Potassii Chloratis; Soda Bicarbonatis; Santonini (.03 gm., ½ gr. of Santonin in each); Zingiberis.

CONFECTIONES, Confections (2 off.).

Known also as conserves and electuaries. Saccharine masses, in which one or many medicinal substances are incorporated.

What are the ingredients in the official confections.

Confectio Rosæ: Rose 8, Sug. 64, Clar. Hon. 12, Rose W. 16. Confectio Senna: Sen. 10, Ol. Coriand. 0.5, Cas. fist. 16, Tamarind 10, Prune 7, Fig. 12, Sug. 55.5, Water 60.

Unctuous and other Preparations for Local Application.

LINIMENTÆ, Liniments (9 off.).

Solutions of various substances in oily liquids, applied to the skin with friction.

Name and classify the official liniments.

Containing Cotton-seed Oil: (Linimentum Ammoniæ; Calcis, each saponaceous); Camphoræ.

Alcoholic: Chloroformi; Saponis; Sinapis Compositum; Saponis Mollis.

Fluid Extract: Belladonnæ (Cam. 5, Ext. Bel. Fld. 95).

Containing Oil Turpentine: Lin. Ol. Terebinthinæ.

COLLODIA, Collodions (4 off.).

Solution of pyroxylin or "gun-cotton" in a mixture of official Ether and Alcohol, and the same impregnated with medicinal substances. When applied or brushed upon the skin, a film is produced upon the evaporation of the solvent.

Name the official collodions and state principal ingredients.

Collodium; Collodium Cantharidatum (Flex. Col. Canthar. Chlorof.); C. Flexile (Col. Can. Turp. Castor Oil); C. Stypticum (Colod. Alc., Ether, Ac. Tannic).

OLEATA, Oleates (3 off.).

Indefinite chemical compounds of oleic acid, alkaloids and metallic bases, made by trituration.

Mention the official oleates.

Oleatum Hydrargyri; Veratrinæ; Zinci.

UNGUENTA, Ointments (24 off.).

Soft, fatty mixtures of lard, wax, spermaceti, etc. Applied by inunction on the skin, when they gradually become liquefied and absorbed.

CERATA, Cerates (6 off.).

Unctuous mixtures, whose fusibility is between plasters and ointments; sufficiently soft to be spread without heat, and firm enough to adhere to the skin without melting.

Name and classify the official ointments and cerates.

Vehicles for medicinal substances.

Ceratum (W. Wax 30, Lard 70); Ceratum Cetacei; Ceratum Resinæ; Unguentum (Y. Wax 20, Lard 80); Aquæ Rosæ (Cold Cream); Adeps Benzoatus; Diachylon.

Those in which the medicinal substances are mixed by fusion and digestion.

Cerat. Cantharides (Canth. 32, Y. Wax 18, Res. 18, Lard 22, Oil of Turpentine 15); Ung. Picis Liquidæ (Tar 50, Y. Wax 12½, Lard 37½).

Those in which the medicinal substances are incorporated by trituration.

Ceratum Camphoræ (Camphor Liniment 10, White Wax 30, Lard 60; melt ingredients); Unguentum Acidi Carbolici (Carbolic Acid 5, Ointment 95); Acidi Tannici 20; Belladonnæ (Al. Ext. Bellad. 10); Chrysarobini (Chrys. 5); Gallæ 20; Hydrarg. 50; Hydrargyri Ammonii 10; Hydrargyri Oxid. Flav. 10; Hyd. Oxid. Rub. 10; Unguent. Iodi (Iodi 4 KI 1); Iodoformi 10; Plumbi Carb. 10; Plumbi Iod. 10; Potassii Iod. 12 + Sod. Hyposulph. 1; Stramonii (Ext. Stram. 10); Sulphuris (Washed Sulphur 30, Benz. Lard 70); Veratrinæ 4; Zinci Oxidi 20.

Those in which the fatty ingredient is chemically changed.

Unguentum Hydrargyri Nitratis; Ceratum Plumbi Subacetatis.

SUPPOSITORIA, Suppositories.

Solid bodies in which the medicinal substance is incorporated. The whole formed into a small cone or cylinder for introduction into the rectum, urethra or vagina, thereby producing a specific effect upon the contiguous parts or upon the whole system.

Why is cocoa butter used in suppositories?

It has the property of fusing at the temperature of the body and solidifying at a temperature just below that point.

Give an outline of the preparation of suppositories.

The official directions are as follows:—

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.

Suppositoria Glycerini: Glycerin 60 Gm., Sodium Carbonate 3 Gm., Stearic Acid 5 Gm.; to make 10 rectal suppositories.

Unless otherwise specified, suppositories should have the following weight and shapes: *Rectal*, cone-shaped, 1 Gm.; *Urethral*, pencil-shaped, 1 Gm.; *Vaginal*, globular, 3 Gm.

EMPLASTRA, Plasters (13 off.).

Tenacious, resinous and waxy, solid compounds, adhesive and pliable, but not fusible at the temperature of the body, requiring heat in order to be spread.

What bases are used in plasters?

Gum Resins, Burgundy Pitch, Resin Plaster and Lead Plaster.

Name the official plasters having extractive material incorporated in them.

Belladonnæ (Bellad. Ext. 20, Resin 40, Soap Plaster); Opii (Ext. Op. 6, Burg. Pitch 18, Lead Plaster 76, Water q. s.); Capsici (Resin Plaster, with thin coating Oleores. Capsici).

Mention those having metallic or inorganic material incorporated.

Ammoniaci cum Hydrargyro (Hg 18, Oleate of Hg 0.8, Ammoniac 72, Dil. Acet. Ac., Lead Plas.); Plumbi (Ox. Pb. 32, Ol. Olive 60); Ferri (Lead Plaster 72, Ol. Olive 5, Burg. Pitch 14, Ferric Hydrate 9); Hydrargyri (Oleate Hg. 1.2, Mercury 30, Lead Plaster q. s.); Saponis (Soap 10, Lead Plaster 90).

Mention those containing principally resinous substances.

Aromatic Resins.—In the Pharmacopœia of 1890 the following plasters were dropped (off. in U. S. P., 1880): Asafœtida, Ammoniaci and Galbani.

Pitches.—Picis Burgundicæ (Burg. Pitch 80, Olive Oil 5, Y. Wax 15); Picis cum Cantharidatum (Cerat. Canth. 8, Burg. Pitch 92). Resinæ (Resin 14, Emp. Pb. 80, Y. Wax 6).

Mention one containing animal substance.

Ichthyocollæ (Isinglass 10, Gly. 1, Tr. Benzoin, Alcohol).

CHARTA, Papers (2 off.).

Spread paper plasters, the medicinal substances being either spread upon the surface of the paper or the latter saturated with the medicinal substances.

Name the official papers and state their ingredients.

Charta Cantharidis (omitted in the Pharmacopœia of 1890; off. in Ph., 1880); Potassii Nitratis (Nit. Potas. 20, Dist. W. 80); Sinapis (Blk. Mustard, Benzine, India-rubber, Carbon Disulphide.

ESSENTIALS OF DRUG AND PLANT ANALYSIS.

PRELIMINARY TEST FOR ALKALOID.

Macerate about five grammes of the powdered drug in "Prollius' fluid"* and filter. Gently evaporate off the ether. To the residue add absolute alcohol slightly acidulated with sulphuric acid, then a large volume of acidulated water, and filter the whole. Evaporate off the alcohol, and filter the liquid through wet double filters. Test the resulting solution with Meyer's reagent, iodine in a solution of iodide of potassium, and bromine water.

---

* Chloroform 20 parts, Alcohol 76 parts, Ammonia water 4 parts.

ANOTHER TEST FOR ALKALOID.

Macerate about five grammes of the drug in Prollius' fluid for twenty-four hours, then filter. Shake out the filtrate with acidulated water, which solution make alkaline with ammonia water, shake this latter with ether, shake out the ethereal solution with acidulated water. Evaporate off the ether adhering to the acid solution, and test with Meyer's reagent and other alkaloidal reagents (Prescott's "Organic Analysis," 1887, p. 43).

OUTLINE OF ANALYSIS.

I.—Dry the material (if freshly gathered) in the air, and record the loss in drying. The loss in weight equals moisture.

Heat the air-dry drug in a hot-air oven at 100° C. for about six hours, or until it ceases to lose weight. The loss in weight report as moisture in the air-dry drug. (See "Summary" below.)

INORGANIC CONSTITUENTS.

II.—Ignite about two grammes of the powdered air-dry drug at a low red-heat in a platinum crucible. Record the weight of the ash. Examine the ash, ascertaining:

(*a*) *Its Solubility in Water.*

(*b*) *Solubility in Hydrochloric Acid.*—The residue, after treatment with water, is digested in diluted hydrochloric acid, evaporated nearly to dryness, to remove excess of acid, and water is then added and the mixture filtered. The amount dissolved from this residue is noted.

(*c*) *Solubility in Sodium Hydroxide.*—The washed residue after treatment with hydrochloric acid is boiled in a 20 per cent. solution of NaOH. This dissolves the combined silica of the ash, leaving as a residue the sand and clay that adhered to the drug, which should be deducted from the original total ash before computing the percentage.

All of the above weights are determined by weighing the residues after treatment with the respective solvents.

The weight of the substance insoluble in the above solvents should be noted and reported.

Analyze, qualitatively, the ash for inorganic constituents.

ORGANIC CONSTITUENTS.*

Treatment of the powdered drug with various solvents.

III.—Five grammes of the finely powdered drug treat with chloroform in a continuous extraction apparatus for say six or eight hours. Evaporate the tincture and weigh the extract.

(*a*) Treat the residue with water. Evaporate the aqueous washings on a water-bath to dryness, then heat to 100° C. in an air-bath. The loss may be calculated and recorded as volatile oil. (See "Summary," below.)

(*b*) The extract is then treated with a small quantity of petroleum spirit and filtered. The filtrate is evaporated and the residue weighed. This product may be recorded as fixed oil.

Describe the physical properties of this fixed oil. State whether it is easily saponified or not. The color reactions with the acids may also be stated. Reactions with other known oils may be studied in Maisch's "Materia Medica," p. 493, fifth edition, or Dragendorff's "Plant Analysis," pp. 101–105.

(*c*) After treatment with petroleum spirit the filter and residue are macerated in 80 per cent. alcohol for about fourteen hours. Estimate the total extractive and record the same. Filter the solution and evaporate to a small bulk, which pour into a large volume of water slightly acidulated. If a resin precipitates collect it on counterbalanced filters, dry, and weigh. Examine the resin for solubility, etc. (See tests for Podophyllin and other resins of the U. S. P.)

---

* For further practical details in the various steps refer to Lyon's "Pharmaceutical Assaying," Dragendorff's "Plant Analysis," and Prescott's "*Organic Analysis*."

(*d*) The chloroformic residue which now remains should be weighed. The physical properties (color, odor, taste, etc.) should be reported.

IV.—Dry the powder (dregs) which has been treated with chloroform and subject the same to the action of 80 per cent. alcohol for fourteen hours. Estimate the total extractive and report the same. (See "Summary," below.)

(*a*) Evaporate the alcoholic extract on a water-bath to a small bulk. Pour into a large volume of water; collect, dry, weigh, and report upon any precipitated resin.

(*b*) To the filtrate from (*a*) add a solution of neutral acetate of lead. Collect the precipitate, and on a tared filter wash repeatedly with small quantities of water, dry and weigh. Remove the precipitate from the filter, and burn in a porcelain crucible with a little nitrate of ammonium. The precipitate itself is next incinerated, and the whole finally ignited until the weight is constant. Deduct the weight of the residue from the weight of the precipitate, and the remainder may be noted as vegetable acids, etc., precipitated by lead. (See Dragendorff, pp. 39, 49, 69, 80. Also Fresenius, "Quantitative Analysis," American edition, 1881, p. 229 *b*.)

(*c*) To an aliquot portion of the filtrate from (*b*) add a solution of subacetate of lead, filter and remove lead from solution by hydrochloric acid and hydrogen sulphide. The clear liquid is then neutralized and made up to a definite volume. This may be then examined for sugar by the well-known Fehling's solution. This will give the quantity of sugar dissolved by alcohol.

(*d*) Weigh and examine the undetermined extractive by using the remaining part of the filtrate from (*b*). This may contain alkaloid, coloring matter, etc.

V.—Dry the residue (dregs) remaining after treatment with chloroform and alcohol, macerate for twelve hours in water; filter through paper; make up to definite volume, and examine a portion for the amount of extractive. The amount of extractive is computed and recorded.

(*a*) 25 cc. of the solution is placed in a test tube and 50 cc. of absolute alcohol added; let stand in a cool place for twenty-four hours, allowing the gum to precipitate. This is collected on counterbalanced filters and weighed. The weight of same recorded. (See Summary below.)

(*b*) The remaining extractive of this solution should then be estimated, and its weight recorded. It may contain albuminoid matter precipitated by tannic acid.

VI.—The residue (dregs) insoluble in chloroform, alcohol and water, is then treated with 500 cc. of water, to which 5 cc. of sulphuric acid (1.84 sp. gr.) has been added and boiled on a wire gauze support for six hours; fresh portions of water are added to keep the volume to about 500 cc. The extractive matter of this solution is examined and the weight recorded.

(*a*) The acid of the solution is neutralized with potassium hydrate and the liquid brought to the boiling point. A precipitate may fall. Note its color and other physical characteristics. Filter off the precipitate; dry and weigh.

(*b*) The clear solution from (*a*) is estimated for sugar. The result of which multiplied by 0.9 gives the amount of starch and allied substances. Estimate the weight of these constituents, and report same.

VII.—The remainder of the drug (residue) treat with 500 cc. of a two per cent. solution of sodium hydrate, boil for two hours on a wire gauze support, keeping the solution to the 500 cc. mark. The total extractive weigh. This contains "cutose," coloring matter, albuminoid matter, decomposition products, etc.

VIII.—The residue from VII. is washed first with water, then with alcohol, then with ether. Finally dried and weighed, then ignited, the difference being cellulose. The amount record.

IX.—The nitrogen in the drug may be estimated by the Kjeldahl method (see Proc. of the sixth annual convention of the Association of Official Agricultural Chemists, 1889, p. 218). The amount of albumen corresponding to the amount of nitrogen may then be computed. (See also Dragendorff, p. 79.)

SUMMARY.

In reporting a summary of the analysis, the following may be a guide:

Moisture in the Fresh Drug..
Moisture in the Air-dry Drug...
Ash..
Solubilities of Ash...
Inorganic Constituents...
Volatile Oil, III. (*a*)...
Fixed Oil, III. (*b*)...
Resin, III. (*c*); IV. (*a*)..
Waxy (?) matter, III. (*d*)..
Organic Acids and Allies, IV. (*b*)...
Glucose, IV. (*c*)..
Extractive (containing alkaloid [?]), IV. (*d*)....................................
Gum, V. (*a*)..
Colored Extractive and Albuminoids, V. (*d*)....................................
Inert Coloring Matter, VI. (*a*)...
Starch and Allied Substances, VI. (*b*)..
Sodium Hydroxide Extractive, VII...
Cellulose, VIII..
Loss..

ASSAY PROCESSES.

The student is advised to practically study the assay processes of the U. S. P., 1890, given under Opium, Cinchona and Ext. Nux Vomica. A brief synopsis of the latter may be stated as follows: A definite quantity of the dried extract is treated with a mixture of Alcohol and of Ammonia Water (sp. g. .960). The mixture agitated with different portions of chloroform in a separator and the chloroformic layers drawn off, mixed and evaporated. The chloroformic residue is dissolved in $\frac{n}{10}$ H_2SO_4; the solution titrated with $\frac{n}{100}$ KOH, using Brazil wood as indicator. From figures obtained in the titration, by simple calculation the percentage of total alkaloids can be obtained. (See U. S. P., 1890, p. 154.)

THE INORGANIC COMPOUNDS.

How may the elements be classified for pharmaceutical study?

The inorganic elements and official compounds may be classified as follows:—

(Compounds to be classed under the metallic or basic elements.)

The Inorganic bases.

ALKALIES: Potassium; Sodium; Lithium; Ammonium.

ALKALINE EARTHS: Barium; Calcium; Magnesium; Strontium.

ARSENIC GROUP: Arsenic; Antimony; Bismuth.

UNGROUPED: Zinc; Lead; Silver; Gold; Platinum; (Copper and Mercury); (Iron; Manganese and Chromium); Aluminum; Cerium.

Non-metallic Elements.

HALOGENS: Chlorin; Bromin; Iodin.

UNGROUPED: Hydrogen; Nitrogen; Oxygen; Sulfur; Phosphorus; Carbon; Boron; Silicon.

The Inorganic Acids.

Hydrochloric; Hydrobromic; Nitric; Nitro-hydrochloric; Sulfuric; Sulfurous; Phosphoric; Boric; Arsenious; Chromic.

What are the characteristics of the alkalies.

The metals of this group are all soft, fusible and volatile; they decompose water, forming hydrates which are caustic.

They form soluble phosphates, carbonates and arseniates. (The term *alkali* was originally applied to the ashes of sea plants, at length to substances whose solutions have a soap-like action to the skin, etc.; the term at present has a wide significance.)

Name and give the symbol and show by chemical equation the manufacture of the salts of potassium.

(.5)* Potassa, $KOH = 55.99$:—
Caustic Potash.

K_2CO_3	+	$Ca(OH)_2$	=	$2KOH$	+	$CaCO_3$.
Potassium Carbonate.		Calcium Hydrate.		Potassium Hydrate.		Calcium Carbonate.

Boiled together.

(2) Potassa Sulphurata (Sulph. Sub. 10, Pot. Carb. 20) =
Liver of Sulphur.

$3K_2CO_3$	+	$4S_2$	=	$2K_2S_3$	+	$K_2S_2O_3$	+	$3CO_2$.
Potassium Carbonate.		Sulphur.		Potassium Sulphide.		Potassium Hyposulphite.		Carbon Dioxide.

Pot. Sulphurata.

(201) Potassii Bitartras, $KHC_4H_4O_6 = 187.67$:—
Cream of Tartar.

Purified argols or tartar.

(1.6) Potassii Bromidum, $KBr = 118.79$:—

$6KOH$	+	$3Br_2$	=	$5KBr$	+	$KBrO_3$	+	$3H_2O$.
Potassium Hydrate.		Bromine.		Potassium Bromide.		Potassium Bromate.		Water.

$$10KBr + 2KBrO_3 + 3C_2 = 12KBr + 6CO.$$

---

* The figures in front of the name indicate solubility in cold water. Thus .5 indicates that one part is soluble in .5 parts of water.

(1.1) Potassii Carbonas, $K_2CO_3 = 137.91$:—

Salts of Tartar.

$2KHCO_3$	+	Heat	=	K_2CO_3	+	CO_2	+	H_2O.
Potassium Bicarbonate.				Potassium Carbonate.		Carbon Dioxid.		Water.

(16.7) Potassii Chloras, $KClO_3 = 122.28$:—

$3Ca(OCl)_2$	=	$2CaCl_2$	+	$Ca(ClO_3)_2$.
Calcium Hypochlorit.		Calcium Chlorid.		Calcium Chlorate.

$Ca(ClO_3)_2$.	+	$2KCl$	=	$2KClO_3$	+	$CaCl_2$.
Calcium Chlorate.		Potassium Chlorid.		Potassium Chlorate.		Calcium Chlorid.

(.6) Potassii Citras, $K_3C_6H_5O_7.H_2O = 323.59$:—

$3KHCO_3$	+	$H_3C_6H_5O_7$	=	$K_3C_6H_5O_7$	+	$3H_2O$	+	$3CO_2$.
Potassium Bicarbonate.		Citric Acid.		Potassium Citrate.		Water.		Carbon Dioxid.

(2.) Potassii Cyanidum, $KCN = 65.01$:—

$K_4Fe(CN)_6$	+	K_2CO_3	=	$5KCN$	+	$KOCN$	+	CO_2	+	Fe.
Potassium Ferrocyanid.		Potassium Carbonate.		Potassium Cyanid.		Potassium Cyanate.		Carbon Dioxid.		Iron.

(1.4) Potassii et Sodii Tartras, $KNaC_4H_4O_6.4H_2O = 281.51$:

Rochelle Salts.

$2KHC_4H_4O_6$	+	Na_2CO_3	=	$2KNaC_4H_4O_6$	+	H_2O	+	Co_2.
Potassium Bitartrate.		Sodium Carbonate.		Potassium and Sodium Tartrate.		Water.		Carbon Dioxide.

(.36) Potassii Acetas, $KC_2H_3O_2 = 97.89$:—

$KHCO_3$	+	$HC_2H_3O_2$	=	$KC_2H_3O_2$	+	CO_2	+	H_2O.
Potassium Bicarbonate.		Acetic Acid.		Potassium Acetate.		Carbon Dioxide.		Water.

(3.2) Potassii Bicarbonas, $KHCO_3 = 99.88$:—

K_2CO_3	+	CO_2	+	H_2O	=	$2KHCO_3$.
Potassium Carbonate.		Carbon Dioxide.		Water.		Potassium Bicarbonate.

(10) Potassii Bichromas, $K_2Cr_2O_7 = 293.78$:—

$$\underset{\text{Chrome Iron Ore.}}{2FeOCr_2O_3} + \underset{\text{Potassium Carbonate.}}{4K_2CO_3} + \underset{\text{Oxygen.}}{7O}$$

$$= \underset{\text{Potassium Chromate.}}{4K_2CrO_4} + \underset{\text{Ferric Oxide.}}{Fe_2O_3} + \underset{\text{Carbon Dioxide.}}{4CO_2}.$$

$$\underset{\substack{\text{Potassium}\\\text{Chromate.}}}{2K_2CrO_4} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\substack{\text{Potassium}\\\text{Bichromate.}}}{K_2Cr_2O_7} + \underset{\substack{\text{Potassium}\\\text{Sulphate.}}}{K_2SO_4} + \underset{\text{Water.}}{H_2O}.$$

(4) Potassii Ferrocyanidum, $K_4Fe(CN)_6 3H_2O = 421.76$:—

$$\underset{\text{Potassium Cyanide.}}{6KCN} + \underset{\substack{\text{Ferrous}\\\text{Carbonate.}}}{FeCO_3} = \underset{\text{Potassium Ferrocyanide.}}{K_4Fe(CN)_6} + \underset{\substack{\text{Potassium}\\\text{Carbonate.}}}{K_2CO_3}.$$

(.6) Potassii Hypophosphis, $KPH_2O_2 = 103.91$:—

$$\underset{\substack{\text{Calcium}\\\text{Hypophosphite.}}}{Ca2(H_2PO_2)} + \underset{\substack{\text{Potassium}\\\text{Carbonate.}}}{K_2CO_3} = \underset{\substack{\text{Potassium}\\\text{Hypophosphite.}}}{2KPH_2O_2} + \underset{\substack{\text{Calcium}\\\text{Carbonate.}}}{CaCO_3}.$$

(.75) Potassii Iodidum, $KI = 165.56$:—

$$\left\{\begin{array}{l} \underset{\substack{\text{Potassium}\\\text{Hydrate.}}}{6KOH} + \underset{\text{Iodine.}}{(I_2)_3} = \underset{\substack{\text{Potassium}\\\text{Iodide.}}}{5KI} + \underset{\substack{\text{Potassium}\\\text{Iodate.}}}{KIO_3} + \underset{\text{Water.}}{3H_2O}. \\ 10KI + 2KIO_3 + 3C_2 = 12KI + 6CO. \end{array}\right.$$

(3.8) Potassii Nitras (Saltpetre or Nitre), KNO_3: Natural product; also result of decay of nitrogenous matter in presence of K_2CO_3, this process being artificially employed for its production.

(16) Potassii Permanganas, $KMnO_4 = 157.67$:—

$$\underset{\text{Manganese Dioxide.}}{3MnO_2} + \underset{\text{Potassium Hydrate.}}{6KHO} + \underset{\text{Potassium Chlorate.}}{KClO_3}$$

$$= \underset{\text{Potassium Manganate.}}{3K_2MnO_4} + \underset{\text{Potassium Chloride.}}{KCl} + \underset{\text{Water.}}{3H_2O}.$$

$$\underset{\text{Boil together.}}{3K_2MnO_4 + 3H_2O} = \underset{\substack{\text{Potassium}\\\text{Permanganate.}}}{(2KMnO_4)} + \underset{\substack{\text{Manganese Hydra-}\\\text{ted Peroxide.}}}{MnO_3H_2} + \underset{\substack{\text{Potassium}\\\text{Hydrate.}}}{4KHO}.$$

(9.5) Potassii Sulphas, $K_2SO_4 = 173.88$:—

$$\underset{\text{Potassium Nitrate.}}{2KNO_3} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Potassium Sulphate.}}{K_2SO_4} + \underset{\text{Nitric Acid.}}{2HNO_3.}$$

What are the ingredients in potassii citras effervescens?

Citric Acid 63 Gm., Potass. Carb. 90 Gm., Sugar 47 Gm. Powder the ingredients separately, and mix them thoroughly in a warm mortar. Dry the resulting uniform paste rapidly at a temperature of 120° C. (248° F.), and when perfectly dry reduce it to a powder of the desired degree of fineness.

Name the official preparations of the potassium salts.

Potassa cum Calce (KOH and $Ca(OH)_2$, equal parts); Liq. Potassa; Liq. P. Arsenitis; Liq. P. Citratis; Mist. P. Cit. (1880); Troch. P. Chloratis; and Ung. P. Iodidi (see respective preparations).

Potassium salts are contained in what other preparations?

$KNaC_4H_4O_6$, in Seidlitz Powders; KNO_3, in Argenti Nit. Dilutus and Charta Potassii Nitras; K_2CO_3, in Mist. Ferri Comp., Syr. Rhei and Test Solution, 10 per cent.; $KHCO_3$, in Liq. Magnesii Citratis. $K_4Fe(CN)_6$ is used in making Hydrocyanic Acid, and $KHC_4H_4O_6$ in making Tartrate of Iron and Potassium.

What popular disinfectants are made by the use of potassium hypochlorite and permanganate?

A solution of the former is called Javelle Water; of the latter, Condy's Fluid.

How may KOH be purified?

By Alcohol and Barium Hydrate; thus we have "Potassa by Alcohol," etc.

Why should its solutions be protected from the air?

Because they rapidly absorb CO_2, forming K_2CO_3.

How are potassium compounds recognized by chemical tests?

By Platinic Chloride—a yellow, crystalline precipitate; Tartaric Acid in excess—a white precipitate (Cream of Tartar); Flame test, etc.

Why does the U. S. P. direct that the permanganate should be kept in well-stoppered bottles and should not be triturated nor combined in solution with organic or readily oxidizable substances?

Because it is not a stable salt. It readily parts with the comparatively loosely-held oxygen.

RESEARCH QUESTIONS.

To be answered by referring to the U. S. P. or Text-Book.

Observe the strength of the following test solutions of the U. S. P.

Potass. Chromate, P. Dichromate, P. Ferricyanide, P. Ferrocyanide, P. Iodide, P. Sulphate, Alkaline Cupric Tartrate Volumetric Solution (Fehling's Solution), etc.

Note some instances in which the above solutions are used in testing chemicals and pharmacopœial preparations.

Mention some of the prominent characteristics of potassium salts.

(*Descriptions of salts are found under their respective headings in the U. S. P.*)

[Note that the Bitartrate is soluble in hot and nearly insoluble in cold water; Bichromate is red, Ferrocyanide yellow, Ferricyanide deep red, and Permanganate purple violet; Acetate, Carbonate, Citrate and Cyanide are deliquescent; Iodide very soluble, etc.]

In potassium salts how may the following impurities be detected,—Alkaline earths, metals, silica, chlorine?

Calcium Salt in *bitartrate.*

Potassium Carbonate, Sodium, Calcium, Arsenic, Lead, Copper, etc. in *bromide.*

Bromate and iodide *in bromide.*
Carbonate and tartrate *in citrate.*
Iodate (or less soluble salts than Iodide) *in iodide.*
The student may extend this list himself by consulting U.S.P.

Name, give the symbol, and show by chemical equation the manufacture of the salts of soda.

(1.7) Soda, $NaOH = 39.96$:—

Caustic Soda.

$$\underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{Na_2CO_3} + \underset{\substack{\text{Calcium}\\\text{Hydrate.}}}{Ca(OH)_2} = \underset{\text{Caustic Soda.}}{2NaOH} + \underset{\substack{\text{Calcium}\\\text{Carbonate.}}}{CaCO_3.}$$

(1.4) Sodii Acetas, $NaC_2H_3O_2.3H_2O = 135.74$:—

$$\underset{\text{Acetic Acid.}}{2HC_2H_3O_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{Na_2CO_3} = \underset{\text{Sodium Acetate.}}{2NaC_2H_3O_2} + \underset{\text{Water.}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{CO_2.}$$

(4) Sodii Arsenas, $Na_2HAsO_4.7H_2O = 311.46$:—

$$\underset{\text{Arsenious Acid.}}{As_2O_3} + \underset{\text{Sodium Nitrate.}}{2NaNO_3} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \text{Heated and Fused.}$$

$$= \underset{\text{Sodium Pyroarseniate.}}{Na_4As_2O_7} + \underset{\text{Nitrous Anhydride.}}{N_2O_3} + \underset{\text{Carbon Dioxide.}}{CO_2.}$$

$$\underset{\text{Sodium Pyroarseniate.}}{Na_4As_2O_7} + \underset{\text{Water.}}{15H_2O} = \underset{\text{Sodium Orthoarseniate.}}{2(Na_2HAsO_4,7H_2O).}$$

(1.8) Sodii Benzoas, $NaC_7H_5O_2 = 143.71$:—

$$\underset{\text{Benzoic Acid.}}{2HC_7H_5O_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\\text{Benzoate.}}}{2NaC_7H_5O_2} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{CO_2} + \underset{\text{Water.}}{H_2O.}$$

(11.3) Sodii Bicarbonas, $NaHCO_3 = 83.85$:—

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sodium Bicarbonate.}}{2HNaCO_3.}$$

Solvay's Method:—

$$\underset{\substack{\text{Sodium}\\\text{Chloride.}}}{NaCl} + \underset{\text{Ammonia.}}{NH_3} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\substack{\text{Sodium}\\\text{Bicarbonate.}}}{HNaCO_3} + \underset{\substack{\text{Ammonium}\\\text{Chloride.}}}{NH_4Cl.}$$

(4) Sodii Bisulphis, $NaHSO_3 = 103.86$:—

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Sulphurous Acid.}}{2H_2SO_3} = \underset{\text{Sodium Bisulphite.}}{2NaHSO_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O.}$$

(16) Sodii Boras, $Na_2B_4O_7.10H_2O = 380.92$. A crystalline
Borax.

deposit found on lake shores in California; also native in Thibet, Persia.

The official salt is a recrystallized native salt ("*tincal*").

(1.2) Sodii Bromidum, $NaBr = 102.76$:—

$$\underset{\text{Ferrous Bromide.}}{FeBr_2} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Bromide.}}{2NaBr} + \underset{\text{Ferrous Carbonate.}}{FeCO_3.}$$

(1.6) Sodii Carbonas, $Na_2CO_3.10H_2O = 285.45$:—
Sal Soda.

1. Leblanc's Process :—

$$\underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Hydrochloric Acid.}}{2HCl.}$$

The exsiccated sulphate mixed with chalk and coal and fused gives the following reaction :—

$$Na_2SO_4 + 4C + 2CaCO_3 = Na_2CO_3 + CaS.CaO + 4CO + CO_2.$$

2. Cryolite Process :—

$$\underset{\text{Cryolite.}}{(6NaF + Al_2F_6)} + \underset{\text{Calcium Carbonate.}}{6CaCO_3}$$
$$= \underset{\text{Sodium Aluminate.}}{3Na_2O, Al_2O_3} + \underset{\text{Calcium Fluoride.}}{6CaF_2} + \underset{\text{Carbon Dioxide.}}{6CO_2.}$$

$$(3Na_2O, Al_2O_3) + 3CO_2 + 3H_2O = 3Na_2CO_3 + Al_2(OH)_6.$$

3. Solvay's Process :—

$$\underset{\text{Sodium Chloride.}}{NaCl} + \underset{\text{Ammonia}}{NH_3} + CO_2 + \underset{\text{Water.}}{H_2O} = \underset{\text{Sodium Bicarbonate.}}{NaHCO_3} + \underset{\text{Ammonia Chloride.}}{NH_4Cl.}$$

$$\underset{\text{Sodium Bicarbonate.}}{2HNaCO_3} + \text{Heat} = \underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide}}{CO_2.}$$

(1.1) Sodii Chloras, $NaClO_3 = 106.25$:—

$$\underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{Na_2CO_3} + \underset{\substack{\text{Tartaric}\\\text{Acid.}}}{2H_2C_4H_4O_6} = \underset{\substack{\text{Acid Sodium}\\\text{Tartrate.}}}{2NaHC_4H_4O_6} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{CO_2} + \underset{\text{Water.}}{H_2O.}$$

$$\underset{\substack{\text{Acid Sodium}\\\text{Tartrate.}}}{NaHC_4H_4O_6} + \underset{\substack{\text{Potassium}\\\text{Chlorate.}}}{KClO_3} = \underset{\substack{\text{Sodium}\\\text{Chlorate.}}}{NaClO_3} + \underset{\substack{\text{Acid Potassium}\\\text{Tartrate.}}}{KHC_4H_4O_6.}$$

(2.8) Sodii Chloridum, $NaCl = 58.37$:—Natural product.
Common Salt.

(1) Sodii Hypophosphis, $NaPH_2O_2,H_2O = 105.84$:—

$$\underset{\substack{\text{Calcium}\\\text{Hypophosphite.}}}{Ca2H_2PO_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\\text{Hypophosphite.}}}{2NaH_2PO_2} + \underset{\substack{\text{Calcium}\\\text{Carbonate.}}}{CaCO_3.}$$

(.65) Sodii Hyposulphis, $Na_2S_2O_3.5H_2O = 247.64$:—

$$\underset{\substack{\text{Calcium}\\\text{Thiosulphate.}}}{CaS_2O_3} + \underset{\substack{\text{Sodium}\\\text{Sulphate.}}}{Na_2SO_4} = \underset{\substack{\text{Sodium}\\\text{Thiosulphate.}}}{Na_2S_2O_3} + \underset{\substack{\text{Calcium}\\\text{Sulphate.}}}{CaSO_4.}$$

(.6) Sodii Iodidum, $NaI = 149.53$:—

$$\underset{\substack{\text{Ferrous}\\\text{Iodide.}}}{FeI_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\\text{Iodide.}}}{2NaI} + \underset{\substack{\text{Ferrous}\\\text{Carbonate.}}}{FeCO_3.}$$

(1.3) Sodii Nitras, $NaNO_3 = 84.89$:—Natural product.

(1.5) Sodii Nitris, $NaNO_2 = 68.93$:—

(5.8) Sodii Phosphas, $Na_2HPO_4,12H_2O = 357.32$:—

$$\underset{\substack{\text{Calcium (Bone)}\\\text{Phosphate.}}}{Ca_3(PO_4)_2} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{2H_2SO_4} = \underset{\substack{\text{Acid Calcium}\\\text{Phosphate.}}}{CaH_4(PO_4)_2} + \underset{\substack{\text{Calcium}\\\text{Sulphate.}}}{2CaSO_4.}$$

$$\underset{\substack{\text{Acid Calcium}\\\text{Phosphate.}}}{CaH_4(PO_4)_2} + \underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{Na_2CO_3}$$

$$= \underset{\substack{\text{Calcium}\\\text{Phosphate.}}}{CaHPO_4} + \underset{\substack{\text{Sodium}\\\text{Phosphate.}}}{Na_2HPO_4} + \underset{\text{Water.}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{CO_2.}$$

(12) Sodii Pyrophosphas, $Na_4P_2O_7.10H_2O = 445.24$:—

$$\underset{\text{Dry Sodium Phosphate.}}{2Na_2HPO_4} + \text{Heat} = \underset{\text{Water.}}{H_2O} + \underset{\text{Sodium Pyrophosphate.}}{Na_4P_2O_7}.$$

(.9) Sodii Salicylas, $NaC_7H_5O_3 = 159.67$:—

$$\underset{\text{Salicylic Acid.}}{2HC_7H_5O_3} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Salicylate.}}{2NaC_7H_5O_3} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

(3) Sodii Santoninas, $2NaC_{15}H_{19}O_4.7H_2O$:—By adding santonin to hot solution Na_2CO_3. (off. in U. S. P., 1880).

(2.8) Sodii Sulphas, $Na_2SO_4.10H_2O = 321.42$:—
Glauber Salts.

By-product; see Leblanc's process for Na_2CO_3.

(4) Sodii Sulphis, $Na_2SO_3,7H_2O = 251.58$:—

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Sulphurous Acid.}}{SO_2} = \underset{\text{Sodium Sulphite.}}{Na_2SO_3} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

(5) Sodii Sulphocarbolas, $NaSO_3C_6H_4(OH) + 2H_2O = 231.56$:—

$$\underset{\text{Sulphuric Acid.}}{H_2SO_4} + \underset{\text{Carbolic Acid.}}{HC_6H_5O} = \underset{\text{Sulphocarbolic Acid.}}{HC_6H_5SO_4} + \underset{\text{Water.}}{H_2O}.$$

$$\underset{\text{Sulphocarbolic Acid.}}{HC_6H_5SO_4} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Sulphocarbolate.}}{2NaC_6H_5SO_4} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O}.$$

Name the official preparations of the sodium salts.

Liquor Sodæ; Liq. Sodæ Chloratæ; Liq. Sodii Arsenatis; Liq. Sodii Silicatis; Trochisci Sodii Bicarb.; Trochisci Santonini; Mist. Rhei et Sodæ.

Sodium salts are contained in what other preparations?

Sodii Hypophosphis, in Syr. of Hypophosphites; Sodii Pyrophosphate, in Ferric Phosphate and Ferric Pyrophosphate, etc., etc.

What is the technical name of the commercial baking soda?

Sodii Bicarbonas Venale. (Recently, most of the "Saleratus" is an imperfectly carbonated bicarbonate of sodium, formerly a potassium salt.)

What is dried carbonate of sodium?

The official name is Sodii Carbonas Exsiccatus. It is prepared by heating the carbonate of sodium; 200 parts are reduced, by exposing to the air, and afterward heating, to 100 parts.

What is the alternative process for making the solutions of soda and potassa?

Dissolve the caustic hydrates in distilled water (strength of both 5.6 per cent.).

How is the commercial bicarbonate of soda purified?

By washing with water until the washings give no precipitate with magnesium sulphate (U. S. P., 1880).

What is sodium hypochlorite, and where found?

$NaClO$; contained in Liquor Sodæ Chloratæ.

Name the principal sodium phosphates.

Disodium Phosphate (Na_2HPO_4 off. salt); Monosodium Phosphate, or Acid Sodium Phosphate.

Give the analytical reactions of the sodium salts.

The only reagent producing a precipitate of the Sodium solutions is potassium pyroantimoniate. Sodium compounds give a yellow color to Bunsen flame; Spectrum, a double yellow line. Distinguished from ammonium salts by not being volatilized by heat, and from potassium by not yielding precipitates with $PtCl_4$ or tartaric acid.

What marked difference is there between the chlorates of sodium and potassium?

The sodium salt is more soluble.

What marked difference is there between the potassium carbonate and the sodium carbonate?

Na_2CO_3 is crystalline and efflorescent, K_2CO_3 is granular and deliquescent. $NaHCO_3$ is a powder permanent in the air, $KHCO_3$ is crystalline and slightly deliquescent.

RESEARCH QUESTIONS.

In sodium salts how may the following impurities be detected,—where do they occur?

Alkaline earths, ammonia salts, aluminium, chlorides, iodide, sulphate, bromate, silica, phosphate, calcium, organic matter, foreign impurities. Also note the detection of—

More than the limit of carbonate, *in bromide* and *in iodide.*

More than the limit of chloride, *in bromide.*

More than the limit of bromide, *in iodide.*

Sulphate, *in sulphocarbolate.*

The student may extend this list from the U. S. P.

Why should not chlorates of potassium or sodium be triturated with readily oxidizable or combustible substances?

Explosives.

Observe the strength of the following test solutions, and note in what cases they are used in pharmaceutical testing:—

Test of bitartrate, carbonate, hyposulphite, phosphate, etc.

Name and give the symbol, and show by chemical equation the manufacture of the salts of lithium.

(4) Lithii Benzoas, $LiC_7H_5O_2 = 127.72$:—

$$\underset{\substack{\text{Lithium}\\\text{Carbonate.}}}{Li_2CO_3} + \underset{\substack{\text{Benzoic}\\\text{Acid.}}}{2HC_7H_5O_2} = \underset{\substack{\text{Lithium}\\\text{Benzoate.}}}{2LiC_7H_5O_2} + \underset{\text{Water.}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{CO_2}.$$

(V. sol.)* Lithii Bromidum, $LiBr = 86.77$:—

$$\underset{\text{Ferrous Bromide.}}{FeBr_2} + \underset{\text{Lithium Carbonate.}}{Li_2CO_3} = \underset{\text{Lithium Bromide.}}{2LiBr} + \underset{\text{Ferrous Carbonate.}}{FeCO_3}.$$

(80) Lithii Carbonas, $Li_2CO_3 = 73.87$:—Natural product.

(2) Lithii Citras, $Li_3C_6H_5O_7 : = 209.57$:—

$$\underset{\text{Lithium Carbonate.}}{3Li_2CO_3} + \underset{\text{Citric Acid.}}{2H_3C_6H_5O_7} = \underset{\text{Lithium Citrate.}}{2Li_3C_6H_5O_7} + \underset{\text{Water.}}{3H_2O} + \underset{\text{Carbon Dioxide.}}{3CO_2}.$$

(V. sol.) Lithii Salicylas, $LiC_7H_6O_3.H_2O = 143.68$:—

$$\underset{\text{Lithium Carbonate.}}{Li_2CO_3} + \underset{\text{Salicylic Acid.}}{2HC_7H_5O_3} = \underset{\text{Lithium Salicylate.}}{2LiC_7H_5O_3} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

What importance is attached to lithium in medicine?

If calculi (*e. g.*, urate of sodium, etc.) be formed in the body, their solution and removal are aided by the formation of lithium urate.

For what is the bromide of lithium noted?

For containing more bromine than any other bromide (91.95 per cent.).

What are the ingredients in lithii citras effervescens?

Lithium Carb. 7, Sod. Bicarb. 28, Citric Acid 37, Sugar q. s. to 100.

RESEARCH QUESTIONS.

In lithium salts, how may the following impurities be detected?

Salts of the alkalies and alkaline earths, carbonate and foreign matter, *in the Salicylate.*

---

* Very soluble.

Name and give the symbol and show by chemical equation the manufacture of the salts of ammonium.

(5) Ammonii Benzoas, $NH_4C_7H_5O_2 = 138.72$:—

$$\underset{\substack{\text{Benzoic}\\ \text{Acid.}}}{HC_7H_5O_2} + \underset{\substack{\text{Water of}\\ \text{Ammonia.}}}{NH_4HO} = \underset{\substack{\text{Ammonium}\\ \text{Benzoate.}}}{NH_4C_7H_5O_2} + \underset{\text{Water.}}{H_2O.}$$

(1.5) Ammonii Bromidum, $NH_4Br = 97.77$:—

$$\underset{\text{Bromine.}}{6Br} + \underset{\text{Ammonia.}}{8NH_3} = \underset{\substack{\text{Ammonium}\\ \text{Bromide.}}}{6NH_4Br} + \underset{\text{Nitrogen.}}{N_2.}$$

(5) Ammonii Carbonas, $NH_4HCO_3NH_4NH_2CO_2 = 157.77$:—

$$\underset{\substack{\text{Ammonium}\\ \text{Chloride.}}}{4NH_4Cl} + \underset{\substack{\text{Calcium}\\ \text{Carbonate.}}}{2CaCO_3}$$

$$= \underset{\substack{\text{Acid Ammonium Carbonate}\\ \text{and Carbamate.}}}{(NH_4HCO_3)NH_4NH_2CO_2} + \underset{\substack{\text{Calcium}\\ \text{Chloride.}}}{2CaCl_2} + \underset{\text{Ammonia.}}{NH_3} + \underset{\text{Water.}}{H_2O.}$$

(3) Ammonii Chloridum, $NH_4Cl = 53.38$:—
Sal Ammoniac.

By-product in the manufacture of bone-black, and obtained from the ammoniacal liquor in the manufacture of illuminating gas.

(1) Ammonii Iodidum, $NH_4I = 144.54$:—

$$\underset{\substack{\text{Potassium}\\ \text{Iodide.}}}{2KI} + \underset{\substack{\text{Ammonium}\\ \text{Sulphate.}}}{(NH_4)_2SO_4} = \underset{\substack{\text{Ammonium}\\ \text{Iodide.}}}{2NH_4I} + \underset{\substack{\text{Potassium}\\ \text{Sulphate.}}}{K_2SO_4.}$$

(.5) Ammonii Nitras, $NH_4NO_3 = 79.9$:—

$$\underset{\substack{\text{Ammonium}\\ \text{Carbonate.}}}{N_3H_{11}C_2O_5} + \underset{\text{Nitric Acid.}}{3HNO_3} = \underset{\substack{\text{Ammonium}\\ \text{Nitrate.}}}{3NH_4NO_3} + \underset{\substack{\text{Carbon}\\ \text{Dioxide.}}}{2CO_2} + \underset{\text{Water.}}{H_2O.}$$

(4) Ammonii Phosphas, $(NH_4)_2HPO_4$ (U. S. P., 1880):—

$$\underset{\substack{\text{Ammonium}\\ \text{Hydrate.}}}{2NH_4HO} + \underset{\substack{\text{Phosphoric}\\ \text{Acid.}}}{H_3PO_4} = \underset{\substack{\text{Ammonium}\\ \text{Phosphate.}}}{(NH_4)_2HPO_4} + \underset{\text{Water.}}{2H_2O.}$$

(1.3) Ammonii Sulphas, $(NH_4)_2SO_4$: Ammoniacal gas liquor neutralized with H_2SO_4, purified by recrystallization (U. S. P., 1880).

(V. sol.) Ammonii Valerianas, $NH_4C_5H_9O_2 = 118.78$: Dry ammonia gas passed into valerianic acid.

Name the official preparations of the ammonium compounds.

Liquor Ammonii Acetat.; Troch. Ammonii Chloridi, etc.

In what preparations is aqua ammonia used?

In Oxide of Antimony (Antimonii Oxidum); Ammoniated Glycyrrhizin; Washed Sulphur; Scaly Salts: Bismuth and Iron; Liniment; Sp. Amm. Ar.; Purified Ext. and Fl. Ext. of Glycyrrhiza; Fl. Ext. and Syr. Senega; Aq. Ammon. Fort. in making Spiritus Ammoniæ, etc.

How may carbonate of ammonium be converted into the bicarbonate, and what is a characteristic of the latter?

By simple exposure to the air the crystalline carbonate falls to a powder, becoming bicarbonate, which is insoluble in alcohol.

How may the bicarbonate be converted into the carbonate?

By dissolving in aqua ammonia, as in making the arom. spts. ammon.

This salt is soluble in a mixture of alcohol and water.

Give the analytical reactions of ammonium salts.

Like potassium, they produce the tartaric and platinic reactions, but potassium compounds are not volatile at red heat.

Heated with alkalies the salts evolve NH_3.

RESEARCH QUESTIONS.

In ammonium salts how are the following impurities detected, and where do they occur?

Ba, Ca, Fe, Pb, CO_2, Bromate, Iodate, Acetate, and empyreumatic matter.

This list may be extended by the student.

Also note the detection of:—

More than the limit of chloride *in bromide.*

More than the limit of chloride and bromide *in iodide.*

Observe the strength of the test solutions named below and others of the ammonium salts, and note where used in U. S. P.:—

Ammon. carbonate, chloride, oxalate, phosphate and sulphide.

Alkaline Earths.

What are the characteristics of this group?

They are bivalent, form basic hydrates, and insoluble carbonates, phosphates and arseniates.

For what purposes are barium salts used?

The solutions of nitrate and chloride are used as test solutions. (See U. S. P.)

Name and give symbol and show by chemical equation the manufacture of the salts of calcium.

(750) Calx (CaO) = 55.87:—
Quicklime.

$$CaCO_3 + \text{Heat} = CaO + CO_2.$$

Calcium Carbonate — Lime. — Carbon Dioxide.

Calx Chlorata, $CaCl_2CaCl_2O_2$:—
"Chloride of Lime."
Bleaching Powder.

$$2CaH_2O_2 + 2Cl_2 = CaCl_2CaCl_2O_2 + 2H_2O.$$

Calcium Hydrate. Chlorine. Chlorinated Lime. Water.

(.7) Calcii Bromidum, $CaBr_2 = 199.43$:—

$$CaCO_3 + 2HBr = CaBr_2 + H_2O + CO_2.$$

Calcium Carbonate. Hydrobromic Acid. Calcium Bromide. Water. Carbon Dioxide.

(Insol.) Calcii Carbonas Præcipitatus ($CaCO_3$) = 99.76:—

$$CaCl_2 + Na_2CO_3 = CaCO_3 + 2NaCl.$$

Calcium Chloride. Sodium Carbonate. Calcium Carbonate. Sodium Chloride.

(1.5) Calcii Chloridum, $CaCl_2 = 110.65$:—

$$\underset{\text{Calcium Carbonate.}}{CaCO_3} + \underset{\text{Hydrochloric Acid.}}{2HCl} = \underset{\text{Calcium Chloride.}}{CaCl_2} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O.}$$

(6.8) Calcii Hypophosphis, $Ca(PH_2O_2)_2 = 169.67$:—

$$\underset{\text{Phosphorus.}}{8P} + \underset{\text{Calcium Hydrate.}}{3Ca(OH)_2} + \underset{\text{Water.}}{6H_2O} = \underset{\text{Calcium Hypophosphite.}}{3Ca(PH_2O_2)_2} + \underset{\text{Phosphoretted Hydrogen.}}{2PH_3.}$$

(Insol.) Calcii Phosphas Præcipitatus, $Ca_3(PO_4)_2 = 309.33$:—

$$\underset{\text{Calcium Phosphate.}}{Ca_3(PO_4)_2} + \underset{\text{Hydrochloric Acid.}}{4HCl} = \underset{\text{Acid Calcic Phosphate.}}{CaH_4(PO_4)_2} + \underset{\text{Calcium Chloride.}}{2CaCl_2.}$$

$$\underset{\text{Acid Calcic Phosphate.}}{CaH_4(PO_4)_2} + \underset{\text{Calcium Chloride.}}{2CaCl_2} + \underset{\text{Ammonia.}}{4NH_4HO} = \underset{\text{Calcium Phosphate.}}{Ca_3(PO_4)_2.} +$$

What are the analytical reactions of calcium?

Alkaline carbonates and phosphates produce precipitates; ammonium oxalate gives a white precipitate with Ca salts, insoluble in weaker acids, but soluble in strong HCl or HNO_3. Sodium tungstate gives a dense white precipitate; Ca salts color a non-luminous flame bright yellow.

Name the official preparations of the calcium salts?

Calx Sulphurata; Hydrargyrum cum Creta; Cretæ Præparata; Pulv. Cretæ Comp.; Mist. Cretæ; Trochisci Cretæ; Liq. Calcis; Syr. Calcis; Syr. Calcii Lactophosphatis.

Calcium salts are contained in what other preparations?

Syr. Hypophosphitum, Syr. Hypophos. cum Ferro.

What is milk of lime and lime-water?

The former is a mixture of lime containing particles of undissolved lime; the latter is a clear, saturated solution of lime in water.

Show by chemical equation the action of water upon quicklime.

$$\underset{\text{Calcium Oxide.}}{CaO} + \underset{\text{Water.}}{H_2O} = \underset{\text{Calcium Hydrate.}}{Ca(OH)_2} \quad \text{(Slaked Lime).}$$

How is the value of chlorinated lime estimated?

By estimating the amount of available Cl. (See U. S. P.)

What is whiting?

A cheap form of prepared or elutriated chalk.

How is calx sulphurata made?

By placing a mixture of Dried Gypsum 70, Charcoal 10, Starch 2, into a crucible and heating to redness.

In what form is gypsum official?

Calcii Sulphas Exsiccatus (Dried Gypsum).

RESEARCH QUESTIONS.

How may the following impurities be detected in calcium salts in which they are found?

Alkalies and their carbonates; bromate; iodide; sulphate; phosphate; chloride; Aluminum; Barium; Magnesium; Iron; Strontium; insoluble matter, etc. (see U. S. P.).

Study the method of estimating Chlorinated Lime.

Study the peculiar chemical reaction in making the precipitated Phosphate of Calcium. (Refer to Dispensatory.)

Observe the following test solutions and note where they are used in pharmaceutical testing.

Calcium Chloride, Sulphate, etc.

Name, give the symbol and show by chemical equation the manufacture of the salts of magnesium.

Magnesia (and Magnesia Ponderosa), $MgO = 40.26$:—

$$\underset{\text{Magnesium Carbonate.}}{(MgCO_3)_4Mg(OH)_2} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Magnesia.}}{5MgO} + \underset{\text{Carbon Dioxide.}}{4CO_2} + \underset{\text{Water.}}{6H_2O.}$$

(Nearly Insol.) Magnesii Carbonas, $(MgCO_3)_4Mg(HO)_2.5H_2O = 484.62$:—

$$\underset{\text{Magnesium Sulphate.}}{5MgSO_4} + \underset{\text{Sodium Carbonate.}}{5Na_2CO_3} + \underset{\text{Water.}}{H_2O}$$

$$= \underset{\text{Magnesium Carbonate.}}{(MgCO_3)_4, Mg(HO)_2} + \underset{\text{Sodium Sulphate.}}{5Na_2SO_4} + \underset{\text{Carbon Dioxide.}}{CO_2.}$$

(1.5) Magnesii Sulphas, $MgSO_4.7H_2O = 245.84$:—
Epsom Salts.

$$\underset{\substack{\text{Magnesium}\\\text{Carbonate.}}}{MgCO_3} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{H_2SO_4} = \underset{\substack{\text{Magnesium}\\\text{Sulphate.}}}{MgSO_4} + \underset{\text{Water.}}{H_2O} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{CO_2.}$$

(20) Magnesii Sulphis, $MgSO_3.6H_2O$: (Magnesia suspended in water and treated with sulphurous acid—U. S. P., 1880).

(2) Magnesii Citras Effervescens: Mg Carb., Acid Cit., made into a paste; dried, powdered with sugar and $NaHCO_3$ and Cit. Acid; dampened with alcohol and granulated.

Name the official preparations of the salts of magnesium.

Hydrated Oxide of Iron with Magnesia; Liq. Mag. Cit. (Mg Carb. 15 Gm., Acid Cit. 30 Gm., Syr. Ac. Cit. 120 Cc., $KHCO_3$ 2.5 Gm., H_2O q. s. (The Bicarbonate added last to generate CO_2.)

Magnesium salts are found in what other preparations?

MgO, in Pulv. Rhei Co. and Massa Copaib.; $MgSO_4$, in Inf. Senna Co.

What is the difference between heavy and light magnesia?

The light (levis) is precipitated from dilute cold solutions; the heavy (ponderosa) is precipitated from dense hot solutions of $MgSO_4$ and Na_2CO_3. Differ merely in density.

Distinguish, by the taste, oxalic acid, sulphate of zinc and Epsom salts.

Epsom salts has a saline bitter taste, while zinc sulphate has a sharp metallic taste. Oxalic acid has a very sour taste.

What prominent analytical reaction has the magnesium compounds?

Barium and Calcium compounds must be removed by addition of sols. of NH_4Cl, NH_4HO and NH_4CO_3, the solution filtered; to the filtrate add solution of sodium phosphate, and ammonio-magnesium (triple) phosphate is formed.

Research Questions.

Name the ingredients in magnesium mixture, T. S., magnesium sulphate, T. S., and state how these are employed in U. S. P.

In magnesium salts, how may the following impurities be detected; where do they occur?

Other alkaline earths, SO_4, Cl, Aluminium, metals; also note—

Limit of sulphate, *in carbonate of magnesia.*

Limit of arsenic, *in sulphate* and limit of sodium, *in sulphate.* Test for absence of Zinc, Iron or Copper.

Name and give symbols of the official salts of strontium.

Strontii Bromidum, $SrBr_2 = 354.58$. Strontii Iodidum, SrI_2,-$6H_2O = 448.12$. Strontii Lactas, $Sr(C_3H_5O_3)_2,3H_2O = 318.76$.

Arsenic Group.

As	Sb	Bi
Arsenic.	Antimony.	Bismuth.

What are the characteristics of this group.

Remarkable for having both basic and acidic properties, Phosphorus being the most negative and Bismuth the most positive; for forming two series of compounds, in one of which they are trivalent and the other quinquivalent; for their poisonous qualities.

Name, give the symbol and show by chemical equation the manufacture of the salts of arsenic.

(30–80)* Acidum Arsenosum, $As_2O_3 = 197.68$:—

$$\underset{\text{Arsenious Oxide.}}{2As_2O_3} + \underset{\text{Water.}}{6H_2O} = \underset{\text{Arsenous Acid.}}{4H_3AsO_3.}$$

---

* Solubility varies with physical condition.

(4) Sodii Arsenas, $Na_2HAsO_4.7H_2O := 311.46$:—

$$\underset{\substack{\text{Arsenous}\\ \text{Acid.}}}{As_2O_3} + \underset{\substack{\text{Sodium}\\ \text{Nitrate.}}}{2NaNO_3} + \underset{\substack{\text{Sodium}\\ \text{Carbonate.}}}{Na_2CO_3} = \underset{\substack{\text{Sodium}\\ \text{Pyroarseniate.}}}{Na_4As_2O_7} + \underset{\substack{\text{Nitrous}\\ \text{Anhydride.}}}{N_2O_3} + \underset{\substack{\text{Carbon}\\ \text{Dioxide.}}}{CO_2}.$$

$$\underset{\substack{\text{Sodium}\\ \text{Pyroarseniate.}}}{Na_2As_2O_7} + \underset{\text{Water.}}{15H_2O} = \underset{\substack{\text{Sodium}\\ \text{Orthoarseniate.}}}{2Na_2HAsO_4.7H_2O}.$$

(3.5) Arseni Iodidum, $AsI_3 = 454.49$:—

$$\underset{\text{Arsenicum.}}{As_2} + \underset{\text{Iodine.}}{3I_2} = \underset{\substack{\text{Arseni}\\ \text{Iodide.}}}{2AsI_3}.$$

Under what other names is the official arsenic known?

Arsenic Trioxide, Arsenous Anhydride, and, improperly, Arsenous Acid and White Arsenic.

What is true arsenous acid?

It has not been isolated; there are, however, a number of salts known as arsenites, having the acid radical represented by AsO_3, the theoretical arsenous acid.

What is arsenic acid?

A combination of As pentoxide and water; thus,—

$$As_2O_5 + 3H_2O = 2AsO_4H_6.$$

What are the official preparations of arsenic?

Various solutions (see Liquors) containing one per cent. of Arsenic.

Give the analytical reactions of arsenic compounds.

Reinsch's test, Marsh's test, H_2S, to an acidulated solution of (ous) acid produces a yellow ppt. (Orpiment); also silver and copper test. (See also Stannous Chloride, T. S., U. S. P., 1890.)

In connection with arsenic the reactions of Antimony, Mercury and Bismuth should be well studied, so that the student may separate them by analysis.

Name, give symbol, and show by chemical equation the manufacture of the salts of antimony.

(17) Antimonii et Potassii Tartras, $2K(SbO)C_4H_4O_6.H_2O = 662.42$:—

$$\underset{\text{Acid Potassium Tartrate.}}{2KHC_4H_4O_6} + \underset{\text{Antimonous Oxide.}}{Sb_2O_3} = \underset{\text{Antimony Potassium Tartrate.}}{2K(SbO)C_4H_4O_6} + \underset{\text{Water.}}{H_2O.}$$

(Insol.) Antimonii Oxidum, $Sb_2O_3 = 287.08$.

$$\underset{\text{Antimony Sulphide.}}{Sb_2S_3} + \underset{\text{Hydrochloric Acid.}}{6HCl} = \underset{\text{Antimonous Chloride.}}{2SbCl_3} + \underset{\text{Hydrosulphuric Acid.}}{3H_2S};$$

then

$$\underset{\text{Antimonous Chloride.}}{12SbCl_3} + \underset{\text{Water.}}{15H_2O} = \underset{\text{Antimony Oxychloride.}}{2SbCl_3.5Sb_2O_3} + \underset{\text{Hydrochloric Acid.}}{30HCl},$$

and

$$\underset{\text{Antimony Oxychloride.}}{2SbCl_3.5Sb_2O_3} + \underset{\text{Ammonia.}}{6NH_3} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Antimonous Oxide.}}{6Sb_2O_3} + \underset{\text{Ammonium Chloride.}}{6NH_4Cl.}$$

(Insol.) Antimonii Sulphidum, $Sb_2S_3 = 335.14$:—

Native Sulphide, purified by fusion and as nearly free from Arsenic as possible.

(Insol.) Antimonium Sulphuratum, $Sb_2S_3 = 335.14$:—

$$\underset{\text{Antimonous Sulphide.}}{Sb_2S_3} + \underset{\text{Sodium Hydrate.}}{6NaHO} = \underset{\text{Sodium Antimonite.}}{Na_3SbO_3} + \underset{\text{Sodium Sulphantimonite.}}{Na_3SbS_3} + \underset{\text{Water.}}{3H_2O},$$

$$\underset{\text{Sodium Antimonite.}}{2Na_3SbO_3} + \underset{\text{Sulphuric Acid.}}{3H_2SO_4} = \underset{\text{Sodium Sulphate.}}{3Na_2SO_4} + \underset{\text{Antimonous Oxide.}}{Sb_2O_3} + \underset{\text{Water.}}{3H_2O},$$

$$\underset{\text{Sodium Sulphantimonite.}}{2Na_3SbS_3} + \underset{\text{Sulphuric Acid.}}{3H_2SO_4} = \underset{\text{Sodium Sulphate.}}{3Na_2SO_4} + \underset{\text{Antimonous Sulphide.}}{Sb_2S_3} + \underset{\text{Hydrosulphuric Acid.}}{3H_2S.}$$

How is antimonii sulphidum purificatum

First preparing the native sulphide by elutriation and then macerating in water containing a trace of water of ammonia.

Name the official preparations of the salts of antimony.

Pilulæ Antimonii Co., Pulvis Antimonialis, Vinum Antimonii.

Antimony salts are contained in what other preparations?

Tart. Emet., in Syr. Scillæ Co. and Vinum; Oxide, in Pulv. Antimonialis; Sb. Sulphuratum in Pil. Ant. Comp.

What is Kermes mineral?

Antimony Oxysulphide of U. S. P. 1870 (replaced in that of 1890 by Antimonium Sulphuratum). (See Pil. Ant. Co.)

Give the analytical reactions of the salts of antimony.

If a piece of tinfoil be dipped in an acidulated sol. of Ant. it will be coated with that metal. By Reinsch's or Marsh's test Antimony (metal) itself must be produced and verified with ammonium sulphydrate in all cases of analysis.

Research Questions.

How may the following impurities be detected in antimony compounds, and where do they occur:—

SO_4, Fe, metals, Ca, Cl.

Also detect: more than traces of arsenic *in Tartar emetic and purified sulphide.*

Note distinction between sulphide and sulphurated.

Name, give symbol, and show by chemical equation the manufacture of the salts of bismuth.

(Insol.) Bismuthi Citras, $BiC_6H_5O_7 = 397.44$:—

$$\underset{\text{Bismuth Subnitrate.}}{BiONO_3.H_2O} + \underset{\text{Citric Acid.}}{H_3C_6H_5O_7} = \underset{\text{Bismuth Citrate.}}{BiC_6H_5O_7} + \underset{\text{Nitric Acid.}}{HNO_3} + \underset{\text{Water.}}{2H_2O.}$$

(V. Sol.) Bismuthi et Ammonii Citras:—Citrate of Bismuth dissolved in water of ammonia, evaporated and scaled.

(Insol.) Bismuthi Subcarbonas, $(BiO)_2CO_3.H_2O$ (?):—Bismuth dissolved in nitric acid, purified and precipitated with sodium carbonate.

(Insol.) Bismuthi Subnitras, $BiONO_3H_2O$ (?):—

$$\underset{\text{Bismuth.}}{Bi_2} + \underset{\text{Nitric Acid.}}{8HNO_3} = \underset{\text{Bismuth Nitrate.}}{2Bi(NO_3)} + \underset{\text{Water.}}{4H_2O} + \underset{\text{Nitrogen Monoxide.}}{2NO};$$

then

$$\underset{\text{Bismuth Nitrate.}}{5Bi(NO_3)_3} + \underset{\text{Water.}}{8H_2O} = \underset{\text{Bismuth Subnitrate.}}{4BiONO_3H_2O} + \underset{\text{Bismuth Nitrate.}}{Bi(NO_3)_3} + \underset{\text{Nitric Acid.}}{8HNO_3}.$$

How may liquor bismuth be made?

It is an ammoniacal solution of ammonio-citrate of bismuth; strength about 2 grs. to f℥j. (See Dispensatory.)

Explain the loss of transparency in the ammonio-citrate and the solution of bismuth when they are exposed.

It is due to the evaporation of the ammonia; if this is restored to the solution it becomes again transparent.

RESEARCH QUESTIONS.

How may the following impurities of bismuth salts be detected, and where do they occur?

Alkalies, Alkaline earths, Pb, Cu, Ag, Sb, Cl and SO_4. How can you detect:—

More than traces of As, in the Subnitrate and Subcarbonate.

Zinc.

Name, give symbol and show by chemical equation the manufacture of the salts of zinc.

Zincum, Zn:—Metallic zinc in the form of thin sheets or irregular granulated pieces.

(2.7) Zinci Acetas, $Zn(C_2H_3O_2)_2.2H_2O = 218.74$:—

$$\underset{\text{Zinc Oxide.}}{ZnO} + \underset{\text{Acetic Acid.}}{2HC_2H_3O_2} = \underset{\text{Zinc Acetate.}}{Zn(C_2H_3O_2)_2} + \underset{\text{Water.}}{H_2O}.$$

(V. Sol.) Zinci Bromidum, $ZnBr_2 = 224.62$:—

$$\underset{\substack{\text{Zinc}\\\text{Sulphate.}}}{ZnSO_4} + \underset{\substack{\text{Potassium}\\\text{Bromide.}}}{2KBr} = \underset{\substack{\text{Zinc}\\\text{Bromide.}}}{ZnBr_2} + \underset{\substack{\text{Potassium}\\\text{Sulphate.}}}{K_2SO_4}.$$

(Insol.) Zinci Carbonas Præcipitatus, $(ZnCO_3)_2 3Zn(HO)_2$ (?) :—

$$\underset{\substack{\text{Sodium}\\\text{Carbonate.}}}{5Na_2CO_3} + \underset{\substack{\text{Zinc}\\\text{Sulphate.}}}{5ZnSO_4} + \underset{\text{Water.}}{3H_2O} = \underset{\substack{\text{Zinc}\\\text{Carbonate.}}}{(ZnCO_3)_2 3Zn(HO)_2} + \underset{\substack{\text{Sodium}\\\text{Sulphate.}}}{5Na_2SO_4} + \underset{\substack{\text{Carbon}\\\text{Dioxide.}}}{3CO_2}.$$

(V. Sol.) Zinci Chloridum, $ZnCl_2 = 135.84$:—

$$\underset{\text{Zinc.}}{2Zn} + \underset{\substack{\text{Hydrochloric}\\\text{Acid.}}}{4HCl} = \underset{\substack{\text{Zinc}\\\text{Chloride.}}}{2ZnCl_2} + \underset{\text{Hydrogen.}}{4H}.$$

(V. Sol.) Zinci Iodidum, $ZnI_2 = 318.16$:—

$$\underset{\text{Zinc.}}{Zn} + \underset{\substack{\text{Hydriodic}\\\text{Acid.}}}{2HI} = \underset{\substack{\text{Zinc}\\\text{Iodide.}}}{ZnI_2} + \underset{\text{Hydrogen.}}{2H}.$$

(Insol.) Zinci Oxidum, $ZnO = 81.06$:—Zinc carbonate, calcined.

(Insol.) Zinci Phosphidum, Zn_3P_2 :—Made by passing a mixture of PH_3 and N over red-hot Zn in a tube, or by throwing P on melted Zn.

(.6) Zinci Sulphas, $ZnSO_4 \cdot 7H_2O = 286.64$:—
(White Vitriol.)

$$\underset{\text{Zinc.}}{2Zn} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{2H_2SO_4} + \underset{\text{Water.}}{H_2O} = \underset{\substack{\text{Zinc}\\\text{Sulphate.}}}{2ZnSO_4} + \underset{\text{Hydrogen.}}{4H} + \underset{\text{Water.}}{H_2O}.$$

(10C) Zinci Valerianas, $Zn(C_5H_9O_2)_2, 2H_2O = 302.56$:—

$$\underset{\text{Sodium Valerianate.}}{NaC_5H_9O_2} + \underset{\text{Zinc Sulphate.}}{ZnSO_4} = \underset{\text{Zinc Valerianate.}}{Zn(C_5H_9O_2)_2} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4}.$$

In what official preparations are zinc salts employed?

Zn Carb. and Zn, in the Solution of Chloride of Zinc.

Zn Oxide, in the Ointment.

RESEARCH QUESTIONS.

Note the prominent characteristics of acetate and valerianate, the deliquescence of the bromide and chloride.

In zinc salts, how may the following impurities be detected, and when do they occur?

As; Pb; Fe; Cu; Al; Alk. earths; CO_3.

Basic salts, *in Chloride.*

Butyrate, *in Valerianate.*

Explain how iron is removed from chloride of zinc by the use of HNO_3 and Zn carb.

The HNO_3 oxidizes the Fe, and the Zn Carb. precipitates the ferric hydrate.

Give the analytical reactions of zinc.

Alkaline hydrates produce a precipitate, soluble in excess; K_2CO_3 and Na_2CO_3, white precipitate, insoluble in excess; $(NH_4)_2CO_3$, white precipitate, soluble in excess. Its sulphide and ferrocyanide are white.

Lead.

Name, give symbol, and show by chemical equation the manufacture of the salts of lead.

(2.3) Plumbi Acetas, $Pb(C_2H_3O_2)_2.3H_2O = 378$:—Metallic lead acted upon by the fumes of acetic acid and decaying matter; also by dissolving litharge in acetic acid, evaporating and crystallizing.

$$\begin{array}{ccccccc} PbO & + & 2HC_2H_3O_2 & = & Pb(C_2H_3O_2)_2 & + & H_2O. \\ \text{Lead Oxide.} & & \text{Acetic Acid.} & & \text{Lead Acetate.} & & \text{Water.} \end{array}$$

(Insol.) Plumbi Carbonas, $(PbCO_3)_2.Pb(OH)_2$.

(2000) Plumbi Iodidum, $PbI_2 = 459.46$:—

$$\begin{array}{ccccccc} 2KI & + & Pb(NO_3)_2 & = & PbI_2 & + & 2KNO_3. \\ \text{Potassium Iodide.} & & \text{Lead Nitrate.} & & \text{Lead Iodide.} & & \text{Potassium Nitrate.} \end{array}$$

(2) Plumbi Nitras, $Pb(NO_3)_2 = 330.18$:—

$$\underset{\text{Lead Oxide.}}{PbO} + \underset{\text{Nitric Acid.}}{2HNO_3} = \underset{\text{Lead Nitrate.}}{Pb(NO_3)_2} + \underset{\text{Water.}}{H_2O.}$$

(Insol.) Plumbi Oxidum, $PbO = 222.36$:—

$$\underset{\text{Lead.}}{Pb_2} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Lead Oxide.}}{2PbO.}$$

Lead salts are contained in what preparations?

Emplastrum, made by boiling PbO (Litharge) with olive oil; Liq. Plumbi Subacetat.; Liq. Pb. Subacetat. Dilutus; Cerat. Pb. Subacetat. (Goulard's Cerate); Ung. Plumbi Carb.; Ung. Pb. Iod.; Ung. Diachylon. (The Carb. is used in making Sol. Gutta Perchæ of U. S. P., 1880.)

RESEARCH QUESTIONS.

Note the sweet taste of sugar of lead and other physical properties.

How may the following impurities be detected; where do they occur?

Zn; alkalies; alkaline earths; Cu; CO_3 in the oxide of lead.

What are the analytical reactions of lead compounds?

They give from acid solutions a black precipitate with H_2S, insoluble in acids; the same with $(NH_4)_2S$, insoluble in excess. Soluble sulphates produce a white precipitate, KI a yellow precipitate, and K_2CrO_4 a yellow precipitate.

NOTE :—Test solution of Acetate of Lead.

Silver.

Name, give symbol, and show by chemical equation the manufacture of the salts of silver.

Argenti Cyanidum, $AgCn = 133.64$:—

$$\underset{\substack{\text{Silver}\\\text{Nitrate.}}}{AgNO_3} + \underset{\substack{\text{Potassium}\\\text{Cyanide.}}}{KCN} = \underset{\substack{\text{Silver}\\\text{Cyanide.}}}{AgCN} + \underset{\substack{\text{Potassium}\\\text{Nitrate.}}}{KNO_3.}$$

Argenti Iodidum, $AgI = 234.15$:—

$$\underset{\text{Potassium Iodide.}}{\mathrm{KI}} + \underset{\text{Silver Nitrate.}}{\mathrm{AgNO_3}} = \underset{\text{Silver Iodide.}}{\mathrm{AgI}} + \underset{\text{Potassium Nitrate.}}{\mathrm{KNO_3}}.$$

Argenti Nitras, $AgNO_3 = 169.55$:—

$$\underset{\text{Silver.}}{\mathrm{Ag_3}} + \underset{\text{Nitric Acid.}}{\mathrm{4HNO_3}} = \underset{\text{Silver Nitrate.}}{\mathrm{3AgNO_3}} + \underset{\text{Nitrogen Monoxide.}}{\mathrm{NO}} + \underset{\text{Water.}}{\mathrm{2H_2O}}.$$

Argenti Oxidum, $Ag_2O = 231.28$:—

$$\underset{\text{Silver Nitrate.}}{\mathrm{2AgNO_3}} + \underset{\text{Potassium Hydrate.}}{\mathrm{2KHO}} = \underset{\text{Silver Oxide.}}{\mathrm{Ag_2O}} + \underset{\text{Potassium Nitrate.}}{\mathrm{2KNO_3}} + \underset{\text{Water.}}{\mathrm{H_2O}}.$$

Name the officinal salts of silver not mentioned above.

Argenti Nitras Fusus (nitrate of silver fused and run into moulds); Argenti Nitras Dilutus (equal parts of $AgNO_3$ and KNO_3 fused together). ($AgCN$ is used in making Ac. Hydrocyan. dilute.)

Why should preparations of Ag be kept in dark, amber-colored vials?

Unless protected from light they turn in color and become chemically changed.

RESEARCH QUESTIONS.

Observe that $AgNO_3$ has no water of crystallization.

How is the absence of chloride in iodide determined?

What is the quantitative analysis given for $AgNO_3$ and dilute nitrate?

How is the absence of foreign metallic impurities in $AgNO_3$ determined?

Observe the strength of the test solutions of $AgNO_3$, Ag_2SO_4, Ag. ammon. nit., and volumetric sol. of $AgNO_3$.

Of what is the chloride of gold and soda composed?

A mixture of equal parts by weight of the two salts.

For what is platinic chloride used?

As a test solution (see U. S. P.) for the presence of compounds of K and NH_4.

What precautions should be exercised in using platinum vessels?

The metal is attacked by nitro-hydrochloric acid, or any substance liberating chlorine. They should not be heated with any metal or easily-reducible oxide, or with the alkalies and alkaline carbonates, and under certain conditions, alkaline phosphates. They should never be heated over an alcohol or coal fire; the metal when so heated becomes blackened and brittle.

Copper and Mercury.

What similarity is there in the nomenclature of these two elements?

The (ic) salts contain a single atom, as CuO (cupr*ic*) and $HgCl_2$ (mercur*ic* chloride), while the term (ous) applies to compounds containing the greater proportion of metal, as Cu_2O (cupr*ous* oxide), $(Hg)_2Cl_2$ (mercur*ous* chloride).

Name, give symbol, and show by chemical equation the manufacture of the salts of copper.

Cupri Acetas, $Cu(C_2H_3O_2)_2,H_2O$:—Copper treated with (Verdigris.) acetic acid, and the product purified by crystallization. (U. S. P., 1880.)

Cupri Sulphas, $CuSO_4,5H_2O = 248.8$:—
(Blue Vitriol.)

$$\underset{\text{Copper.}}{Cu_2} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{4H_2SO_4} = \underset{\substack{\text{Sulphate}\\\text{of Copper.}}}{2CuSO_4} + \underset{\substack{\text{Sulphurous}\\\text{Anhydride.}}}{2SO_2} + \underset{\text{Water.}}{4H_2O}.$$

In copper salts, how may the following impurities be detected; where do they occur?

Alkalies, Alkaline earths, Fe, Pb, Zn, and foreign impurities *in sulphate.*

What are the analytical reactions of copper salts?

Bright metallic iron surfaces become coated with copper when dipped in acidulated solutions of Cu; H_2S = black ppt.; NH_4HO = deep blue color; K Ferro-Cy. = a brown ppt.

Name, give symbol, and show by chemical equation the manufacture of the salt of mercury.

Hydrargyrum, Hg: With the exception of bromine, it is the only liquid element at ordinary temperatures. The principal ore of mercury is the native sulphide, known as cinnabar.
Quicksilver.

(Insol.) Hydrargyrum Ammoniatum, $NH_2HgCl = 251.18$:—

$$\underset{\text{Mercuric Chloride.}}{HgCl_2} + \underset{\text{Water of Ammonia.}}{2NH_4HO} = \underset{\text{Ammonium Chloride.}}{NH_4Cl} + \underset{\text{Mercurammonium Chloride.}}{NH_2HgCl} + \underset{\text{Water.}}{2H_2O.}$$

(16) Hydrargyri Chloridum Corrosivum, $HgCl_2 = 270.54$:—

$$\underset{\text{Sulphuric Acid.}}{2H_2SO_4} + \underset{\text{Mercury.}}{Hg} = \underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Sulphurous Acid.}}{SO_2} + \underset{\text{Water.}}{2H_2O.}$$

$$\underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Sublimation.}}{\text{High heat}} = \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Mercuric Chloride.}}{HgCl_2.}$$

(Insol.) Hydrargyri Chloridum Mite, $Hg_2Cl_2 = 470.34$ (or $HgCl = 235.17$):—

$$\underset{\text{Sulphuric Acid.}}{2H_2SO_4} + \underset{\text{Mercury.}}{Hg} = \underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Sulphurous Acid.}}{SO_2} + \underset{\text{Water.}}{2H_2O.}$$

$$\underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Mercury.}}{Hg} = \underset{\text{Mercurous Sulphate.}}{Hg_2SO_4.}$$

$$\underset{\text{Mercurous Sulphate.}}{Hg_2SO_4} + \underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{(Sublimation.)}}{\text{High heat}} = \underset{\text{Mercurous Chloride.}}{Hg_2Cl_2} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4.}$$

(12.8) Hydrargyri Cyanidum, $Hg(CN)_2 = 251.76$:—

$$\underset{\text{Hydrocyanic Acid.}}{(HCN)_2} + \underset{\text{Mercuric Oxide.}}{HgO} = \underset{\text{Mercuric Cyanide.}}{Hg(CN)_2} + \underset{\text{Water.}}{H_2O.}$$

(Insol.) Hydrargyri Iodidum Rubrum, $HgI_2 = 452.86$:—

$$\underset{\substack{\text{Mercuric}\\\text{Chloride.}}}{HgCl_2} + \underset{\substack{\text{Potassium}\\\text{Iodide.}}}{2KI} = \underset{\substack{\text{Mercuric}\\\text{Iodide.}}}{HgI_2} + \underset{\substack{\text{Potassium}\\\text{Chloride.}}}{2KCl.}$$

(Insol.) Hydrargyri Iodidum Flavum, $Hg_2I_2 = 652.66$:—Sol. Hg-ous nitrate precipitated by Sol. KI (Hydrarg. Iod. Viride, U. S. P., 1880). Protiodide of Hg. Yellow (or Green) Iod. of Mercury.

(Insol.) Hydrargyri Oxidum Flavum, $HgO = 215.76$:—

$$\underset{\substack{\text{Mercuric}\\\text{Chloride.}}}{HgCl_2} + \underset{\substack{\text{Potassium}\\\text{Hydrate.}}}{2KHO} = \underset{\substack{\text{Mercuric}\\\text{Oxide.}}}{HgO} + \underset{\substack{\text{Potassium}\\\text{Chloride}}}{2KCl} + \underset{\text{Water.}}{H_2O.}$$

(Insol.) Hydrargyri Oxidum Rubrum, $HgO = 215.76$:—

$$\underset{\substack{\text{Mercuric}\\\text{Nitrate.}}}{(Hg2NO_3)_2} + \text{Heat} = \underset{\substack{\text{Mercuric}\\\text{Oxide}}}{2HgO} + \underset{\substack{\text{Nitrogen}\\\text{Dioxide.}}}{4NO_2} + \underset{\text{Oxygen.}}{O_2.}$$

(Insol.) Hydrargyri Subsulphas Flavus, $Hg(HgO)_2SO_4 = 727.14$:—By adding mercuric sulphate to boiling water.

(Insol.) Hydrargyri Sulphidum Rubrum, HgS :—Fusing and subliming mercury and sulphur. (U. S. P., 1880.)

Name the plasters containing mercury in metallic state.

Emp. Hydrarg. (30 per cent.), Emp. Amm. cum. Hydrarg. (1.8 per cent.).

Name the ointments of mercury and its salts?

Unguentum Hydrarg., Ung. Hydrarg. Amm., Ung. Hydrarg. Ox. Flav., Ung. Hydrarg. Ox. Rub., Ung. Hydrarg. Nit.

Name the other official preparations of Mercury.

Hydrarg. Cum Creta, Massa Hydrarg., Oleatum Hydrarg., Liq. Hydrarg. Nit. (Hg_2Cl_2, in Pil. Ant. Co. and Pil. Cath. Co.; HgI_2, in Donovan's solution).

What is vermilion?

Composed largely of red sulphide of Hg.

RESEARCH QUESTIONS.

Observe the physical properties of the (ic) and (ous) salts of mercury.

Note similarity in composition of yellow and red oxide.

How are the following impurities detected in mercury salts, and where are they found?

Pb, Sn, As, Sb, and other metals.

Note, also, moisture and organic impurities in metallic mercury; ous *in ic* and ic *in ous* salts.

What are the analytical reactions of mercury?

A piece of bright copper in a solution containing mercury is coated with that metal; if the copper, with its adherent deposit, be washed, dried and heated in a glass tube, minute globules of mercury condense in the cold part of the tube; $H_2S =$ a black precipitate.

NOTE.—Test solutions of Iodides of Mercury and Potassium, and Mercuric Chloride.

Iron. Manganese and Chromium.

What peculiarity is there in the valence of these elements?

They form two series of compounds designated respectively *ous* and *ic* compounds; in the former the atom is bivalent, as in $FeCl_2$, in the latter a double atom (Fe_2) behaves as a hexivalent atom as in $(Fe_2)Cl_6$.

Name, give symbol and show by chemical equation the manufacture of the salts of iron.

Ferrum Reductum, Fe = 55.88 :—

$$\underset{\text{Ferric Oxide.}}{Fe_2O_3} + \underset{\text{Hydrogen.}}{6H} = \underset{\text{Iron}}{2Fe} + \underset{\text{Water.}}{3H_2O.}$$

(S. Sol.)* Ferri Carbonas Saccharatus :—

$$\underset{\text{Ferrous Sulphate.}}{FeSO_4} + \underset{\text{Sodium Bicarbonate.}}{2NaHCO_3} = \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Ferrous Carbonate.}}{FeCO_3} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon. Dioxide.}}{CO_2.}$$

(V. Sol.) Ferri Chloridum, $Fe_2Cl_6\,12H_2O = 539.5$:—

$$\underset{\text{Iron.}}{Fe_2} + \underset{\text{Hydrochloric Acid.}}{4HCl} = \underset{\text{Ferrous Chloride.}}{(FeCl_2)_2} + \underset{\text{Hydrogen.}}{4H.}$$

$$\underset{\text{Ferrous Chloride.}}{6FeCl_2} + \underset{\text{Hydrochloric Acid.}}{6HCl} + \underset{\text{Nitric Acid.}}{2HNO_3} = \underset{\text{Ferric Chloride.}}{3Fe_2Cl_6} + \underset{\text{Nitrogen Dioxide.}}{N_2O_2} + \underset{\text{Water.}}{4H_2O.}$$

(3) Ferri et Ammonii Sulphas, $Fe_2(NH_4)_2(SO_4)_4,24H_2O$
Iron Alum. = 962.1 :—

$$\underset{\text{Ferric Sulphate.}}{Fe_23SO_4} + \underset{\text{Ammonium Sulphate.}}{(NH_4)_2SO_4} = \underset{\text{Ammonio-ferric Sulphate.}}{Fe_2(NH_4)_2(SO_4)_4.}$$

(S. Sol.) Ferri Hypophosphis, $Fe_2(H_2PO_2)_6 = 501.04$:—

$$\underset{\text{Calcium Hypophosphite.}}{Ca(H_2PO_2)_2} + \underset{\text{Ferrous Sulphate.}}{FeSO_4} = \underset{\text{Calcium Sulphate.}}{CaSO_4} + \underset{\text{Ferrous Hypophosphite.}}{Fe(H_2PO_2)_2.}$$

(40) Ferri Lactas, $Fe\,(C_3H_5O_3)_2.3H_2O = 287.34$:—

$$\underset{\text{Iron.}}{Fe_2} + \underset{\text{Lactic Acid.}}{4HC_3H_5O_3} = \underset{\text{Ferrous Lactate.}}{2Fe(C_3H_5O_3)_2} + \underset{\text{Hydrogen.}}{H_4.}$$

Ferri Oxidum Cum Magnesia (Arsenic Antidote): Sol. Ferric Sul. 50 Gm., Mg. 10 Gm., Water q. s.

(Insol.) Ferri Oxidum Hydratum, $Fe_2(HO)_6 = 213.52$:—

$$\underset{\text{Ferric Sulphate.}}{Fe_2(SO_4)_3} + \underset{\text{Ammonium Hydrate.}}{6NH_4HO} = \underset{\text{Ferric Hydrate.}}{Fe_2(HO)_6} + \underset{\text{Ammonium Sulphate.}}{3(NH_4)_2SO_4.}$$

---

* Sparingly soluble.

(1.8) Ferri Sulphas, $FeSO_4,7H_2O = 277.42$:—

$$\underset{\text{Iron.}}{Fe_2} + \underset{\text{Sulphuric Acid.}}{2H_2SO_4} = \underset{\text{Ferrous Sulphate.}}{2FeSO_4} + \underset{\text{Hydrogen.}}{4H.}$$

(Insol.) Ferri Valerianas, $Fe(C_5H_9O_2)_6$:—Double decomposition between ferric sulphate and sodium valerianate.

Give the official names of the scale salts of iron.

Ferri Citras, F. et Ammonii Citras, F. et Quiniæ Citras, F. et Strychniæ Citras, F. et Ammonii Tartras, F. et Potass. Tart., F. Phosphas Solubilis, F. Pyrophosphas Solubilis, F. et Quin. Cit. Solubilis.

Give a general formula for the preparation of the scale salts of iron.

Ferric Hydrate is first made by precipitating a solution of Ferric Sulphate with solution of Ammonia, washing the precipitate, then adding prescribed proportions of the respective acids (tartaric or citric) or acid salt (acid potassium tartrate), etc., evaporating to a syrupy consistence and spreading on plates to dry (or scale).

How are the citrates of iron and strychnine and iron and quinine made?

The former is an evaporated mixture of Citrate of Iron and Ammonia with Citric Acid and Strychnine, the latter is made by dissolving Quinine (alk.) in a mixture of Ferric Citrate, Citric Acid, Ammonia Water, etc.; evaporating and scaling.

How is the pyrophosphate and phosphate made?

In the former by mixing the solution of Citrate of Iron and Pyrophosphate of Sodium, in the latter the Cit. of Iron and Phosphate of Sodium evaporating, etc.

Why are the alkaline salts used in these iron preparations?

To make them soluble; such double compounds of Iron are readily dissolved and retained in solution.

What salts of iron are official not mentioned above?

Ferri Sulphas Exsiccatus (Sulphate heated till loss of weight ceases), Ferri Iodidum Saccharatum.

Ferri Sulphas Granulatus (Sulphate dissolved in acidulated (H_2SO_4) water, the solution filtered and precipitated by Alcohol).

Iron salts are contained in what other preparations?

Vinum Ferri Citratis, various Liquors and Syrups (which see), Lactate, in Syr. Hypophosphitum cum Ferro (Comp. Syr. Hypophos. with Iron); $FeSO_4$, in Massa Ferri Carb. and Mist. Ferri. Co.; Ferri Sulphas Exsiccatus, in Pil. Aloes et Ferri; Ferrum Reductum, in Pil. Ferri Iod.

What are some of the synonyms of ferric oxide?

Sesquioxide, Peroxide, and Red Oxide of Iron, Colcothar Rouge, Venetian Red, etc.

By what other name is the subsulphate of iron known?

Persulphate and Basic Ferric Sulphate.

Give the analytical reactions for salts of iron.

Ferrous Salts with K Ferro-Cy = a greenish white ppt.; with K Ferri-Cy = blue ppt. (Turnbull's Blue). *Ferric Salts* with Ferro-Cy = blue ppt. (Prussian blue), Ferri-Cy = no ppt., greenish brown color. With ic salts, only, K Sulphocyanate produces a deep red color.

RESEARCH QUESTIONS.

Observe the strength of the following test solutions of the U. S. P.

Ferric Chloride, Ferrous Sulphate and Ferric Ammonium Sulphate.

How is the per cent. of unoxidized sulphate in copperas determined?

In iron salts, how may the following impurities be detected, and where do they occur?

Zn, Cu, Alkalies and NO_3; Fe (ous) *in ic*, and Fe (ic) *in ous*. Al. *in Iron Alum.* Iodine *in Saccharated Iodide of Iron.*

Name, give symbol, and show by chemical equation the manufacture of the salts of manganese.

(Insol.) Mangani Dioxidum, $MnO_2 = 86.72$: Also known as black oxide, is the chief ore of manganese.

(.8) Mangani Sulphas, $MnSO_4.4H_2O = 222.46$.

In what preparations are the manganese compounds used?

MnO_2, used in making chlorine water, and in permanganate of potassium.

What is a prominent physical property of Mn salts?

Pinkish in color.

In the sulphate, how may the following impurities be detected?

Zn, Cl, Cu, Alkalies, and Mg.

Name, give symbol, and show by chemical equation the manufacture of official compounds of chromium.

Acidum Chromicum, $CrO_3 = 99.88$:—

$$\underset{\substack{\text{Potassium}\\ \text{Bichromate.}}}{K_2Cr_2O_7} + \underset{\substack{\text{Sulphuric}\\ \text{Acid.}}}{2H_2SO_4} = \underset{\substack{\text{Chromic}\\ \text{Acid.}}}{2CrO_3} + \underset{\substack{\text{Potassium}\\ \text{Acid Sulphate.}}}{2KHSO_4} + \underset{\text{Water.}}{H_2O}.$$

RESEARCH QUESTIONS.

How may H_2SO_4 be detected in chromic acid?

What is the effect and danger of mixing the above with oxidizable bodies?

Aluminum.

Name, give symbol, and show by chemical equation the manufacture of the salts of aluminum.

(9) Alumen, $K_2Al_2(SO_4)_4.24H_2O = 946.46$:—
Potassa-alum.

Al_2O_3 +	$3H_2SO_4$ +	K_2SO_4 +	$21H_2O$ =	$K_2Al_2(SO_4)_4 24H_2O$.
Aluminum Oxide.	Sulphuric Acid.	Potassium Sulphate.	Water.	Alumen.

(Insol.) Alumini Hydras, $Al_2(OH)_6 = 155.84$:—

$K_2Al_2(SO_4)_4$ +	$3Na_2CO_3$ +	$3H_2O$ =	$Al_2(HO)_6$ +	K_2SO_4 +	$3Na_2SO_4$ +	$3CO_2$.
Potassa-Alum.	Sodium Carbonate.	Water.	Aluminum Hydrate.	Potassium Sulphate.	Sodium Sulphate.	Carbon Dioxide.

(1.2) Alumini Sulphas, $Al_2(SO_4)_3 16H_2O$:—Aluminum hydrate treated with sulphuric acid and crystallized.

What is dried or burnt alum?

Alumen Exsiccatum is made by heating 100 Gm. of alum on a sand-bath until reduced to 55 parts.

What other compounds, besides the official alum, are termed alums?

The officinal alum is known as the Potassa-alum, but any double sulphate of a trivalent and a univalent radical with 24 molecules of water of crystallization is considered an alum. We have, therefore, besides Potassa-alum, Ammonia-alum; NH_4, replacing the univalent K, thus: $Al_2(NH_4)_2(SO_4)_4 24H_2O$. We have also double sulphates of Cr, Fe, Mn (replacing the Al), and an alkali metal, plus $24H_2O$. All these are termed alums.

Give the analytical reactions of the aluminum compounds.

Hydrates of K and Na produce white, gelatinous precipitates soluble in excess; alkaline carbonates produce precipitates, with evolution of CO_2; NH_4OH produces a white precipitate insoluble in excess.

RESEARCH QUESTIONS.

In aluminum salts, how may the following impurities be detected? Where are they found?

Alkalies, Fe, Pb, Zn; SO_4 *in hydrate.*

More than 5 per cent. of alkaline sulphate, *in sulphate.*

Name, give symbol and method of preparation of the official salt of cerium.

(Insol.) Cerii Oxalas, $Ce_2(C_2O_4)_3.9H_2O = 704.78$:—Cerium chloride precipitated by oxalic acid.

RESEARCH QUESTION.

In cerium salts, how may the following impurities be detected; where do they occur?

Al, Zn, CO_3, metals.

Non-metallic Elements.

Halogens:—Chlorine, Bromine and Iodine.

How may chlorine be separated from HCl?

$$\underset{\text{Manganese Dioxide.}}{MnO_2} + \underset{\text{Hydrochloric Acid.}}{4HCl} = \underset{\text{Manganese Chloride.}}{MnCl_2} + \underset{\text{Chlorine.}}{Cl_2} + \underset{\text{Water.}}{2H_2O.}$$

(Officinal preparations of Cl:—Calx Chlorata; Liq. Sodæ Chlorata.)

Give an extemporaneous method of preparing chlorine water.

1. NaCl 60 grs., lead oxide (red) 350 grs.; triturate and introduce into a bottle; add water, ℥viij, and H_2SO_4, fʒij, and let stand. ($PbSO_4$ precipitates, while Cl and $NaSO_4$ are in solution.)

2. $KClO_3$, 60 grs., is put into an 8-oz. bottle; add HCl, f℥ij; let stand till reaction ceases, and add water to make one pint.

How does Cl act as a bleaching, deodorizing and disinfecting agent?

As an indirect oxidizer by decomposing any water present; the liberated nascent O acting energetically —

$$H_2O + Cl_2 = 2HCl + O.$$

How may bromine be separated from its native combination?

It is found as a magnesium or calcium bromide in the mother liquors ("bittern"), separated as follows:—

$$MgBr_2 + 4HCl + MnO_2 = MgCl_2 + MnCl_2 + Br_2 + 2H_2O;$$
$$\text{or,}\quad MgBr_2 + Cl = MgCl_2 + Br_2.$$

What are the physical properties of bromine?

It is a dark-brown liquid, volatile, giving off brown fumes, which are disagreeable in odor and irritating to the mucous surfaces.

How is iodine separated from its native combinations?

Crude NaI is decomposed by MnO_2 and H_2SO_4 and sublimed.

State the physical properties of iodine.

Scaly, volatile substance, of acrid odor and taste, having metallic lustre; its fumes violet colored, very sparingly soluble in H_2O.

(Official preparations of Iodine:—Tr; Liq. Iod. Co.; Ung. Iod.; Tinctura Iodi; Syr. Ac. Hydriodici.)

RESEARCH QUESTION.

Give an account of the preparation and use of the volumetric solution of iodine.

Elementary Gases (H, N, O, Cl).

What are the elementary gases, and give their physical properties?

Hydrogen, Oxygen and Nitrogen are colorless, odorless and tasteless. Chlorine is a yellowish-green gas, of suffocating odor.

Into what official compound do these elements enter?

See Inorganic Acids, etc.

What preparations of sulphur are official?

(Insol.) Sulphur Sublimatum: By subliming crude sulphur.

(Insol.) Sulphur Lotum: By washing sublimed sulphur.

(Insol.) Sulphur Præcipitatum:—

$$\underset{\text{Calcium Oxide.}}{3CaO} + \underset{\text{Sulphur.}}{6S} = \underset{\text{Calcium Disulphide.}}{2CaS_2} + \underset{\text{Calcium Thiosulphate.}}{CaS_2O_3}.$$

$$\underset{\text{Calcium Disulphide.}}{2CaS_2} + \underset{\text{Calcium Thiosulphate.}}{CaS_2O_3} + \underset{\text{Hydrochloric Acid.}}{6HCl} = \underset{\text{Calcium Chloride.}}{3CaCl_2} + \underset{\text{Sulphur.}}{6S} + \underset{\text{Water.}}{3H_2O}.$$

(Insol.) Sulphuris Iodidum: By treating iodine with sulphur.

Unguentum Sulphuris: 30 parts of sublimed sulphur mixed with 70 parts of benzoinated lard.

Unguentum Sulphuris Alkalinum: 20 parts of washed sulphur, 10 parts of carb. pot., 5 parts water, and 65 parts of benzoinated lard (U. S. P., 1880).

(Insol.) Carbonei Disulphidum, $Cs_2 = 75.93$:—Sulphur vapor passed over red-hot charcoal.

Acidum Hydrosulphuricum (Sulphuretted Hydrogen): Ferrous sulphide acted upon by diluted sulphuric acid. (In Test solution.)

What preparations of phosphorus are official?

Phosphorus: Phosphoric acid deoxidized with carbon.

Oleum Phosphoratum: 1 per cent. of phosphorus dissolved in almond oil. Also Spirit and Elixir.

Pilulæ Phosphori: $\frac{1}{100}$ gr. (.006 Gm.) of phosphorus contained in each pill.

What preparations of carbon are official?

Carbo Animalis: Bones carbonized, air excluded during carbonization ("burning").

Carbo Animalis Purificatus: Animal charcoal purified by digesting with a mixture of HCl and water, etc.

Carbo Ligni: Wood carbonized as above.

Carbonei Disulphidum: See preparations of Sulphur.

In making purified animal charcoal, what effect has HCl?

It dissolves out the calcium salts.

By what other names is animal charcoal known?

Ivory black or bone black.

What use has this substance in pharmacy?

It deprives certain kinds of solutions of color (see decolorization).

What preparations of boron are official?

Acidum Boricum, H_3BO_3: Natural product purified.

(16) Sodii Boras: See preparations of Soda.
Borax.

How may boric acid be produced artificially?

By decomposing Borax with HCl, thus:—

$$Na_2B_4O_7.10H_2O + HCl = NaCl + 4H_3BO_3 + 5H_2O.$$

Give the analytical test for boric acid?

Alcohol flame turns green with boric acid; Turmeric paper, brown.

What preparations of silicon (or silicium) are official?

Liquor Sodii Silicatis, Na_2SiO_3 (soluble glass): Silica fused with dried sodium carbonate and the product dissolved.

By what other name is silica known?

Silicic Oxide, SiO_2.

Inorganic Acids.

1. STRONG ACIDS.

Name, give symbol, and show by chemical equation how the inorganic acids are made.

Acidum Hydrochloricum, $HCl = 36.37$:—

31.9 per cent. (by weight) absol. acid.

$$\underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Hydrochloric Acid.}}{HCl} + \underset{\text{Sodium Chloride.}}{NaCl} + \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4},$$

$$\underset{\text{Sodium Chloride.}}{NaCl} + \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4} = \underset{\text{Hydrochloric Acid.}}{HCl} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4}.$$

Acidum Nitricum, $HNO_3 = 62.89$:—

68 per cent. (by weight) absol. acid.

$$\underset{\text{Sodium Nitrate.}}{NaNO_3} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4} + \underset{\text{Nitric Acid.}}{HNO_3}.$$

Acidum Nitrohydrochloricum :—

$\left.\begin{array}{l}\text{180 parts } HNO_3.\\ \text{820 " } HCl.\end{array}\right\}$ (by volume).

$$\underset{\text{Nitric Acid}}{HNO_3} + \underset{\text{Hydrochloric Acid.}}{3HCl} = \underset{\text{Nitrosyl Chloride.}}{NOCl} + \underset{\text{Chlorine.}}{Cl_2} + \underset{\text{Water.}}{2H_2O}.$$

Acidum Sulphuricum, $H_2SO_4 = 97.82$:—

92.5 per cent. (by weight) absol. acid.

$$\underset{\text{Sulphurous Oxide.}}{2SO_2^{*}} + \underset{\text{Nitrogen Tetroxide}}{N_2O_4} = \underset{\text{Sulphuric Oxide.}}{2SO_3} + \underset{\text{Nitrogen Dioxide.}}{N_2O_2};$$

then

$$\underset{\text{Nitrogen Dioxide.}}{N_2O_2} + \underset{\text{Oxygen (from air, etc.).}}{O_2} = \underset{\text{Nitrogen Tetroxide.}}{N_2O_4};$$

(Continously furnishing O_2 as above and converting SO_2 into SO_3.)

then

$$\underset{\text{Sulphuric Oxide.}}{SO_3} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sulphuric Acid.}}{H_2SO_4}.$$

---

* Obtained by heating S, or Iron pyrites, in a current of air.

Acidum Sulphurosum, $SO_2 = 63.9$:—

6.4 per cent. of (SO_2) gas.

$4H_2SO_4$	+	C_2	=	$4SO_2$	+	$2CO_2$	+	$4H_2O$.
Sulphuric Acid.		Carbon.		Sulphurous Anhydride.		Carbon. Dioxide.		Water.

Acidum Phosphoricum, $H_3PO_4 = 97.8$:—

85 per cent. (by weight) absol. acid.

$12P$	+	$20HNO_3$	+	$8H_2O$	=	$12H_3PO_4$	+	$20NO$.
Phosphorus.		Nitric Acid.		Water.		Phosphoric Acid.		Nitrogen Oxide.

(The other inorganic acids are mentioned under other headings.)

2. Dilute Acids.

Name and give the mode of preparation of the dilute inorganic acids.

Acidum Hydrochloricum Dilutum: Water and HCl mixed.

10 per cent. (by weight) absol. acid.

Acidum Hydrobromicum Dilutum, HBr :—

10 per cent. absol. acid.

KBr	+	H_2SO_4	=	$KHSO_4$	+	HBr.
Potassium Bromide.		Sulphuric Acid.		Acid Potassium Sulphate.		Hydrobromic Acid.

Acidum Hypophosphorosum Dilutum (HPH_2O_2).

10 per cent. (by weight) absol. acid.

Acidum Nitricum Dilutum: Water and HNO_3 mixed.

10 per cent. (by weight) absol. acid.

Acidum Nitrohydrochloricum Dilutum: HNO_3 4 parts, HCl 18 parts, H_2O 78 parts.

Acidum Sulphuricum Aromaticum: H_2SO_4 100 parts, Tr. ginger 50 parts, oil cinnam. 1 part, alcohol q. s. to 1000.

20 per cent. absol. acid.

Acidum Sulphuricum Dilutum: H_2SO_4 and H_2O mixed.
10 per cent. (by weight) absol. acid.

Acidum Phosphoricum Dilutum: H_3PO_4 and H_2O mixed.
10 per cent. (by weight) absol. acid.

Name the common impurities in some of the inorganic substances.

1. Sulphur Præcipitatum:—Metallic Impurities, Arsenic, Acid, Alkalies, Soluble Impurities, Selenium.
2. Bismuthi Subcarbonas:—Lead, Copper, Chloride, Sulphate, Silver, Alkalies, Ammonia, Nitrates, Arsenic.
3. Hydrargyri Chloridum Mite:—Mercuric Chloride, Soluble Impurities, Ammoniated Mercury.
4. Potassii Bromidum:—Potassium Carbonate, Sodium, Bromate, Iodine, Calcium, Barium, Sulphate, Iron.
5. Potassii Bitartras:—Chlorides, Sulphates, Copper, Lead, Iron, Calcium, Ammonium Salts, Acidity.
6. Calcii Hypophosphitum:—Phosphate, Sulphate, Arsenic, Magnesium.
7. Acidum Hydrochloricum:—Copper, Non-volatile Impurities, Arsenic.

This list may be extended by the pupil, and the (V. S.) Volumetric Solutions and (T. S.) Test Solutions of the Pharmacopœia, used in testing for these impurities, should be studied; such as:—

Volumetric Solutions.—Silver Nitrate, Sodium Hyposulphite, Sulphuric Acid, Potassium Hydrate, Bromine, Fehling's Solution, Iodine, Potassium Permanganate, Oxalic Acid, Sodium Hydrate.

Test Solutions.—Chlorine Water, Ammonium Sulphide, Starch, Silver Nitrate, Barium Nitrate, Indigo, Stannous Chloride, Sodium Hydrate, Ammonium Oxalate, Barium Chloride, Potassium Iodide, Ammonium Chloride, Ammonium Carbonate, Potassium Hydrate, Calcium Hydrate.

Table of Official Organic Drugs, with Natural Order, and their Constituents.

DRUG.	NAT. ORDER.	CONSTITUENTS.
Absinthium, Herba *	[Composit.]	Absinthin and Volatile Oil.
Acacia, Gummi (9)	[Legumin.]	Arabin.
Aconitum, Tuber (3)	[Ranunc.]	Aconitine, (and Starch).
Allium, Bulbus (1)	[Liliac.]	Mucilage, Acrid Volatile Oil.
Aloe Purif. (10)	[Liliac.]	Aloin.
Amygdala amara, Semen (1)	[Rosac.]	Fixed Oil, 45% ; Amygdalin, 2% ; Synaptase ; Sugar.
Amygdala dulcis, Semen (2)	[Rosac.]	Fixed Oil, 50% ; Synaptase, Sugar.
Althæa, Radix (3)	[Malvac.]	Mucilage, (Starch) and Asparagin.
Ammoniacum Gummi-resina (2)	[Umbellif.]	Volatile Oil ; Resin.
Anisum, Fructus (1)	[Umbellif.]	Volatile Oil.
Anthemis, Flores *	[Composit.]	Bitter Prin., Blue Volatile Oil, 1% ; Resin.
Apocynum, Radix (1)	[Apocyn.]	Apocynin (Resin), and Apocyneine.
Aspidosperma (1)	[Apocynac.]	Aspidospermine, a mixture of several alkaloids.
Arnica, Flores (1)	[Composit.]	Arnicin and Resins, and Volatile Oil.
Arnica, Radix (3)	[Composit.]	Arnicin, Resins, Volatile Oil.
Asafetida, Gummi-resina (4)	[Umbellif.]	Volatile Oil and Resin.
Asclepias, Radix (1)	[Asclepiadac.]	Crystalline glucoside ; Resin.

---

* The numbers indicate the number of preparations into which the drug enters. See pages 60–64. Italics indicates that the drug enters into no official preparation.

Aspidium, Rhizoma (1)	[Filices.]	Felicic Acid, Oleoresin, Fixed Oil.
Aurantium, Dulcis Cortex (2)	[Aurant.]	Volatile Oil and Hesperidin.
" amara, " (4)	[Aurant.]	" " " "
Aurantium, Flores (1)	[Aurantiac]	Volatile Oil.
Belladonna, Folia (2)	[Solanac.]	Atropine; Hyoscyamine; Belladonnine.
Belladonna, Radix (1)	[Solanac.]	Atropine; Belladonnine; Hyoscyamine.
Benzoin, Resina Balsamica (3)	[Styrac.]	Benzoic Acid; Volatile Oil; Vanillin.
Brayera (Cusso), Flores (1)	[Rosac.]	Kossin; Volatile Oil; (Tannin, 24%).
Bryonia, Radix (1)	[Cucurbit.]	Bryonin.
Buchu, Folia (1)	[Rutac.]	Volatile Oil (Mucilage).
Calamus, Rhizoma (1)	[Aroid.]	Calamine, Volatile Oil; Acorin.
Calendulæ Herba (1)	[Composit.]	Volatile oil; bitter principle.
Calumba, Radix (2)	[Menisperm.]	Calumbin, Calumbic Acid, (Resin, Starch, Pectin, Gum).
Cambogia, Gummi-resina (1)	[Guttifer.]	Gum, Cambogic Acid.
*Cannabis Americana**	[Urticac.]	Volatile Oil and Resin.
Cannabis Indica, Summitates (3)	[Urticac.]	Choline, Volatile Oil and Resin.
Cantharis (6)	[*Insecta*-Coleopt.]	Cantharidin.
Capsicum, Fructus (3)	[Solanac.]	Capsaicin; Volatile Oil; Resin.
Cardamomum, Semen (7)	[Scitamin.]	Volatile Oil 4½ %.
Carum, Fructus (1)	[Umbellif.]	Volatile Oil 6 %.
Caryophyllus, Flores (3)	[Myrtac.]	Volatile Oil 18 %; Eugenin, Caryophyllin; Resin; Tannin (Gum).
Cascarilla, Cortex	[Euphorb.]	Volatile Oil; Cascarillin; Resin.
Cassia Fistula, Fructus pulpa (1)	[Legumin.]	Fruit acids; Sugar.
Castanea, Folia (1)	[Cupulif.]	Tannin (Mucilage).
Catechu (2)	[Legumin.]	Catechu-tannic Acid, Catechin, etc.

---

* Italics indicates that the drug is not contained in any official preparation.

OFFICIAL ORGANIC DRUGS, WITH NATURAL ORDER, AND THEIR CONSTITUENTS.—*Continued.*

DRUG.	NAT. ORDER.	CONSTITUENTS.
Caulophyllum, Rhizoma	[Berberidac.]	Caulophylline, Leontin, Saponin, Resins, etc.
Cetraria (1)	[Lichenes.]	Lichenin, Cetrarin.
Chelidonium, Herba	[Papaver.]	Chelidonine, Chelerythrine.
Chenopodium, Fructus	[Chenopod.]	Volatile Oil.
Chimaphila, Folia (1)	[Ericac.]	Arbutin, Chimaphilin, Tannin 4 %.
Chirata, Herba (2)	[Gentian.]	Ophelic Acid, Chiratin.
Chondrus, Alga	[Algæ.]	Pectin.
Cimicifuga, Radix (3)	[Ranunculac.]	Acrid principle.
Cinchona, Cortex, Rub. (1), Flav. (4)	[Rubiac.]	Quinine, Quinidine, Cinchonine, Cinchonidine, Quinamine, Paricine, etc.; Cincho-tannic acid, Kinic Acid, Kinovin, Cinchona-red.
Cinnamomum (Cassia Zeylanicum and Saigon.) Cortex (5)	[Laurac.]	Volatile Oil, Cinnamic Acid.
Coccus	[*Insecta.* Hemiptera.]	Carminic Acid.
Colchicum, Cormus (3)	[Melanthac.]	Resin, Colchicine (Starch).
Colchicum, Semen (3)	[Melanthac.]	Colchicine (Fixed Oil).
Colocynthis, Fructus Pulpa (1)	[Cucurbitac.]	Pectin, Colocynthin.
Conium, Fructus (2)	[Umbellif.]	Coniïne, Conhydrine (Fixed Oil; Volatile Oil).
Copaiba, Oleo-resina (1)	[Legumin.]	Volatile Oil, Copaivic Acid (Resin).
Coriandrum, Semen (1)	[Umbellif.]	Mucilage, Volatile Oil 1 % (Fixed Oil).
Convallariæ, Rhizoma	[Liliac.]	Convallarin; Convallamarin.
Crocus, Stigmata (1)	[Iridac.]	Crocin, Volatile Oil.
Cubeba, Fructus (3)	[Piperac.]	Volatile Oil 12 %, Cubebic Acid (Resin), Cubebin.
Cuprea, Cortex	[Rubiac.]	Quinine, Quinidine, Cinchonine, Homoquinine.
Cydonium, Semen	[Rosac.]	Proteids, Mucilage.
Cypripedium, Radix (1)	[Orchid.]	Volatile Oil, Resin.
Digitalis, Folia (4)	[Scrophular.]	Digitonin, Digitoxin; Digitalin; Digitalëin.
Dulcamara, Stipites (1)	[Solanac.]	Resin; Dulcamarin, etc.

Elaterium (1)	[Cucurbit.]	Hydroelaterin; Elaterin.
Ergota, Sclerotium (3)	[Fungi.]	Various alkaloids, Sclerotic Acid; Scleromucin, etc.
Erythroxylon (Coca) Folia (1)	[Lineæ.]	Cocaine; Hygrine.
Eucalyptus, Folia (1)	[Myrtac.]	Tannin; Volatile Oil; Resin.
Euonymus, Cortex (1)	[Calastrin.]	Bitter principle; Resin; (Asparagin).
Eupatorium perfoliatum, Herba (1)	[Composit.]	Bitter principle; Volatile Oil.
Ficus, Fructus (1)	[Urticac.]	Sugar, 60 %; Gum, etc.
Fœniculum, Semen (1),	[Umbellif.]	Fixed Oil; Sugar; Volatile Oil, 4 %.
Frangula, Cortex (1)	[Rhamnac.]	Frangulin (Rhamnoxanthin); Emodin.
Galbanum, Gummi-Resina	[Umbellif.]	Volatile Oil; Resin.
Galla (2)	[Cupulif.]	Resin; Tannin; Gallic Acid.
Gaultheria, Folia	[Ericac]	Volatile Oil; Tannin; Arbutin, Ursone and Ericolin.
Gelsemium, Radix (2)	[Loganiac.]	Gelsemine; Volatile Oil; Resin.
Gentiana, Radix (3)	[Gentianac.]	Gentiopicrin; Gentisic Acid; (Pectin; Sugar).
Geranium, Radix (1)	[Geraniac.]	Tannin, 15 %; (Starch; Pectin), etc.
Glycyrrhiza, Radix (11)	[Legumin.]	Glycyrrhizic Acid (Glycyrrhizin); Acrid Resin; (Starch; Asparagin; Albumen).
Gossypium, Radix (1)	[Malvac.]	Fixed Oil; Resin (Coloring Matter), etc.
Granati Radicis Cortex	[Lythrar.]	Punicine Pelletierine, Isopelletierine, Methyl-pelletierine, Pseudopelletierine; Tannin, (Gum; Sugar).
Grindelia, Herba (1)	[Composit.]	Resin; Volatile Oil; Bitter principle.
Guaiaci Resina (3)	[Zygophyll.]	Resin, about 25 %.
Guarana (1)	[Sapindac.]	Caffeine, about 4 %; Tannin; Saponin; Volatile Oil.
Hæmatoxylon, Lignum (1)	[Legumin.]	Hæmatoxylin; Tannin.
Hamamelis, Folia (1)	[Hamamelac.]	Tannin; Bitter principle.
Hedeoma, Herba	[Labiat.]	Volatile Oil.
Humulus, Strobili (1)	[Urticac.]	Tannin, 4 %; Volatile Oil; Resin; Lupuline.

OFFICIAL ORGANIC DRUGS, WITH NATURAL ORDER, AND THEIR CONSTITUENTS.—*Continued.*

DRUG.	NAT. ORDER.	CONSTITUENTS.
Hydrastis, Rhizoma (3)	[Ranuncul.]	Berberine; Hydrastine; Xantho-puccine.
Hyoscyamus, Folia (3)	[Solanac.]	Hyoscyamine; Hyoscine; Hyoscypicrin.
Ignatia, Semen	[Loganiac.]	Strychnine; Brucine, (Albumen).
Illicium, Fructus	[Magnoliac.]	Volatile Oil; Resin.
Inula, Radix	[Composit.]	Acrid Resin; Helenin; Inulin.
Ipecacuanha (4)	[Rubiac.]	Emetine (Ipecacuanhic Acid); Starch; Pectin; trace of Volatile Oil.
Iris versicolor, Rhizoma (2)	[Iridac.]	Acrid Resin; Volatile Oil (Starch).
Jalapa, Tuber (3)	[Convolvul.]	Resin, about 15 % (chiefly convolvulin); (Starch), etc.
Juglans, Cortex (1)	[Juglandac.]	Fixed Oil; Tannin; Nucin.
Juniperus, Fructus	[Conif.]	Volatile Oil; Resin; Sugar 30 %.
Kamala, Glandulæ	[Euphorb.]	Resin 80 %; (Rottlerin), etc.
Kino, Succus inspissatus (1)	[Legumin.]	Kino-tannic Acid; (Coloring Matter); (Kinoin); Pectin.
Krameria, Radix (3)	[Polygalac.]	Kramerio-tannic Acid; (Coloring Matter).
Lactucarium (1)	[Composit.]	Lactucin; Lactucic Acid; Lactucopicrin; (Lactucerin 50 %).
Lappæ Radix	[Composit.]	Mucilage; Resin; Inulin.
Lavandula, Flores	[Labiat.]	Resin; Volatile Oil 2½ %.
Leptandra, Radix (2)	[Scrophular.]	Leptandrin; Saponin; Volatile alkaloid?; Volatile Oil; Resin.
Limonis Cortex (1)	[Aurantiac.]	Volatile Oil; Hesperidin?.
Limonis Succus	[Aurantiac.]	Citric Acid; water, etc.
Linum, Semen		Fixed Oil; Mucilage.
Lobeliæ Herba (2)	[Lobeliac.]	Lobeline; Lobelacrin; Lobelic Acid.

Lupulinum (2)	[Urticac.]	Volatile Oil ; Resin ; Lupamaric Acid.
Lycopodium	[Lycopod.]	Fixed Oil, about 47 %.
Macis, Arillus	[Myristic.]	Volatile Oil, 9 % ; (Fixed Oil).
Magnolia, Cortex	[Magnoliac.]	Magnolin ; Volatile Oil ; Resin ; Tannin.
Manna (1)	[Oleac.]	Mannit ; Glucose ; Gum ; Acrid Resin ; Fraxin.
Marrubium, Herba	[Labiat.]	Marubin ; Bitter extractive.
Mastiche [1]	[Anacard.]	Resin and Volatile Oil.
Matico, Folia (2)	[Piperac.]	Volatile Oil ; Soft, pungent Resin ; Artanthic Acid ; Tannin.
Matricaria, Herba	[Composit.]	Volatile Oil ; Bitter principle ; Tannin.
Mel (1)	[*Insecta.* Hymenopt.]	Melitose ; Lævulose ; Glucose.
Melissa, Herba	[Labiat.]	Volatile Oil ; Bitter Extractive.
Menispermum, Radix (1)	[Menispermac.]	Menispine ; Berberine.
Mentha Piperita Herba (2)	[Labiat.]	Volatile Oil 1 %.
Mentha Viridis, Herba (1)	[Labiat.]	Volatile Oil 0.5 %.
Mezereum Cortex (3)	[Thymelac.]	Acrid Resin ; Volatile Oil ; Daphnin.
Moschus (1)	[*Mamm.* Ruminant.]	Cholesterin ; Bitter Resin ; Fat.
Myristica, Semen (5)	[Myristicac.]	Volatile Oil ; Fixed Oil ; (Starch.)
Myrrha, Gummi-Resina (5)	[Burserac.]	Bitter principle ; Volatile Oil ; Resin.
Nux Vomica, Semen (3)	[Loganiac.]	Strychnine ; Brucine ; (Fixed Oil ; Albumen.)
Opium (Pulv.) (10)	[Papaverac.]	Morphine, Codeine, Narcotine, Narceine, Pseudomorphine, Thebaine, Papaverine, Meconic Acid, etc.
Origanum, Herba	[Labiat.]	Tannin Resin ; Volatile Oil.
Pareira, Radix (1)	[Menispermac.]	Pelosine ; (Buxine) ; Resin.
Pepo, Semen	[Cucurbit.]	Proteids, Fixed Oil.
Physostigma, Semen (2)	[Legumin.]	Physostigmine ; Calabarine ; (Starch ; Albumen).
Phytolaccæ Fructus	[Phytolaccac]	Acrid principle.

OFFICIAL ORGANIC DRUGS, WITH NATURAL ORDER, AND THEIR CONSTITUENTS.—*Continued.*

DRUG.	NAT. ORDER.	CONSTITUENTS.
Phytolaccæ Radix and Fructus	[Phytolaccac.]	Resin Tannin, Acrid principle.
Pilocarpus, Folia (1)	[Rutac.]	Pilocarpine; Volatile Oil.
Pimenta, Fructus	[Myrtac.]	Volatile Oil; Resin.
Piper, Fructus (1)	[Piperac.]	Volatile Oil; Acrid Resin; Piperin.
Podophyllum, Radix (3)	[Berberidac.]	Resin, containing Podophyllotoxin and Picropodophyllin. (Starch).
Prinos, Cortex	[Aguifoliac.]	Resin; Bitter principle; Tannin.
Prunus Virginiana, Cortex (3)	[Rosac.]	Tannin; Amygdalin; Synaptase; Bitter principle, etc. Yields HCy when moistened.
Prunum Fructus (1)	[Rosac.]	Pectin Sugar; Malic Acid.
Pulsatilla, Herba	[Ranuncul.]	Acrid principle, Volatile.
Pyrethrum, Radix (1)	[Composit.]	Volatile Oil; Acid Resin.
Quassia, Lignum (3)	[Simarubac.]	Mucilage, Resin, Quassin.
Quercus, Cortex	[Cupulif.]	Tannin; Bitter principle.
Quillaja, Cortex	[Rosac.]	Saponin; Resin.
Resina (Colophonium) (5)	[Conif.]	Abietic anhydrid.
Rhamnus Purshiana, Cortex (1)	[Rhamnac.]	
Rheum, Radix (8)	[Polygonac.]	Chrysophan; Chrysophanic Acid; Phæoretin; Aporetin; Erythroretin; Emodin; Rheo-tannin.
Rhus glabra, Fructus (1) *Rhus Toxicodendron, Folia*	[Anacard.]	Acid Pot. and Ca., Malates, Tannin; Toxicodendric Acid. (Tannin).
Rosa Gallica, Petala (4)	[Rosac.]	Quercitrin; Tannin? Volatile Oil. (Coloring matter).
Rosa centifolia, and damascena Petala (1)	[Rosac.]	Tannin; Volatile Oil.
Rosmarinus, Folia	[Labiat.]	Volatile Oil; Tannin; Resin; Bitter principle.
Rubus, Radicis Cortex (1)	[Rosac.]	Tannin, 10%.

Rumex crispus, Radix (1)	[Polygonac.]	As Rhubarb, but more astringent.
Sabina, Ramuli (1)	[Conif.]	Volatile Oil (Resin ; Tannin).
Salix, Cortex	[Salicac.]	Salicin ; Populin (Benzoyl-Salicin) ; Tannin.
Salvia, Folia	[Labiat.]	Resin, Volatile Oil ; Tannin.
Sambucus, Flores	[Caprifol.]	Mucilage, Volatile Oil ; Acrid Resin.
Sanguinaria, Radix (2)	[Papaverac.]	Resin, Starch, Sanguinarine.
Santalum rubrum, Lignum (1)	[Legumin.]	Santal, Santalic Acid.
Santonica, Flores	[Compos.]	Santonic Acid (or Santonin) ; Volatile Oil ; Resin.
Sarsaparilla, Radix (4)	[Smilac.]	Smilacin (Parillin) ; Saponin ; Resin (Starch ; Gum).
Sassafras, Cortex	[Laurac.]	Starch ; Volatile Oil.
Sassafras, Medulla (1)	[Laurac.]	Mucilage.
Scammonium, Resina cruda (1)	[Convolvul.]	Scammonin, identical with Orizabin.
Scilla, Bulbus (4)	[Liliac.]	Scillipicrin ; Scillitoxin ; Scillin ; Gum.
Scoparius, Summitates	[Legumin.]	Sparteine, Scoparin.
Scutellaria, Herba (1)	[Labiat.]	Bitter principle ; Volatile Oil.
Senega, Radix (3)	[Polygalac.]	Senegin (Saponin ?) ; (Fixed Oil. Pectin ?).
Senna, Folia (5)	[Legumin.]	Cathartic Acid ; Chrysophanic Acid ? etc.
Serpentaria, Radix (3)	[Aristoloch.]	Volatile Oil ; Resin ; Bitter principle (aristolochin).
Sinapis alba, Semen	[Crucif.]	Myrosin and Sinalbin, giving rise to Acrid Volatile Oil. Fixed Oil.
Sinapis nigra, Semen (1)	[Crucif.]	Nigrosin and Sinigrin, giving rise to Acrid Volatile Oil. Fixed Oil.
Spigelia, Rhizoma (1)	[Loganiac.]	Volatile Oil ; Bitter principle ; Spigeline ?.
Staphisagria, Semen	[Ranuncul.]	Delphinine ; Delphinoidine ; Delphisine ; Staphisagrine. Fixed Oil.
Stillingia, Radix (1)	[Euphorbiac.]	Resin. (Starch, Tannin.)
Stramonium, Folia	[Solanac.]	Atropine and Hyoscyamine (together constituting what was formerly called *daturine*) ; (Albumen).
Stramonium, Semen (3)	[Solanac.]	Atropine and Hyoscyamine (see Stramonii Folia).
Strophanthus, Semen (1)	[Apocynac.]	Strophanthin.

OFFICIAL ORGANIC DRUGS, WITH NATURAL ORDER, AND THEIR CONSTITUENTS.—*Continued.*

DRUG.	NAT. ORDER.	CONSTITUENTS
Styrax, Balsamum (1)	[Hamamel.]	Styrol; Cinnamic Acid; Styracin; Resin, etc.
Sumbul, Radix (1)	[Umbellif.]	Volatile Oil; Resin; Angelicic and Valerianic Acids.
Tabacum, Folia	[Solanac.]	Nicotine, 2 to 10 %; Nicotianin; Resin (Albumen).
Tamarindus, Fructuus Pulpa (1)	[Legumin.]	Fruit Acids; Sugar; Pectin.
Tanacetum, Flores	[Compos.]	Resin; Volatile Oil 0.25 %; Tanacetin.
Taraxacum, Radix (2)	[Compos.]	Taraxacin; Taraxacerin; Inulin.
Terebinthina (Pinis Oleoresina)	[Conifer.]	Volatile Oil; Resin.
Terebinthina Canadensis, Oleoresina	[Coniferæ.]	Volatile Oil; Resin.
Thuja, Ramuli	[Conifer.]	Volatile Oil; Resin; Thujin.
Tolubalsamum (2)	[Legumin.]	Cinnamic and Benzoic Acids, and Tolene.
Tragacantha, Gummi (9)	[Legumin.]	Tragacanth; Bassorin.
Triticum repens, Rhizoma (1)	[Gramin.]	Sugars; Triticin.
Ulmus, Cortex (1)	[Urticac.]	Mucilage.
Ustilago	[Fungi.]	Sclerotic Acid ? (Fixed Oil), etc.
Uva Ursi, Folia (2)	[Ericaceæ.]	Gallic Acid; Arbutin; Urson; Ericolin; Tannin.
Valeriana, Radix (3)	[Valerianac.]	Volatile Oil; Valerianic Acid.
Vanilla, Fructus (2)	[Orchid.]	Vanilin (Fixed Oil; Resin; Gum).
Veratrum viride, Rhizoma (2)	[Melanthac.]	Jervine; Pseudojervine; Rubijervine; Veratralbine. Jervic Acid. Veratramarin.
Viburnum prunifolium, Cortex (1)	[Caprifoliac.]	Viburnin; Valerianic Acid; Resin; Tannin.
Viburnum opulus	[Caprifoliac.]	" " " " "
Xanthoxylum, Cortex (1)	[Rutac.]	Acrid Oleoresin; Xanthoxylin; Berberine.
Zea stigmata, etc.	[Graminac.]	
Zingiber, Radix (5)	[Scitamin.]	Volatile Oil; Pungent Resin (Starch).

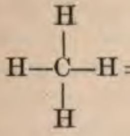
Organic Compounds.*

What are organic compounds?

Any compound containing carbon is an organic compound, whether it be a constituent of the animal or vegetable body or not. Practically all carbon compounds are organic compounds, and all the so-called organic compounds are carbon compounds.

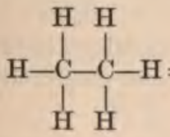
How may carbon unite with other elements and with itself?

If we combine carbon with hydrogen, for example, and form a *saturated* molecule, this combination may be represented graphically as follows:—



$$\begin{array}{c} H \\ | \\ H-C-H \\ | \\ H \end{array} = \text{Methane (Marsh Gas).}$$

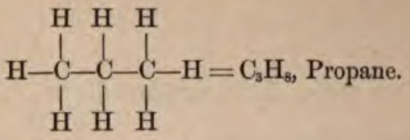
In all hydrocarbons, molecules containing more than one carbon atom, all of the carbon atoms present must be united to each other into a continuous chain or ring. The chain may be "straight" or "forked." As examples of "straight" chain:—



$$\begin{array}{c} H\ \ H \\ |\ \ \ | \\ H-C-C-H \\ |\ \ \ | \\ H\ \ H \end{array} = C_2H_6, \text{ Ethane or}$$

---

* For a treatise upon "New Remedies" and synthetic products of the carbon compounds the student is referred to monographs by Dr. David cerna, "Notes on the Newer Remedies," Helbing's "Materia Medica," and Squibb's "Ephemeris" (vol. iv., No. 1).

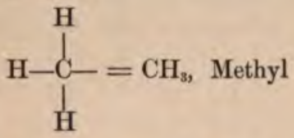


$$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H = C_3H_8, \text{ Propane.}$$

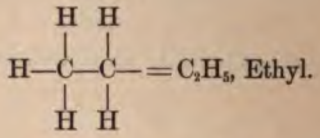
An example of "forked" chain may be seen in Amylene Hydrate, see below.

Explain how the radicals methyl and ethyl may be derived from methane and ethane.

By removing one atom of H from each molecule respectively. This would leave *radicals* graphically represented as follows:—



$$H-\overset{H}{\underset{H}{C}}- = CH_3, \text{ Methyl}$$



$$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}- = C_2H_5, \text{ Ethyl.}$$

Explain how methyl ether and ethyl ether may be derived from the preceding.

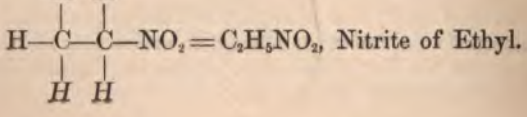
All simple ethers are oxides of hydrocarbon radicals, the oxygen replacing its equivalent of H, example:—

$CH_3—O—CH_3.$
Methyl Ether.

$C_2H_5—O—C_2H_5.$
Ethyl Ether.

What is an ester?

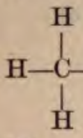
Esters are ethereal salts, formed when hydrocarbon radicals unite with acids, as when ethyl (C_2H_5) unites with NO_2, forming nitrite of ethyl, the ethereal ingredient in sweet spirits of nitre. The formula for this may be graphically represented as follows:—



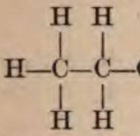
$$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-NO_2 = C_2H_5NO_2, \text{ Nitrite of Ethyl.}$$

What is understood by an alcohol in organic chemistry?

These are hydrocarbons in which OH (hydroxyl) is substituted for H. Graphically represented thus:—



$$\begin{array}{ccccc} & & H & & \\ & & | & & \\ H & - & C & - & OH \\ & & | & & \\ & & H & & \end{array} = CH_3OH,\ \text{Methyl Alcohol.}$$



$$\begin{array}{ccccccc} & & H & & H & & \\ & & | & & | & & \\ H & - & C & - & C & - & OH \\ & & | & & | & & \\ & & H & & H & & \end{array} = C_2H_5OH,\ \text{Ethyl (common) Alcohol.}$$

(All *Primary Alcohols* have the general formula $C_nH_{2n+1}CH_2OH$; that is, they all contain the group CH_2OH; *n* signifies any number.)

What are aldehyds?

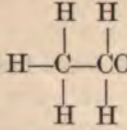
When primary alcohols (or glycols,* etc.) are partially oxidized they become dehydrogenated. The name aldehyd is derived from syllables beginning the words *al*cohol and *dehyd*rogenated. Oxidation of a primary alcohol may be represented thus:—

$$\left.\begin{array}{c} CH_3CH_2OH. \\ \text{Ethyl Alcohol.} \end{array}\right\} \text{yields} \left\{\begin{array}{c} CH_3COH. \\ \text{Acetic Aldehyd.} \end{array}\right.$$

What is paraldehyd?

It is a polymeric form of Ethylic Acetic Aldehyde, C_2H_4O. Now official.

What are organic acids?

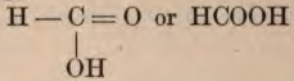
By completely oxidizing an alcohol or an aldehyd an acid is formed, as 

$$\begin{array}{ccccc} & & H & & H \\ & & | & & | \\ H & - & C & - & COOH \\ & & | & & | \\ & & H & & H \end{array} = CH_3COOH,\ \text{Acetic Acid.}$$

---

* Alcohols having two hydroxyl groups (dihydric alcohols).

They all contain hydroxyl (OH) and carboxyl (CO). So, when the combination COOH meets the eye in organic chemical formula an acid is at once recognized. The simplest organic acid of the hydrocarbon series is Formic Acid, represented as follows:—



$$\underset{\displaystyle \mathrm{OH}}{\mathrm{H}-\overset{}{\mathrm{C}}=\mathrm{O}} \text{ or } HCOOH$$

What are mercaptans?

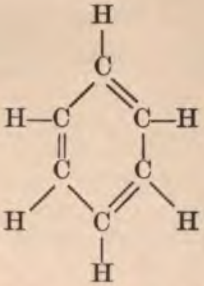
They are compounds analogous to alcohols in structure, but contain SH instead of OH—hydrosulphides of hydrocarbon radicals.

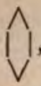
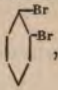
What are ketones?

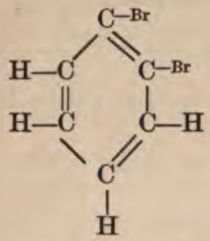
They are carbon radicals united by Carbonyl (CO), As, $CH_3—CO—CH_3$ = Acetone, the simplest Ketone.

What is meant by the ring method of representing organic compounds?

In representing *Benzene* (sometimes called Benzol) we easily illustrate a "Carbon ring." Benzene is represented as follows:—

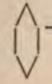


In this case the Carbon unites with itself, furnishing first and second bonds alternately, which with the H, forming the fourth bond, makes a saturated molecule. This very familiar compound is so well known to chemists that it is frequently represented as follows: , and combinations with it, as, for example, dibrom benzene is represented as , which is the same as—



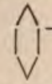
What substitution products of benzene are of importance?

Nitrobenzene, Nitrobenzol (Oil of Myrbane), which may be represented thus:—

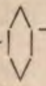


$—NH_2$ or $C_6H_5NO_2$.

Aniline is another substitution product of benzene which may be thus represented:—

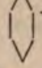


$—NH_2$ or $C_6H_5NH_2$.

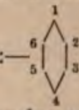
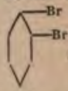
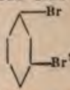
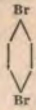
Acetanilid is probably a little more complicated, but still may be regarded as a substitution product of benzene, represented thus:—  $—NH(CH_3CO)$ or $C_6H_5NHC_2H_3O = 134.73$, Phenylacetamide, Acetanalid. It is official in U. S. P., 1890.

Illustrate by graphic formula the relation between carbolic acid and benzene.

If we substitute for one of the H atoms of a benzene molecule OH (hydroxyl) we obtain Carbolic Acid or Phenol (Phenylic Alcohol), thus:—

—OH or $C_6H_5OH = 93.78$.

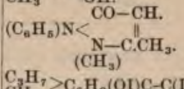
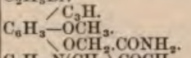
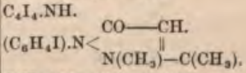
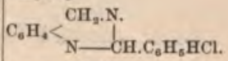
What is meant by the terms ortho, meta and para used in naming organic compounds?

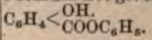
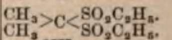
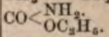
In order to explain these terms we will take a benzene ring and number (from 1 to 6) the bonds thus:—. If now we act upon benzene, for example, with Bromine to form the familiar compound, dibrom benzene, represented by , it will be seen that the bromine is placed in contiguous bonds, this represents the *ortho* variety. The characteristic, then, of ortho compounds is that the atoms of the replacing element occupy contiguous positions. If instead of occupying the first and second position the Bromine occupies the first and third position or alternate arrangement, thus: , we have a *meta* compound. If, further, we have the first and fourth positions occupied, thus: , we have a para variety of Di brom benzene. We have thus described graphically Ortho di brom-benzene, Meta di brom-benzene and Para di brom-benzene, all having the same amount of bromine and other elements, but differing in structure and, strange to say, physical properties. In similar manner all the di substitutions of benzene exist in three modifications.

What is resorcin?

It is a hydroxyphenol ($C_6H_4(OH)_2$), Resorcinum, Meta dioxybenzol.—U. S. P., 1890.

Name and give the chemical formula of some of the new medicinal organic chemicals belonging to the carbon compounds.

NAME.	SYNONYMS.	FORMULA.
Amylene Hydrate	Dimethyl-ethyl-carbinol	$\genfrac{}{}{0pt}{}{CH_3}{CH_3}>C<\genfrac{}{}{0pt}{}{C_2H_5.}{OH.}$
Antipyrin	Dimethyl-phenyl-pyrazolon, analgesine, phenazone, etc.	 $(C_6H_5)N<\begin{array}{l} CO-CH. \\ \qquad\Vert \\ N-C.CH_3. \\ (CH_3) \end{array}$
Aristol	Dithymol-diiodide	$\genfrac{}{}{0pt}{}{C_3H_7}{CH_3}>C_6H_2(OI)C\text{-}C(IO)H_2C_6<\genfrac{}{}{0pt}{}{C_3H_7}{CH_3.}$
Benzanilid	Phenyl-benzamide	$C_6H_5.NH.CO.C_6H_5.$
Benzosol	Benzoyl-guaiacol	$C_6H_4(OCH_3).O.CO.C_6H_5.$
Betol	Naphtalol, naphtosalol, etc.	$C_6H_4<\genfrac{}{}{0pt}{}{OH.}{COOC_{10}H_7.}$
Bromoform	Tribrom-methane	$CH.Br_3.$
Chloralamide	Chloral-formamide	$CCl_3CH.OH.CO.NH_2.$
Chloralimid.		$CCl_3CH.NH.$
Chloracetone		$CH_3.CO.CH_2Cl.$
Cresalol	Cresol salicylate	$C_6H_4<\genfrac{}{}{0pt}{}{OH.}{COOC_6H_4.CH_3.}$
Diaphtherin.	Oxy-quinaseptol.	$C_6H_4<\genfrac{}{}{0pt}{}{C(OH)-N.C_9H_6(OH).}{C(SO_3H)-N.C_9H_6(OH).}$
Diuretin.	Sodio-theobromin-salicylate	$C_7H_7NaN_4O_2+C_6H_4<\genfrac{}{}{0pt}{}{OH.}{COONa.}$
Ethyl-bromide	Monobromethane	$C_2H_5Br.$
Eugenol Acetamid.		 $C_6H_3\begin{array}{l} /\,C_3H. \\ -OCH_3. \\ \backslash\,OCH_2.CONH_2. \end{array}$
Exalgine	Methyl-acetanilid	$C_6H_5.N(CH_3).COCH_3.$
Guaiacol	Methyl-pyrocatechin	$C_6H_4<\genfrac{}{}{0pt}{}{OCH_3.}{OH.}$
Hypnone	Methyl-phenyl-ketone	$CH_3.CO.C_6H_5.$
Ichthyol	Ammonium Ichthyol-sulphonate	$C_{28}H_{36}S_3O_6(NH_4)_2.$
Iodol	Tetra-iod-pyrrol.	$C_4I_4.NH.$
Iodopyrine	Mono-iodo-antipyrin	 $(C_6H_4I).N<\begin{array}{l} CO-\!\!-CH. \\ \qquad\quad\Vert \\ N(CH_3)-C(CH_3). \end{array}$
Methacetine	Para-methoxy-acetanilid	$C_6H_4.(OCH_3).NH.COCH_3.$
Methylal	Methylene-dimethyl-ether	$CH_2.(OCH_3).$
Methylene Chloride	Dichlor-methane	$CH_2.Cl_2.$
Orexine hydrochloride	Phenyl-dihydro-quinazoline-hydrochloride	 $C_6H_4<\begin{array}{l} \quad CH_2.N. \\ \qquad\quad\vert \\ N-\!\!-CH.C_6H_5HCl. \end{array}$
Phenacetine	Para-acet phenetidine or para-ethoxy-acetanilid	$C_6H_4<\genfrac{}{}{0pt}{}{OC_2H_5.}{NH.COCH_3.}$
Phenocoll hydrochloride		$C_6H_4<\genfrac{}{}{0pt}{}{OC_2H_5.}{NH.COCH_2.NH_2.HCl.}$
Piperazine	Di-ethylene-diamine	$C_2H_4<\genfrac{}{}{0pt}{}{NH}{NH}>C_2H_4.$
Saccharin	Benzoic sulphinide	$C_6H_4<\genfrac{}{}{0pt}{}{CO}{SO_2}>NH.$

NAME.	SYNONYMS.	FORMULA.
Salipyrin	Antipyrin-salicylate	Formula not given.
Salol	Phenyl Salicylate	 $C_6H_4<\begin{matrix}OH.\\COOC_6H_5.\end{matrix}$
Sozoiodol	Di-iodo-paraphenol sulphonic acid	$C_6H_2.I_2.OH.SO_2OH.$
Sulfonal	Di-ethyl-sulfon-di-methyl-methane	 $\begin{matrix}CH_3\\CH_3\end{matrix}>C<\begin{matrix}SO_2C_2H_5.\\SO_2C_2H_5.\end{matrix}$
Urethane	Ethyl-urethane	 $CO<\begin{matrix}NH_2.\\OC_2H_5.\end{matrix}$

How may the organic compounds be classified for pharmaceutical study?

They may be classified as Hydrocarbons, Carbohydrates, etc., as follows:—

NATURAL HYDROCARBONS: Benzin, Petrolatum.

DERIVATIVES OF THE PARAFFIN SERIES OF HYDROCARBONS, C_nH_{2n+2}.

Derivatives of Methane, CH_4: Chloroform, Iodoform.

Derivatives of Ethane, C_2H_6: Alcohol, Ether, Acetic Ether, Nitrous Ether, Tartaric Acid, Chloral, Oxalic Acid.

Derivatives of Propane, C_3H_8: Glycerin, Lactic Acid, Citric Acid.

Derivatives of Pentane, C_5H_{12}: Amyl Nitrite, Valerianic Acid.

Acids of Acrylic Acid Series, $C_nH2_{n-2}O_2$: Oleic Acid.

Benzene Series, C_nH_{2n-6}: Phenol, Benzoic Acid, Salicylic Acid, Gallic Acid, Tannic Acid, Thymol, Benzene, Camphor.

NATURAL HYDROCARBONS.

What natural product is composed mainly of saturated hydrocarbons?

Petroleum, composed of various hydrocarbons having different boiling points, from the lowest, which is gaseous at ordinary temperatures, to the sixteenth in the series, which *boils only at* about 280° C.; Rhigolene is a mixture of the lighter and more volatile, and Paraffin a mixture of the heavier and least fusible.

What is benzin of the U. S. P.?

Benzinum (pentane C_5H_{12}, hexane C_6H_{14}). It is a purified distillate from Petroleum, known also as Petroleum spirit. A very volatile liquid; boiling point 50° to 60° C. (122° to 140° F.). Sp. gr. from 0.670 to 0.675. (Benzene or Benzol is quite a different fluid. See *Index.*)

What is petrolatum?

It is a soft, unctuous substance, recognized as an ointment of paraffin, known in commerce under various fanciful names; is really a semi-solid paraffin, obtained by purifying the less volatile portions of petroleum.

In the U. S. P., 1890 three varieties are recognized as follows:—

PETROLATUM LIQUIDUM.

PETROLATUM MOLLE (Soft Petrolatum).

PETROLATUM SPISSUM (Hard Petrolatum).

NOTE.—In the U. S. P., 1890 the following hydrocarbons have been recognized:—

NAPHTALINUM, Naphtalin, $C_{10}H_8 = 127.7$:—A hydrocarbon from coal tar in colorless shining lamillæ.

NAPHTOL, Beta-Naphtol, $C_{10}H_7OH = 143.66$:—A phenol occurring in coal tar, but usually prepared artificially from Naphtalin, in colorless or buff-colored crystals.

DERIVATIVES OF THE PARAFFIN SERIES OF HYDROCARBONS, C_nH_{2n+2}.

DERIVATIVES OF METHANE, CH_4.

(200) CHLOROFORM (boils at 60°–61° C.; sp. gr. at 15° C. 1.490), $CHCl_3$ (Methane with three Cl's substituted for three H's).

Name two varieties of chloroform.

(Purified and commercial chloroform (Chlor. Purificatum and Chlor. Venale). In U. S. P., 1890 only the pure article is recognized under the name Chloroformum.

How is chloroform made?

It is made by acting upon alcohol by means of chlorinated lime, which, yielding chlorine, produces, in the first step of the process, aldehyde (CH_3COH), and chloral (CCl_3COH) in the second step. The chloral thus produced is acted upon by calcium hydrate, according to the following equation:—

$$\underset{\text{Chloral.}}{2CCl_3COH} + \underset{\text{Calcium Hydrate.}}{Ca(HO)_2} = \underset{\text{Chloroform.}}{(CHCl_3)_2} + \underset{\text{Calcium Formate.}}{(HCOO)2Ca}$$

How is commercial chloroform purified?

By treating with H_2SO_4, which destroys (blackens) the organic impurities, the chloroform separating into a distinct layer; the chloroformic layer is removed, neutralized by Na_2CO_3, mixed with alcohol (a preservative), and redistilled from lime to separate water.

What are the official preparations of chloroform?

Aqua, Emuls., Liniment., Spirit.

(Insol.?) Iodoform, CHI_3 (Methane with three I's substituted for three H's).

How is iodoform made, and what are its physical properties?

It is formed by the action of K_2CO_3 or NaOH in water on alcohol, with iodine. It is a crystalline solid, of yellow color and saffron-like odor; it contains 96.7 per cent. of iodine.

What is the official name of artificial oil of wintergreen?

Methyl Salicylas, $CH_3C_7H_5O_3$.

What is methyl alcohol? Give its properties, and the names under which it is known in market.

It is the hydrate of methyl. CH_3OH, obtained by the destructive distillation of wood; it is known as *wood spirits*, *pyroxylic spirit* or *wood naphtha*. It is a solvent similar to alcohol; poisonous, inflammable, disagreeable odor; used in making varnishes, etc.

What is methylated spirits?

A mixture of 90 per cent. of ethyl alcohol with methyl alcohol.

DERIVATIVES OF ETHANE, C_2H_6.

ALCOHOL (boils at 78° C,; sp. gr. .820), C_2H_5OH (Ethane with OH substituted for H).

What tests are applied to alcohol to insure its purity and to detect any foreign substances present?

The Pharmacopœia prescribes that:—

Alcohol should not affect the color of blue or red litmus paper previously moistened with water.

If 50 Cc. of Alcohol be evaporated in a clean glass vessel, no color or weighable residue should remain.

On allowing Alcohol, mixed with one-third of its volume of water, to evaporate spontaneously from clean blotting-paper saturated with it, no odor of *fusel oil* or other foreign odor should become manifest.

If 10 Cc. of Alcohol be mixed in a test-tube with 5 Cc. of potassium hydrate T. S., the liquid should not at once become dark-colored (absence of *aldehyde, methyl alcohol,* or *oak tannin*).

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 standing during six hours in diffused daylight (limit of *organic impurities, amylic alcohol,* etc.).

NOTE.—It may be stated, in a general way, that the tests applied by the U. S. P. ascertain the *absence* of impurity; in other words, if the substances under examination respond to the tests—proving the *absence* of suspected impurity—the article corresponds to the standard of *medicinal* purity of our national standard.

How is ethylic alcohol obtained, and by what other name is it known?

Obtained by distillation of fermented glucose (the latter obtained from starch), by the following reaction:—

$$\underset{\text{Glucose.}}{C_6H_{12}O_6} = \underset{\text{Alcohol.}}{2C_2H_5OH} + \underset{\text{Carbon Dioxide.}}{2CO_2}.$$

Fermentation. (See *Index.*)

From what substances is the starch usually obtained for making alcohol?

Corn, rye, potatoes, etc.

How are these substances converted into glucose?

They are *mashed;* and on the addition of malt, by the influence of its *diastase*, at a proper temperature, the starch is converted first into *maltose*, then into *glucose.*

Name the various crude alcohols and give their source.

Whiskey, from corn, etc., above mentioned; *Brandy*, distilled from wine; *Rum*, distilled from fermented molasses; *Gin*, spirit distilled with juniper berries.

What aromatic substances are contained in these crude alcohols?

Whiskey contains amyl alcohol (fusel oil), œnanthic ether, etc.; Brandy, œnanthic, propylic ethers, etc.; Rum, butyric acid, etc.

How may alcohol be purified or deodorized?

By the use of animal charcoal, which absorbs most of the fusel oil; sometimes distilled with certain chemicals which destroy these foreign odors (Alcohol Deodoratum).

What is absolute alcohol?

Alcohol freed from water by treatment with lime, chloride of calcium, or some salt having a great affinity for water.

Official: Alcohol Dilutum (sp. gr. 0.936; Al. 50, Aq. Dest. 50). A liquid composed of about 41 per cent. by weight (about 48.6 per cent. by vol.) of absol. ethyl alcohol, and 59 per cent. by weight of water. (Rules for dilution, see page 29.)

ETHER (boils at 37° C.; sp. gr. .725 to .728), $(C_2H_5)_2O$ (two Ethanes with O substituted for H in each).

How is Ether made?

A mixture of H_2SO_4 and alcohol is maintained at a temperature of 130°–137.7° C. in a retort, into which flows a slow but constant stream of alcohol; the distillate (composed of crude ether, acid, alcohol, etc.) is shaken with milk of lime and water. Upon standing, the ether (purified from H_2SO_4 and alcohol) rises to the surface. The decanted ether, treated with calcium chloride (to remove water) and redistilled, constitutes the *æther* of the U. S. P.

Explain the above reaction.

$$\underset{\text{Alcohol.}}{C_2H_5OH} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Ethyl-sulphuric Acid.}}{C_2H_5HSO_4} + \underset{\text{Water.}}{H_2O.}$$

$$\underset{\text{Ethyl-sulphuric Acid.}}{C_2H_5HSO_4} + \underset{\text{Alcohol.}}{C_2H_5HO} = \underset{\text{Ether.}}{(C_2H_5)_2O} + \underset{\text{Sulphuric Acid.}}{H_2SO_4.}$$

What is the danger in handling ether?

Unlike chloroform, it is very inflammable; danger is, therefore, to be apprehended from fire. The container should always be held at a distance from any flame.

What preparations of ether are official? and state the percentage of their constituents.

Spiritus Ætheris (Ether 32.5 Cc., Alcohol 67.5 Cc.); Spiritus Ætheris Compositus (Hoffmann's Anodyne), (Ether 32.5 Cc., Alcohol 65, Ethereal Oil 2.5 Cc.).

What is a compound ether or an ester?

A substance resembling a chemical salt, the difference being that the hydrogen of the acid is not replaced by a *metal*, but by an *organic radical*, as in Acetic Ether, etc.

What is ethereal oil?

Ethereal Oil (heavy oil of wine) is produced when alcohol is treated with H_2SO_4 at a temperature between 150°–157° C. The purified product is mixed with an equal volume of stronger ether, which constitutes the *Oleum Ætherium* of the U. S. P. (It is a salt of Ethyl, Sulphuric and Sulphurous acids, used in Sp. ether, comp.)

ACETIC ETHER [boils at 76° C.; sp. gr. 893–895] $CH_3COOC_2H_5$ (Ethane with acetic acid radical substituted for H) or acetic acid, the basic H of which is replaced by ethyl.

What is the official and chemical name of acetic ether?

Æther Aceticus, Acetate of Ethyl. ($CH_3COOC_2H_5$).

How is acetic ether made?

By decomposing acetate of sodium by means of H_2SO_4 in the presence of alcohol.

NITROUS ETHER [Boils at 63° C.; sp. gr. 823–825] $C_2H_5NO_2$ (Ethane with nitrous acid radical substituted for H).

How is nitrous ether made?

By decomposing alcohol by means of sodium nitrite and sulphuric acid, liberating nitrous acid, which, in turn, acts upon alcohol according to the following equation:—

$$\underset{\text{Alcohol.}}{C_2H_5OH} + \underset{\text{Nitrous Acid.}}{HNO_2} = \underset{\text{Ethyl Nitrite.}}{C_2H_5NO_2} + \underset{\text{Water.}}{H_2O.}$$

What is sweet spirits of nitre (spiritus ætheris nitrosi)?

It is an alcoholic solution of nitrite of ethyl, yielding eleven times its volume of NO [sp. gr. 836–842; boils at 65° C.].

TARTARIC ACID $(CHOHCOOH)_2$ (Ethane with 2OH substituted for 2H and 2COOH for 2H) Acidum Tartaricum Dihydroxy succinic acid.

What is the source of tartaric acid?

Formed in grapes, tamarinds and other fruits, and prepared commercially from *argols*, or impure acid potassium tartrate, deposited from grape juice during fermentation into wine.

How is it made from argols?

By first purifying the argols (recrystallizing) and converting the cream of tartar into a calcium salt by means of $CaCO_3$ and $CaCl_2$, decomposing the resulting Ca. tartrate with diluted H_2SO_4 and allowing the filtered solution to crystallize in a warm place.

ACETIC ACID, CH_3COOH (Ethane with O substituted for 2H and OH for another H). Composed of 36 per cent. of absolute acid.

How is acetic acid made?

Acetic acid is made by distilling *vinegar*, which is made by oxidation of dilute alcoholic liquids, such as cider and wine. It is also made very largely by subjecting oak wood in small billets to the process of dry distillation, the heat being so regulated as not to char the fiber and produce empyreumatic products.

How is the strongest acid designated, and what are its properties?

Glacial acetic acid (Acidum Aceticum Glaciale). At or below 15° C. a crystalline solid. It is a colorless, pungent liquid, attracting moisture from the air. Should be kept in well-stoppered bottles.

Off. Prep. Acidum Aceticum Dilutum. (6 per cent.).

CHLORAL, $CCl_3CH(OH)_2$ (Ethane, with 3Cl substituted for 3H, and 2OH for 2H).

What is the official synonym of chloral, and how is it made?

Hydrate of Chloral is made by passing dry chlorine gas through absolute alcohol until no more is absorbed. The alcohol is thus converted into aldehyd and HCl, and, finally, the aldehyd into chloral, according to the following equation:—

$$\underset{}{CH_3COH} + 3Cl_2 = \underset{\text{Chloral.}}{CCl_3COH} + 3HCl.$$

The chloral is hydrated by mixing it with the necessary amount of water; then, purified and crystallized, it constitutes the officinal product of the following composition:—

$$CCl_3COHH_2O = C_2HCl_3 + H_2O = 164.97.$$

Oxalic Acid, $(COOH)_2$ (Ethane with 2O substituted for 4H, and 2OH for 2H) $= C_2H_2O_4 + 2H_2O = 125.7$.

In what preparations of the pharmacopœia is this found?

Volumetric solution of oxalic acid.

What salts of oxalic acid are official?

Ammonii Oxalas (in test solution four per cent.), Cerii Oxalas.

How is oxalic acid made?

It is made by acting upon sugar, starch, cellulin with HNO_3, by the aid of heat. It is made on a large scale by heating sawdust with caustic soda, etc.

What is salts of lemon, and why should it be handled with care?

Salts of lemon is the common name for oxalate of potassium, used as a bleaching agent and for removing iron stains. Its name and appearance (like Epsom salts) at once show why it should be handled carefully, as a poison.

DERIVATIVES OF PROPANE, C_3H_8.

Glycerine, $C_3H_5(OH)_3$ (Propane with 3OH substituted for 3H).

From what is glycerine obtained?

It is obtained from fats as a by-product of saponification, and by the decomposition of fats and oil with pressure and superheated steam. (See Oleic Acid.)

What official preparations contain glycerine?

Glyceritum Acid. Carbol., Gly. Ac. Tannici, Gly. Amyli, Gly. Boroglycerini, Gly. Hydrastis, and Gly. Vitelli.

LACTIC ACID (sp. gr. 1.212), $C_2H_4OH(COOH)$ (Hydroxypropionic acid).

How is lactic acid made?

It is made from sour milk, cheese, and other animal substances, but preferably by treating cane sugar with H_2SO_4, so as to convert it into invert sugar. Solution of caustic soda is then added, and heated until the absence of sugar is shown by Fehling's solution. The lactic acid formed is freed from soda by the addition of H_2SO_4, the two latter crystallizing out as sulphate of sodium, aided by the addition of alcohol. Lactate of zinc is now formed by the addition of Zn Carb. to the crude acid; the zinc salt is finally decomposed by H_2SO_4.

Off. Prep. Syr. Calcii Lactophosphatis.

CITRIC ACID, $C_3H_4OH(COOH)_3$. (Propane with OH substituted for H and 3COOH for 3H.)

What is the source of citric acid?

It occurs in the juice of lemons, gooseberries, currants, etc.

How is it obtained?

By allowing the juice to undergo an incipient fermentation, filtering and neutralizing by means of powdered chalk and milk of lime, the insoluble calcium citrate is precipitated and then decomposed by H_2SO_4.

Into what does citric acid decompose when fused with KHO?

Into oxalic and acetic acids. (Has been synthetically formed from glycerine, etc.)

DERIVATIVES OF PENTANE, C_5H_{12}.

NITRITE OF AMYL (Boils at 96° C. sp. gr. 870–880) $C_5H_{11}NO_2$. (Pentane with NO_2 substituted for H.)

How is this compound ether made?

It is made by acting upon amylic alcohol by means of HNO_2 thus:—

$$\underset{\text{Amylic Alcohol.}}{C_5H_{11}OH} + \underset{\text{Nitrous Acid.}}{HNO_2} = \underset{\text{Amyl Nitrite.}}{C_5H_{11}NO_2} + \underset{\text{Water.}}{H_2O.}$$

Describe the medical and physical properties of amyl nitris.

It is a yellow liquid, having a suffocating odor, flushing the face by paralyzing the peripheral capillaries, and thereby relieving cardiac tension. It is used in angina pectoris; also, in asthma, 5–6 drops being inhaled from a handkerchief. It is dispensed in glass capsules (pearls).

What other important compound ethers are extensively used?

Artificial fruit essences, used as fruit flavors in syrups, confections (Butyric ether, etc.).

What ethereal salt is oil of winter-green?

Methyl salicylate. The artificial product is scarcely distinguished from the natural.

VALERIANIC ACID (Valeric or Pentylic Acid), $(CH_3)_2CH\text{-}CH_2COOH$. (Pentane with O substituted for 2H and OH for H).

What is the natural and artificial source of valerianic acid?

It is obtained naturally from valerian root associated with the volatile oil, from which it is derived, but it is prepared *artificially from* amylic alcohol (fusel oil), H_2SO_4, and bichromate of potassium. The two latter substances furnishing oxygen and acting upon the alcohol, thus:—

$$\underset{\substack{\text{Amylic}\\\text{Alcohol.}}}{C_5H_{11}OH} + O_2 = \underset{\substack{\text{Valerianic}\\\text{Acid.}}}{C_4H_9COOH} + H_2O.$$

Off. Prep. Ammonii Valerianas $NH_4C_5H_9O_2$.

Made by passing ammonia gas into mono-hydrated valerianic acid.

What chemical resemblance is there between valerianic and acetic acids?

Valerianic acid bears the same relation to amylic alcohol that acetic acid bears to ethylic alcohol, thus:—

$$\underset{\substack{\text{Ethylic}\\\text{Alcohol.}}}{C_2H_5OH} + O_2 = \underset{\substack{\text{Acetic}\\\text{Acid.}}}{CH_3COOH} + H_2O.$$

(Compare with above equation.)

ACIDS OF ACRYLIC ACID SERIES, $C_nH_{2n}=2O_2$.

OLEIC ACID $(C_{18}H_{34}O_2)=(C_{17}H_{33}COOH)$.

What is oleic acid?

Acidum Oleicum. Liquid portion of congealed crude oleic acid.

It occurs as a glyceride in fats; a yellowish, oily liquid, gradually becoming brown, rancid, and acid when exposed to the air; neutral reaction, but unites with alkalies, forming salts (soaps). It is associated with *stearic* and *palmitic* acids in fats; if, therefore, an alkali or a basic substance be added to an oil or fat an *oleate*, *stearate* and *palmitate* of a base are formed, while the glycerin (the organic base with which the fatty acids were combined) is liberated. To make this plain we will use a *vegetable oil*, containing wholly oleate of glyceryl, and decompose it as follows:—

$$\underset{\substack{\text{Hydrate of}\\\text{Sodium}\\\text{(Caustic Soda).}}}{3NaOH} + \underset{\substack{\text{Oleate of}\\\text{Glycerol}\\\text{(Vegetable Oil).}}}{C_3H_5(C_{18}H_{33}O_2)_3} = \underset{\substack{\text{Oleate of}\\\text{Sodium}\\\text{(Hard Soap).}}}{3NaC_{18}H_{33}O_2} + \underset{\substack{\text{Hydrate of}\\\text{Glyceryl}\\\text{(Glycerol).}}}{C_3H_53HO.}$$

Oleic acid can be obtained by decomposition of various soaps and purification of the cruder products. Crude Oleic Acid is known commercially as "Red Oil," obtained from soap works.

BENZENE SERIES, C_nH_{2n-6}.

BENZENE, C_6H_6.

Give a brief account of this interesting organic substance.

It is obtained from coal tar. The fraction boiling below 150° C., is freed from phenols by shaking with NaOH, Aq.; and from bases by shaking with H_2SO_4. It is then rectified. It is a colorless, scarcely soluble liquid. Dissolves S, P, I, fats, resins, oils, and many alkaloids. It is converted by fuming HNO_3 into nitro-benzene (nitro-benzol—"artificial oil of bitter almond"—also called oil of mirbane).

When this "nitro-benzol" is washed with water it is reduced by tin and HCl to *aniline*.

NOTE.—This substance must not be confounded with *benzinum*, petroleum ether of the Pharmacopœia (*q. v.*).

(20.) PHENOL, C_6H_5OH (Fuses at 36°–42° C. Boils at 181°–186° C.) (Benzene with OH substituted for H).

How is carbolic acid (phenol) obtained, and what are some of its properties?

It is a product of the distillation of coal tar between the temperatures of 180° and 190° C. Deliquescent, slightly aromatic (resembling creasote), needle-shaped crystals; colorless, becoming pinkish on exposure, having (diluted) a sweetish taste, (undiluted) a peculiar caustic effect upon the skin. Deliquescent on exposure, and remains permanently liquid on the addition of 5 per cent. of water. (See also Creosote.)

What is creosote?

A mixture of substances, of phenolic character, which may be extracted by alkalies from tar obtained by dry distillation of wood. Beech tar creosote contains phenol, guaiacol, cresols. Creosote is partly cresol ($C_6H_4CH_3OH$).

Off. Prep. Aqua Creosoti.

How may creosote and carbolic acid be distinguished?

Creasote does not (carb. acid does) coagulate albumin or collodion. If one volume of creasote be mixed with one volume of glycerine a nearly clear mixture results, from which the creasote may be separated by one or more volumes of water. Carbolic acid under like conditions is dissolved, forming a transparent solution. On adding to ten c.c. of a 1 per cent. aqueous solution, one drop of test solution of ferric chloride the liquid acquires a violet-blue tint, rapidly changing to greenish and brown, with formation usually of a brown ppt. (creosote),—the liquid acquires a violet-blue color, which is permanent (carbolic acid).

Carbolic acid is associated with what official salt?

Sulphocarbolate of sodium. Carbolic acid is soluble in H_2SO_4, furnishing sulphocarbolic acid, phenolsulphonic acid, or sulphophenic acid, which unites with bases to form salts.

Off. Prep. of Carbolic Acid. Unguentum.

(500) BENZOIC ACID, C_6H_5COOH (Benzene with COOH substituted for H).

What is the source of benzoic acid?

Various resins, *e. g.*, gum benzoin, dragon's blood, and balsams—storax, Peru, and tolu. In the higher boiling phenolic portion of coal-tar, etc.

How is it made, and give its physical properties?

It is best made from varieties of benzoin containing no cinnamic acid, by sublimation. It is also obtained from hippuric acid, urine of horses or oxen. Milk of lime is added to the putrefied urine; excess of lime is ppt. by CO_2 and the filtrate ppt. by Fe_2Cl_6; the ferric benzoate is decomposed by

HCl. Crystallizes in needles or pearly plates, which are generally aromatic. Inodorous when pure,

(450) Salicylic Acid, $C_6H_4OHCOOH$ (Benzoic acid with OH substituted for H). Orthohydroxybenzoic acid.

How does this acid exist in nature, and how is it prepared?

It exists as methyl salicylate in oil of wintergreen, from which it may be obtained. It is, however, made artificially on a large scale by the combined action of sodium and carbonic anhydride upon phenol

The following equation illustrates the reaction:—

$$C_6H_5OH + ONa + CO_2 = \underset{\text{Sodium Salicylate.}}{C_6H_4COONa.}$$

$$\text{Na Salicylate} + HCl = NaCl + \text{Acid Salicylic.}$$

What are some of the properties of salicylic acid?

White, light (floating on water), crystalline substance; when rapidly heated, is converted into phenol and carbon dioxide. The aqueous solution is colored intensely violet-red by test solution of ferric chloride. It unites with alkalies, forming soluble salts, salicylate of sodium being officinal. (See Sodium.)

(100) Gallic Acid, $C_6H_2(OH)_3COOH$ (Benzoic Acid with 3OH substituted for 3H). Trihydoxybenzoic Acid.

How is gallic acid obtained?

Moistened nutgalls are exposed to the air for a month or more, to allow a peculiar fermentation to set in; the tannic acid of the galls is thus converted into gallic acid, which is then extracted by subjecting the pasty mass to pressure, and purified by solution, filtration through purified animal charcoal, and crystallization.

What effect has heat upon gallic acid?

When heated at 210° C., it forms pyrogallol and carbon *dioxide* $= C_6H_2(OH)_3COOH + \triangleright = CH_3(OH)_3$.

How can it be distinguished from tannic acid?

By its sparing solubility in cold water and by not precipitating gelatin or alkaloids from their solution, and by its crystalline form, which is acicular.

Off. Prep. Ung. Acidi Gallici.

(1) TANNIC ACID, $C_{14}H_{10}O_9$ (Anhydride of Digallic Acid).

What are the sources of tannin or tannic acid?

The officinal tannic acid is obtained from nutgalls, but tannins exist also in oak bark, cinchona, catechu, coffee, krameria, salix, kino, rhus glabra, salvia, etc. They are astringent, amorphous bodies; they precipitate albumin, alkaloids, ferric salts (differently colored, inky precipitates) and gelatin. Tannic acid also precipitates tartar emetic.

How is tannin made?

Powdered nutgalls is exposed to a damp atmosphere for two or three days. It is then made into a soft paste, by mixing with ether, and macerated for twenty-four hours. By strong pressure the liquid portion is separated; the compressed cake is then mixed with sufficient ether and water (16 of the former to 1 of the latter) to form a soft paste, and expressed as before; the expressed liquids are then evaporated at a temperature not exceeding 100° C.

Off. Prep. Collod. Stypt.; Tro. Acidi Tannici; Ung. Acidi Tannici.

(1200) THYMOL (sp. gr. 1.028; melts at 50° C.), $C_{10}H_{14}O$ (Cymene, $C_{10}H_{14}$, with OH substituted for H).

What is the source and properties of thymol?

Thymol crystallizes out when oil of thyme is kept at a low temperature for a day or two. It may also be obtained by shaking the oil with caustic alkali, treating the alkaline liquid with an acid, and crystallizing from alcoholic solution. It is the stearopten of oil of thyme; has antiseptic properties.

What is a stearopten?

Volatile oils are usually mixtures of the liquid hydrocarbons, or *elæoptens*, with oxidized hydrocarbons, which are commonly solid or camphor-like bodies, termed *stearoptens.*

CAMPHOR, $C_{10}H_{16}O$ (sp. gr. .990–.995; melts at 175° C.).

What is camphor?

A stearopten derived from *cinnamomum camphora,* and purified by sublimation.

Off. Prep. Aq.; Liniment.; Liniment. Saponis; Spts.; Tr. Opii Camph.

What unofficial stearopten has a prominent place among the remedial agents, and how is it related to the other stearoptens?

Menthol, bearing the same relation to oil of mint as that of thymol to oil of thyme; its composition is $C_{10}H_{19}OH$.

RESEARCH QUESTIONS ON SOME OF THE ABOVE ORGANIC COMPOUNDS.

How may the sweet spirits of nitre be quantitatively examined?

How may the alcoholic strengths of brandy, whisky, wine, etc., be determined?

How can brandy and whisky be examined for fusel oil, undue amounts of solids, glycerine, etc.?

What are the tests for lead, copper, iron, H_2SO_4, in tartaric acid?

What is the test for tartaric and oxalic acids in citric acid; also, Pb, Cu, Fe, SO_4, in the same?

Absence of acids (and HCl) and presence of alcoholate, *in chloral?*

THE TERPENE SERIES OF HYDROCARBONS.

C_nH_{2n-4}.

TEREBINTHINA, oil of turpentine, $C_{10}H_{16}$ (sp. gr. .855–.870).

What is the source and properties of oil of turpentine?

It is obtained by the distillation of the oleoresin (gum) turpentine, which flows naturally (or by incision) from the wood of most coniferous trees; soluble in three parts of alcohol; decomposed with violence by bromine and iodine, and inflames with a mixture of H_2SO_4 and HNO_3. See also TEREBENUM, $C_{10}H_{16}$, U. S. P., 1890.

What is terpini hydras?

The hydrate of the diatomic alcohol terpin. Its formula is $C_{10}H_{18}(OH)_2 + H_2O = 189.58$.

VOLATILE OR ESSENTIAL OILS.

Give a brief account of this class of substances.

Volatile oils exist in aromatic plants, from which they may be separated by distillation in the presence of water, or by passing steam through the bruised substance. The steam, in its passage through the material, carries with it the minute globules of oil over the neck of the retort, and finally into the receiver, where the oil is found floating on the condensed water; oils of lemon and orange are sometimes obtained by mere pressure of the rind of the fruit. Essential oils contain terpenes and a non-terpenoid substance, to which they sometimes owe their fragrance. (See also Stearoptens.)

How may the common adulterations of volatile oils be detected?

Fixed oil, by leaving a greasy stain on paper upon evaporation.

Alcohol, by decreasing in volume when shaken with glycerine or water (the glycerine or water increasing in proportion to the decrease in the bulk of volatile oil). A well-cultivated sense of smell is invaluable in guarding against adulteration with inferior oil.

Into what other classes, beside the terpenes, may the volatile oils be divided?

Oxygenated, *e.g.,* cinnamon; Sulphurated, *e.g.,* mustard; Nitrogenated (because of the presence of HCN), *e. g.,* oil of bitter almond.

What oils are derived by the action of a ferment?

Oleum Amygdalæ Amaræ and Oleum Sinapis Volatile.

What is enfleurage?

It is a name of a process by which delicate odors or volatile oils are extracted by the agency of fats; layers of flower-petals are placed upon trays covered with a layer of purified, inodorous fat. The absorptive property of the fat is thus taken advantage of by repeated macerations of fresh petals from time to time; the fat becomes the "*pommade*" of the perfumers. To extract from this pomade the odor of the flower-petal with which it has become impregnated, it is only necessary to macerate the fat with agitation in deodorized alcohol or cologne spirits; the solution thus prepared constitutes the *handkerchief extract* of commerce.

Mention the drugs yielding official volatile oils.*

Amygdala amara.
Anisum.
Aurantii Cortex.
Aurantii Flores.
Carum.
Cajuput.
Caryophyllus.
Chenopodium.
Cinnamomum.
Copaiba.
Cit. Bergamia
Coriander.
Cubeba.
Erigeron.
Eucalyptus.
Fœniculum.
Gaultheria.
Hedeoma.
Juniperus.
Lavendula { Tops and Flowers.
Limonis Cortex.
Menthæ (Pip. and Vir.).
Myrcia.
Myristica.
Pimenta.
Rosa damascena.
Rosmarinus.
Ruta.
Sabina.
Santalum album.
Sassafras.
Sinapis nigra.
Terebinthinæ.
Thymus.
Valeriana.

---

*For other constituents, natural order, etc., see pages 134–142.

Are volatile oils a prominent constituent in other drugs than the above-named?

There is a class of drugs in which volatile oil is associated with soft resin, another with certain bitter or acrid principles, etc.

Mention the drugs belonging to the above classes.*

Absinthium.
Ammoniacum.
Anthemis.
Artemisia.
Arnica.
Arnica root.
Asafetida.
Aspidium.
Aurantii Folia.
Aurantii Fructus.
Buchu.
Calamus.
Calendula.
Cannabis Americana.
Cannabis Indica.
Cardamon.
Capsicum.
Cascarilla.
Cypripedium.
Eupatorium.
Galbanum.
Grindelia.
Humulus.
Illicium.
Inula.
Lupulinum.
Macis.
Matico.
Matricaria.
Magnolia.
Marrubium.
Melissa.
Mezereum.
Menthæ (Pip. and Vir.).
Origanum.
Pilocarpus.
Piper.
Salvia.
Sambucus.
Santonica.
Scoparius.
Serpentaria.
Sinapis Alba.
Sinapis Nigra.
Tabacum.
Tanacetum.
Thuja.
Viburnum.

RESINS, OLEORESINS, GUM RESINS AND BALSAMS.

What are resins?

The natural resins obtained by exudation from plants seem to be oxidized products of terpenes and the allied hydro-

---

* For other constituents, natural order, etc., see pages 134–142.

carbons. They resemble stearoptens, but are not volatile; they differ from fats in being solid and brittle. They are insoluble in water and mostly soluble in alcohol. (The natural exuded resins must not be confounded with the resins and resinoids extracted from resinous drugs. See below.)

Name the natural resins of the U. S. P.

Elastica (?), Resinæ (a residuum from distilled turpentine), Mastiche, Guaiaci resinæ (the latter is made by boiling the chips of guaiac wood in salt water, the resinous gum collected, melted and strained). The *pitches* (pix burgundica and pix canadensis) are resins containing but a small quantity of volatile oil, water, etc.

What is an oleoresin, and give official examples?

They are mixtures of resin and volatile oil, Terebinthina (gum turpentine), Terebinthinæ Canadensis (balsam of fir), Copaiba. These natural oleoresins should not be confounded with the officinal preparations known by this title. (q. v.)

What is a gum resin, and give examples?

They are mixtures of resin or oleoresin and gum; they form with water milky emulsions. Asafetida, Galbanum, Gamboge, Ammoniac and Myrrh.

What is a balsam, and give official examples?

A balsam is generally understood to be a resin or oleoresin containing benzoic or cinnamic acid; balsam Peru, balsam tolu and storax. (Canada balsam and copaiba are not balsams).

What drugs of the Pharmacopœia contain peculiar resins extracted by alcohol?

Cannabis Indicæ, Cimicifugæ, Gossypii Radix, Jalapa, Podophyllum, Rheum, Scammonium, Spigelia, Stillingia, etc.

What are the so-called (eclectic) resinoids?

Resin-like precipitates from concentrated alcoholic solutions of the drug. The concentrated tincture is precipitated by a large quantity of water. This is collected, dried and powdered *e. g.*, Cimicifugin, Irisin. See also p. 77.

FIXED OIL, FATS AND SOAPS.

Give a brief sketch of the chemistry of fixed oils and fats.

They are regarded as ethereal salts of the fatty acids (oleic, stearic and palmitic) and an organic base (mainly glyceryl). Oils consist chiefly of *olein*, that is, of trioleate of glyceryl, $(C_{17}H_{33}COO)_3C_3H_5$.

Hard fats mainly consist of *stearin*, that is, of tristearate of glyceryl, $(C_{17}H_{35}COO)_3CH_3$. See also oleic acid.

Name the official fixed oils and fats.

Oleum Adipis, Amygdalæ Expressum, Gossypii Seminis Lini, Morrhuæ, Olivæ, Ricini, Theobromæ, Tiglii, Adeps, Sesamum (Benne oil).

What are waxes?

They are fats having a high fusing point. Wax, however, is a term more properly applied to the compounds of the fatty acids with radicals, such as *cetyl*, $C_{16}H_{33}$ (in spermaceti—cetaceum), ceryl, $C_{27}H_{55}$ (in Chinese wax) and myricil, $C_{30}H_{61}$ (in beeswax). *Off. Cera alba* and *Cera flava.*

What are soaps?

Salts of oleic, stearic, palmitic acid, or a mixture of these three; those made with KOH are soft; those with NaOH are hard. Lead plaster is sometimes (not inappropriately) called lead soap.

Name the official soaps.

Sapo, prepared from soda and olive oil (Castile).

Sapo Mollis, prepared from potassa, linseed oil, alcohol, etc.

Off. Prep. Containing soap: Emp. Saponis; Linimentum Saponis; Tr. Saponis Viridis.

CARBOHYDRATES.

What are carbohydrates?

Substances composed of carbon, hydrogen and oxygen, the two latter being in the proportion to form water.

Mention the principal groups of the carbohydrates and their formulas.

Celluloses.	Saccharoses.	Glucoses.
$(C_6H_{10}O_5)_n$.	$C_{12}H_{22}O_{11}$.	$C_6H_{12}O_6$.
Cellulose.	Cane sugar (sucrose).	Grape sugar (dextrose).
Starch.	Milk sugar (lactose).	Fruit sugar (lævulose).
Glycogen.	Maltose.	Galactose.
Dextrin.	Melitose.	Arabinose.
Gums.	Melezitose.	

What official substance represents the purest form of cellulose (cellulin)?

Gossypium Purificatum. Composed of ordinary cotton deprived of adhering impurities and fatty matter; it is known as *absorbent cotton.*

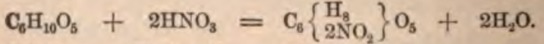
What effect have the strong acids upon it?

H_2SO_4 first swells, dissolves, and finally forms dextrin, which may be converted into glucose.

HNO_3 forms several compounds, prominent among which is gun-cotton, $C_6H_7O_5.(NO_2)_3$, trinitrocellulose.

What is soluble gun-cotton, and how is it made?

Pyroxylinum; is made by acting upon cotton by means of H_2SO_4 and HNO_3. The HNO_3 only is decomposed, represented by the following formula:—



$$C_6H_{10}O_5 + 2HNO_3 = C_6\left\{\begin{matrix}H_8\\2NO_2\end{matrix}\right\}O_5 + 2H_2O.$$

Cellulin. Nitric Acid. Dinitrocellulose.

What are the physical properties of pyroxylin, and what important official preparations contain it?

It is dissolved by alcohol and ether, when it forms the *officinal* collodions (*q. v.*).

What is the source, official name, and principal characteristics of starch?

Amylum, the fecula of wheat (of corn, 1890); insoluble in cold water; neutral to test-paper; under the microscope appearing as concentrically striated granules, angular or lenticular in form. When boiled with water, it yields a white jelly, having a bluish tinge, which, when cool, acquires a deep-blue color on the addition of test solution of iodine.

Mention some drugs containing amylaceous substances.

Althæa; Calumba; Chondrus; Cetraria; Jalap; Sarsaparilla; Ginger, etc.

What are the characteristics of gums?

They are insipid substances, soluble in water, forming a mucilaginous liquid or a jelly-like adhesive mass.

What two gums are official, and what are their properties?

Acacia, comes in roundish, brittle tears of various sizes, or broken, angular fragments, soluble in water, forming a thick, mucilaginous liquid.

Tragacanth, comes in thin bands, more or less curved, not transparent, swelling in water, forming a gelatinous mass.

What are the chemical composition and properties of acacia and tragacanth?

Acacia is a salt of Arabic acid and lime, magnesium and potassium.

Tragacanth contains tragacanthin and a salt of gummic acid and calcium, not identical with that of gum arabic. Mucilage of acacia yields a gelatinous ppt. with subacetate of lead, ferric chloride, and concentrated solution of borax, and is not colored by iodine. Tragacanth mucilage is tinged blue by iodine, the fluid portion is not disturbed by ferric chloride or borax.

What is dextrin?

It is called British gum; its mucilage is very adhesive. It is obtained by exposing starch to a dry heat of 175° C.; is a yellow amorphous powder.

What sugars are official?

Saccharum (saccharose), saccharum lactis (lactose). There are other officinal substances containing sugar, such as manna (containing mannit). Mel. (glucose, etc.).

What is glucose, and how is it made?

Grape sugar, or dextrose, is found in honey, raisins, etc. It is also a product of decomposition of glucosides. Made on a large scale by treating starch with sulphuric acid; precipitating the acid with $CaCO_3$, decolorizing the liquid with animal charcoal and concentrating it in vacuum pans.

How may cane sugar, milk sugar, and glucose be distinguished?

Milk sugar is the least soluble crystalline sugar; it slowly reduces alkaline cupric solutions.

Glucose is very soluble; rapidly reduces metallic oxides; minute traces of glucose reducing cupric solutions.

Cane sugar, very sweet taste; does not reduce cupric solutions.

Glucose is less soluble in water and more soluble in alcohol than cane sugar.

Glucose rotates the plane of polarization strongly to the right.

Cane sugar furnishes a thick syrup, is dextro-rotary, but not so strongly as glucose.

What is the specific angle of rotation of glucose?

$+56$, and the formula for computation is $\frac{100 \times \text{angle}}{56}$; thus, if 2.8° were the observed angle, the formula would read $\frac{100 \times 2.8}{56} = \frac{280}{56} = 5$ per cent.

GLUCOSIDES.

What are glucosides?

Organic neutral compounds existing in plants, which, when acted upon by ferments or acids, are split up into glucose and other bodies; most probably they are ethereal salts of the polyacid alcohol glucose.

Mention a few glucosides.

Amygdalin, Elaterinum, Glycyrrhizin, Digitonin, Picrotoxinum, Salicinum, Quercitrin.

How may santonin be isolated from santonica?

Santonin is said by *some authorities* to be a glucoside. The process for its extraction is as follows:—

Santonica is mixed with lime and extracted by dilute alcohol; the alcohol is distilled off and acetic acid is added to the residue when the santonin precipitates. The crude santonin is dissolved in alcohol, and purified by treating the alcoholic solution with charcoal and crystallizing. Processes of extraction vary, however, according to the nature of the drug in which the glucoside resides.

How is ammoniated glycyrrhizin made?

The powdered licorice root is extracted with ammoniacal water; the alkaline solution is then precipitated by H_2SO_4; the ppt. washed and redissolved, by the aid of water of ammonia; again precipitated by H_2SO_4; ppt. collected and washed, and redissolved in diluted water of ammonia; finally, the clear solution is spread upon plates of glass to dry (scale).

Mention some drugs said to contain glucosides.

Absinthium (absinthin).
Aloe (aloin).
Althæa (asparagin).
Amygdala amara (amygdalin).
Arnica (arnicin).
Asclepias (asclepidin).
Bryonia (bryonin).
Calamus (acorin).

Cantharis (cantharidin).
Chimaphila (arbutin).
Colocynthis (colocynthin).
Digitalis (digitoxin).
Euonymus (euonymin).
Elaterium (eleterin).
Frangula (frangulin).
Gaultheria (arbutin, ursone).
Mezereon (daphnin).
Myrcia (myricin).
Podophyllum (podophyllotoxin, etc.).
Quassia (quassiïn).
Quercus (quercitrin).
Quillaia (saponin).
Sarsaparilla (sarsaparillin).
Scilla (scillitoxin scillipicrin, etc.).
Simaruba (quassin).
Taraxacum (taraxacin).
Uva Ursi (arbutin, ursone, ericolin).
Vanilla (vanillin).
Viburnum (viburnin).

ACRID PRINCIPLES.

What is meant by the term acrid principle?

Acrid principles are extractive substances, frequently amorphous, of various composition; they are usually neutral principles, sometimes resinous, whose names end in *in;* some, however, have acid character, as senegin (polygallic acid); many of them resemble the glucoside saponin, as found in quillaja, etc.

Mention some acrid drugs.

Aconitum.
Allium.
Armoracia.
Arnica.
Arum.
Bryonia.
Cambogia.
Cantharis.
Capsicum.
Caulophyllum.
Chelidonium.
Colchicum.
Dracontium.
Elaterium.
Helleborus.
Iris.
Leptandra.
Lobelia.
Methysticum.
Piper.
Podophyllum.
Pyrethrum.
Quillaja.
Rhus Toxicodendron.
Sabadilla.
Sanguinaria.
Saponaria.
Sarsaparilla.
Scammonium.
Scilla.
Senega.
Sinapis.
Stillingia.
Tabacum.
Tiglii Semen.
Veratrum Viride.

ALKALOIDS.

Mention the characteristics of the alkaloids.

They are active vegetable principles, behaving toward acids as does ammonia, which fact gives them the Greek termination (oid) = alkali-like bodies; most of them contain nitrogen; they form precipitates with tannic acid, forming insoluble tannates (for this reason tannin is used as an antidote for them); they are precipitated also by the fixed alkalies, also by phospho-tungstic acid, ammonium molybdate, potassium iodo-hydrargyrate, platinic chloride, picric acid, etc.

Name the official alkaloids.

The following is a list of the official alkaloids, some of which form official salts, as indicated:—

OPIUM ALKALOIDS.

Opium, contains 9 per cent. *morphine.*

Opium Deodoratum, contains 13–15 per cent. *morphine.*

Morphina, $C_{17}H_{19}NO_3H_2O$.

Morphinæ Hydrochloras, Hydrochlorate of Morphine, $C_{17}H_{19}NO_3HCl.3H_2O$.

Morphinæ Sulphas, Sulphate of Morphine, $C_{17}H_{19}NO_3H_2SO_4.5H_2O$.

Morphinæ Acetas, Acetate of Morphine, $C_{17}H_{19}NO_3.HC_2H_3O_2.3H_2O$.

Codeina, Methyl Morphine, $C_{18}H_{21}NO_3H_2O$.

Apomorphinæ Hydrochloras, Hydrochlorate of Apomorphine, $C_{17}H_{17}NO_2.HCl$. An artificial alkaloid formed by heating morphine in a sealed tube with strong hydrochloric acid.

CINCHONA ALKALOIDS.

Cinchona Flava contains 2.5 per cent. *quinine.*

Cinchona Rubra contains 5 per cent. of alkaloids.

Quinina, Quinine, $C_{20}H_{24}N_2O_2 + 3H_2O$.

Quininæ Bisulphas, Bisulphate of Quinine, $C_{20}H_{24}N_2O_2H_2SO_4.7H_2O$.

Quininæ Hydrobromas, Hydrobromate of Quinine, $C_{20}H_{24}N_2O_2HBr.H_2O$.

Quininæ Hydrochloras, Hydrochlorate of Quinine, $C_{20}H_{24}N_2O_2HCl.2H_2O$.

Quininæ Sulphas, Sulphate of Quinine, $(C_{20}H_{24}N_2O_2)_2H_2SO_4.7H_2O$.

Quininæ Valerianas, Valerianate of Quinine, $C_{20}H_{24}N_2O_2.C_5H_{10}O_2.H_2O$.

Quinidinæ Sulphas, Sulphate of Quinidine, $(C_{20}H_{24}N_2O_2)_2H_2SO_4.2H_2O$.

Cinchonina, *Cinchonine*, $C_{19}H_{22}N_2O$.

Cinchoninæ Sulphas, Sulphate of Cinchonine, $(C_{19}H_{22}N_2O)_2H_2SO_4.2H_2O$.

Cinchonidinæ Sulphas, Sulphate of Cinchonidine, $(C_{19}H_{22}N_2O)_2H_2SO_4.3H_2O$.

Chinoidin, Mixture of alkaloids.

STRYCHNINE.

Nux Vomica contains 0.2–0.5 per cent. *strychnine.*

Ignatia contains 1.0–1.5 per cent. *strychnine.*

Strychnina, Strychnine, $C_{21}H_{22}N_2O_2$.

Strychninæ Sulphas, Sulphate of Strychnine, $(C_{21}H_{22}N_2O_2)_2H_2SO_4.5H_2O$.

ACONITINE. (Unofficial.)

Aconitum.

ATROPINE.

Belladonnæ Folia.

Belladonnæ Radix.

Atropina, Atropine, $C_{17}H_{23}NO_3$.

Atropinæ Sulphas, Sulphate of Atropine, $(C_{17}H_{23}NO_3)_2H_2SO_4$.

CAFFEINE.

Caffeina, $C_8H_{10}N_4O_2.H_2O$.

Caffeina Citrata.

Caffeina Citrata Effervescens. (See also p. 180.)

COCAINE, $C_{17}H_{21}NO_4$.

Erythroxylon.

Cocainæ Hydrochloras, $C_{17}H_{21}NO_4,HCl$.

HYDRASTINE, $C_{11}H_{11}NO_2$.

Hydrastis.
Hydrastininæ Hydrochloras, $C_{11}H_{11}NO_2,HCl$.

HYOSCYAMINE, $C_{17}H_{23}NO_3$.

Hyoscyamus.
Hyoscinæ Hydrobromas, $C_{17}H_{21}NO_4HBr,3H_2O$.
Hyoscyaminæ Hydrobromas, $C_{17}H_{23}NO_3HBr$.
Hyoscyaminæ Sulphas, $(C_{17}H_{23}NO_3)_2H_2SO_4$.

PHYSOSTIGMINE, $C_{15}H_{21}N_3O_2$.

Physostigma.

Physostigminæ (Eserine) *Salicylas*, Salicylate of Physostigmine, $C_{15}H_{21}N_3O_2.C_7H_6O_3$.

Physostigminæ Sulphas, $(C_{15}H_{21}N_3O_2)_2H_2SO_4$.

PILOCARPINE, $C_{11}H_{16}N_2O_2$.

Pilocarpus.

Pilocarpinæ Hydrochloras, Hydrochlorate of Pilocarpine, $C_{11}H_{16}N_2O_2HCl$.

PIPERINE.

Piper Nigrum.
Piperina, $C_{17}H_{19}NO_3$, Piperine.

SPARTEINE.

Scoparius (Broom).
Sparteinæ Sulphas, $C_{15}H_{26}N_2H_2SO_4 + 4H_2O$.

VERATRINE.

Sabadilla.
Veratrina, Veratrine, $C_{37}H_{53}NO_{11}$.

Mention some drugs containing other alkaloids.

Colchicum (colchicine).
Ergot (ergotinine, cornutine).
Granatum (pelletierine).
Guarana (caffeine).
Hydrastis (berberine, hydrastine).
Ipecac (emetine).
Sabadilla (veratrine).
Stramonium (daturine).
Tabacum (nicotine).
Veratrum viride (jervine).

Antifebrin (acetanilid) and many like artificial products are erroneously supposed by some to be *alkaloid* in character. They are, however, organic chemical products. *Antifebrin* is obtained by the action of glacial acetic acid and heat on aniline (see page 147).

What are the ingredients in effervescent citrate of caffeine?

Caffeine 10 Gm., Citric Acid 10 Gm., Sodium Bicarbonate 330 Gm., Tartaric Acid 300 Gm., Sugar, in very fine powder, 350 Gm., Alcohol q. s. ft. 1000 Gm.

FERMENTS AND THEIR PRODUCTS.

Give a brief account of this class of bodies.

There are two classes of ferments, known respectively as *organized* and *soluble* ferments. The former are minute bodies of organic structure capable of growth and reproduction, illustrated by the so-called brewer's yeast (*torula*, or *saccharomyces cerevisiæ*). The *soluble* ferments, on the other hand, have no organic structure and do not grow and reproduce as animalcula. These fermentative principles are formed in certain fluids of the body, etc.—*Ptyalin* (in the saliva), *Pepsin* (in the gastric juice), *Pancreatin* (in the pancreatic juice), *Diastase* (in malt), *Emulsin* (in almonds), *Myrosin* (in mustard), etc.

What are some of the special properties of these unorganized ferments?

Ptyalin converts starch into sugar.

Diastase converts starch into sugar.

Pepsin converts albumen into peptone in acid solutions. (See pepsin test in U. S. P.)

Pancreatin converts albumen and caseine into peptone in alkaline solutions, emulsifies fats, and converts starch into sugar.

Emulsin and *myrosin* (see below, under cyanogen).

How is pepsin made?

Pepsina Saccharatum, U. S. P., is made by digesting the inner mucous lining of the stomach of the hog with acidulated (HCl) water; straining the solution and precipitating it by NaCl; the light flocculent precipitate which rises and floats on the surface is collected, washed, dried, pulverized and diluted with sugar of milk, so that it will be of such strength that 1 gr. will dissolve 300 grs. of coagulated albumen.

Mention some of the products resulting from the action of ferments (including the organized ferments).

All of the crude alcohols, such as wine, whiskey, brandy, acetic acid, etc., the by-products, cream of tartar and tartaric acid (from organized ferments).

Oil of bitter almonds and oil of mustard are the result of unorganized fermentative action.

In making citric acid, fermentation is employed.

NOTE.—For further details, see substances named.

CYANOGEN COMPOUNDS.

What is the composition and properties of cyanogen?

Cyanogen (CN) as met with in compounds is a univalent radical, and behaves chemically like the halogens. The gas $(CN)_2$ is very irritating to the eyes and air passages, and possesses a penetrating odor like bitter almonds.

What compound is formed with Cy and H?

Hydrocyanic, or Prussic Acid, HCN or HCy.

Name two methods of manufacture of this acid and its strength.

It is made first by decomposing ferrocyanide of potassium with H_2SO_4, thus:

$$\underset{\substack{\text{Potassium}\\ \text{Ferrocyanide.}}}{2K_4FeCy_6} + \underset{\substack{\text{Sulphuric}\\ \text{Acid.}}}{6H_2SO_4}$$

$$= \underset{\substack{\text{Potassium Ferrous}\\ \text{Ferrocyanide (Everitt's salt).}}}{K_2Fe_2Cy_6} + \underset{\substack{\text{Bisulphate}\\ \text{of Pot.}}}{(KHSO_4)_6} + \underset{\substack{\text{Hydrocyanic}\\ \text{Acid.}}}{6HCN.}$$

Second by decomposing AgCy by means of HCl. Strength two per cent. of absol acid.

What other substances contain HCN?

Bitter almonds, wild cherry bark, and the kernels of the peach and plum, etc.

Does HCN pre-exist in bitter almonds and wild cherry, etc.?

No; it is formed by the action of two substances, known as amygdalin and emulsin (the former does not exist in sweet almonds); this action takes place when these substances are brought in contact with water, and is found associated with the volatile oil (oleum amygdalæ amaræ). (See also Ferments.)

What cyanogen compounds are found in oil of mustard?

Crude oil of mustard often contains *cyanide of allyl*, C_3H_5-CN.

The oil of white mustard is known as sulphocyanate of acrinyl (C_7H_7OCNS), and the oil of black mustard the sulphocyanate of allyl (C_3H_5CNS).

Explain the formation of this oil.

The white mustard seed contains *sinalbin*, a glucoside which, in contact with *myrosin*, a ferment, produces the oil of white mustard.

The black mustard contains *sinigrin* and *myrosin*, which, like the former, under the influence of moisture and consequent fermentation produces the pungent volatile oil.

Animal Drugs.

Name the official animal drugs and their products which have not been previously mentioned.

Cantharis, Coccus, Fel Bovis (inspissated and purified ox-gall), Moschus, Sevum, Vitellus, Adeps, Ichthyocolla, etc.

Name some of the active constituents found in the above drugs.

Cantharis (cantharidin), Coccus (red coloring matter, wax and fat), Moschus (ammonia, cholesterin, fat), Sevum (stearin *and palmitin)*, Vitellus (albumen vitellin).

What is the official name and composition of lanolin?

Adeps Lanæ Hydrosus. Hydrous Wool Fat: The purified fat of the wool of sheep mixed with not more than 30 per cent. of water.

Coloring Matter.

Mention some drugs containing coloring matter and coloring principles.

Alkanna.
Arnotta.
Calendula.
Carthamus.
Catechu.
Cochineal.
Crocus.
Curcuma.
Draco.
Gamboge.
Hæmatoxylon.
Kino.
Krameria.
Litmus.
Madder.
Rheum.
Rhœas.
Rosa Gallica.
Sanguinaria.
Santalum rubrum.
Chlorophyl.
Erythrophyl.
Xanthophyl.
Sap Green.
Indigo.
Orseille.

Alkanin, soluble in ether, alcohol, fats and certain volatile oils, alkalies change to blue; for coloring tinctures or pomade.

Rubia (Madder) contains *Ruberythrin* (yellow needles, blood-red with alkalies), *Alizarin* (orange-red needles, purple or blue with alkalies), *Purpurin* (red needles, violet-colored with alkalies).

Crocin, insoluble in ether, soluble in alcohol, colored blue by H_2SO_4.

Curcumin, orange-yellow, insoluble in water, soluble in alcohol and ether, red-brown with alkalies and boric acid.

Cambogic acid (soluble in alcohol and ether, colored black-brown by ferric chloride; soluble in alkalies with a red color).

Hæmatoxylin, colorless, sweet, soluble in water and alcohol, red in sunlight purplish by alkalies.

Hæmatin (a product of the above), green metallic lustre, soluble in alkalies with blue color.

Litmus, blue; red with acids.

Quercitrin (in rosa gallica and quercus tinctoria), yellow crystalline, nearly insoluble in cold water, colored dark green by ferric salts (an infusion of rosa gallica by dilute acid is colored red).

Sanguinarine, white, soluble in alcohol, ether and benzol, yields bright red salts.

Santalic Acid, red needles, soluble in ether with a yellow, and in alkalies with violet color; *pterocarpin* and *santal*, colorless, insoluble in water; the solution of the latter in alkalies turns red and green.

DISPENSING—INCOMPATIBILITY.

Defined.—That condition in which there exists either "*a chemical change*" or decomposition, a *therapeutical* opposition of constituents, or a *mechanical* dissociation of constituents (the latter may be termed *pharmaceutical* incompatibility).

Chemical Incompatibility.—Where chemical change results.

Therapeutical Incompatibility.—Where there is antagonism in physiological action.

Pharmaceutical Incompatibility.—Where there is dissociation of constituents, resulting, it may be, from quality of ingredients or from violation of correct pharmaceutical procedure.

Remarks.—*A prescription may be chemically or pharmaceutically incompatible and be compatible therapeutically*, because it furnishes just what the physician demands. (Ex., $ZnSO_4 + Pb\,(C_2H_3O_2)_2 + Aq$,—Injection.)

A Prescription is Absolutely Incompatible when the chemical or pharmaceutical incompatibility sustained defeats the object of the physician, producing new products having totally different therapeutic effects than those obviously intended.

The intended therapeutic action is therefore the basis of final decision *as to whether* the pharmacist shall or shall not decline or hesitate to *compound a prescription*.

Incompatibility, embraced as it is within the foregoing propositions, seems quite comprehensible; but we must remember that there are a vast variety of combinations possible in prescription compounding, and while incompatibility is not a formidable subject, it becomes complicated when we consider that almost every new prescription is largely a law unto itself until tried. Therefore, expertness in pharmaceutical manipulation, of which prescription work is the highest type, becomes a matter of *individual ability*, and can only be acquired in the largest and best measure by *personal experience.* To be expert, however—to be able to detect any deviation from the right standard and solve the multifarious puzzling problems—requires *first*, the knowledge and realization of the truths of the fundamental principles laid down, and a clear understanding of the *chemical and pharmaceutical properties* of medicinal substances.

ARRANGEMENT OF INCOMPATIBLE SUBSTANCES.

In using the following table, it is only needful to remember the well-known chemical law that if a solution of a compound be brought in contact with a solution of another compound, and by an interchange of radicals an insoluble compound be produced that compound is precipitated.

Acetates are soluble.

Arseniates are insoluble, except those of the alkali metals.

Arsenites are insoluble, except those of the alkali metals.

Bromides are soluble, except mercurous and silver; those of *antimony and bismuth are decomposed by water to form oxysalts.*

Carbonates are insoluble, except those of the alkali metals.

Chlorides are soluble, except those of lead (*s*),* mercurous and silver.

---

* Sparingly soluble (*s*).

Citrates are soluble, except those of magnesia, mercurous, silver and strontium, aluminium (*s*), barium (*s*), bismuth (*s*), cadmium (*s*), calcium (*s*), lead (*s*), zinc (*s*).

Cyanides are insoluble, except the mercuric and those of the alkaline metals and earths.

Hydrates are insoluble, except those of barium, strontium, calcium (*s*) and lead (*s*) and the alkali metals.

Iodides are soluble, except those of antimony, bismuth, gold, lead (*s*), mercuric, mercurous, platinum (*s*) and silver.

Nitrates are soluble.

Oxalates are insoluble, except those of antimony (*s*), chromium, ferrous (*s*), stannic, and the alkali metals.

Oxides are insoluble, except those of barium, strontium, calcium (*s*), and the alkaline metals.

Phosphates (ortho) are insoluble, except those of the alkali metals.

Sulphates are soluble, except those of barium, strontium, calcium (*s*), antimony, lead, mercurous (*s*) and silver (*s*).

Sulphides are insoluble, except those of barium, calcium (*s*), strontium and the alkali metals.

Sulphites are soluble, except those of aluminium, antimony, barium, bismuth, calcium (*s*), cobalt (*s*), copper, ferrous (*s*), lead, manganese (*s*), nickel (*s*), silver, stannous, strontium and zinc (*s*).

Tartrates are soluble, except those of antimony, barium, bismuth, cadmium (*s*), calcium (*s*), copper (*s*), ferrous (*s*), lead, manganese (*s*), mercuric, mercurous, nickel (*s*), silver, strontium (*s*), and zinc (*s*).

ACIDS decompose hydrates, carbonates and acid carbonates to form salts.

STRONGER ACIDS (largely inorganic) set free the weaker acids (largely organic), or, brought in contact with alcohol or alcoholic solutions, form ethers.

Alkaline hydrates, carbonates and *acid carbonates* neutralize free acids, decompose some glucosides, and precipitate all alkaloids, some of which precipitates are soluble in excess of the precipitant, or in alcohol, if that liquid be present in sufficient amount to dissolve them.

OXIDIZING AGENTS, such as *nitric, hydrochloric, nitro-hydrochloric, picric* and *chromic acids,* and *potassium bichromate* and *permanganate, with readily oxidizable substances, such as carbohydrates, alcohols, ethers, sulphur, phosphorus, sulphides, and organic matter in general,* form explosive compounds.

Potassium permanganate, if ordered in pill form, can best be made with cacao butter and cosmoline in very small quantity, and enclosed in gelatin capsules.

Silver nitrate is reduced by organic matter to oxide, with the exception, it is said, of opium and extract of hyoscyamus. A very good way of making pills of it is with cacao butter and cosmoline, etc., as mentioned above, under potassium permanganate.

Syrup of ferrous iodide and potassium chlorate form a poisonous compound.

Potassium iodide and potassium chlorate form a mixture which yields the poisonous iodate on being taken internally.

Iodine and the iodides yield precipitates with the alkaloids.

Bromides precipitate morphine and strychnine salts on standing, but a few drops of dilute hydrochloric acid added, after the addition of the alkaloid, prevents the change.

Sodium biborate precipitates morphine and cocaine salts, but on the addition of a small quantity of boric acid, or with boric acid, precipitation does not take place.

Mercuric chloride with acidulated solutions of alkaloids forms crystalline double salts.

Potassium-mercuric iodide precipitates alkaloidal solutions.

Solutions of quinine salts with those of the alkaline acetates, or with Basham's mixture, precipitate the sparingly soluble quinine acetate. *Morphine solutions*, give the phenol reaction, if mixed with tincture of ferric chloride.

GLUCOSIDES are decomposed by free acids and precipitated by tannin; *tannic and gallic acids* precipitate alkaloids, albumen, gelatin and the majority of metallic salts, and yield inks with iron solutions.

Resinous tinctures and fluid extracts, prescribed with aqueous solutions, should always be emulsified with acacia; *tinctures and fluid extracts made of stronger alcohol, mixed with those made of diluted alcohol*, become turbid and precipitate, since the special solvent power of alcohol, or of water, for a substance diminishes in proportion to the quantity of the other liquid present. A "shake" label should always be used.

Fixed and volatile oils and oleo-resins, and aqueous solutions, when for internal use, should always be emulsified, whether ordered or not, and, to better emulsify the volatile oils, they should have mixed with them, prior to emulsification, an equal volume of olive, almond, or cotton-seed oil.

Tincture of ferric chloride gelatinizes mucilage of acacia.

Free acids separate insoluble carminic acids from compound tincture of cardamon; *free acids precipitate glycyrrhizin* from fluid extract of licorice.

Commercial spirits of nitrous ether liberates iodine from solutions of iodides, *decomposes antipyrine solutions*, to form a green nitro-derivative, and precipitates mucilage of acacia, but if it be well diluted with water it can usually be added last without precipitating. Tannin preparations decompose it.

Tincture of guaiac and spirits of nitrous ether are stated to be pharmaceutically incompatible by Potter (although they are often prescribed together), likewise infusion of wild cherry with compound infusions of gentian, and infusions with metallic salts generally.

Sodium salicylate in solution precipitates the sparingly soluble salicylic acid if mixed with acids, and yields, if dispensed in powders with potassium acetate, the very deliquescent potassium salicylate. *Sodium salicylate in strong solution* is decomposed by tincture of ferric chloride, but if well diluted first changes only into ferric salicylate. *Sodium benzoate* solution is decomposed by acids to yield the sparingly soluble benzoic acid.

Mercuric chloride is decomposed by solution of potassium arsenite, but if the alkaline solution has first added to it, in slight excess, diluted hydrochloric acid, no precipitation will take place on the addition of the mercurial salt.

Pyrophosphate and phosphate of iron solutions precipitate with phosphoric acid.

The national formulary recommends the use of dilute metaphos. acid, in place of the officinal "ortho" variety, as yielding a permanently clear solution.

ANTAGONISTS.

(THERAPEUTIC INCOMPATIBLES, ETC.)

Antagonists are agents which directly oppose each other in some or all of their physiological actions, and, therefore, may be used one against the other, in a case of poisoning by either, to counteract its effect upon the organism after it has been absorbed, and when, therefore, the time for an antidote has passed. Antagonistic action takes place in the blood and tissues, and is applicable almost entirely to vegetable poisons.

Antagonist of Phosphorus.—Sulphate of copper.

Antagonists of Cinchona Alkaloids.—Morphine is antagonistic to cinchona in its cerebral action; belladonna or atropine to its nervous, cardiac and antipyretic powers.

Antagonists of Ammonia.—Cardiac sedatives, aconite, digitalis, veratrum, etc. (HCl vapor, vegetable acids).

Antagonists of Strychnine.—Chloral, chloroform, chamomile oil, physostigma, tobacco and potassium bromide. The latter is slow in its action.

Picrotoxin.—Chloral is antagonistic to its cerebral action, also spinal, but synergistic to its depressing power over the heart and respiration.

Digitalis.—Aconite is the best antagonist, also opium. Saponin and senegin are considered complete physiological antagonists.

Belladonna.—Opium is the physiological antagonist (?) for its effect on the cerebrum, pupil, heart, respiration, arterial tension, and kidneys. Physostigmine, aconite, pilocarpine and quinine are each antagonistic to some of its effects; muscarine to most of them.

Coca.—Amyl nitrite is the antagonist in cardiac depression, then alcohol and opium as stimulants to the heart. Chloral is the most direct antagonist, also chloroform and ether. Morphine is also directly antagonistic at almost all points.

Chloral.—Atropine antagonizes its cardiac, respiratory and spinal depression. Morphine given with chloral prevents the tendency to cardiac failure, while synergistic to its hypnotism.

Opium.—Atropine antagonizes its cerebral action, also its action on the pupil, respiration, heart and arterial tension. Strychnine, coffee, caffeine and cocaine are also physiologically antagonistic to morphine.

Bromides.—Digitalis, ergot and belladonna antagonize many of the effects of the bromides, but morphine is the most efficient antagonist, especially for the mental symptoms.

Conium.—Nux vomica and its alkaloids; also picrotoxin and other tetanizers are physiological antagonists.

Gelsemium.—Opium is the antagonist.

Curare.—Strychnine, though from the same family, is antagonistic as to the effects on the heart and respiration.

Pilocarpus.—Atropine; its antagonism is very complete *throughout* the whole range of action. Conversely, *Pilocar-*

pine is exactly antagonistic to atropine, but jaborine acts similar to the latter drug.

Muscarine.—Atropine exactly opposes muscarine, and *vice versâ.*

Physostigma.—Atropine as to the respiration, heart and pupil. Chloral is also antagonistic.

Aconite.—Atropine, morphine and ammonia antagonize its effects on the heart and respiration. Digitalis counteracts its heart action and the relaxation of cardiac inhibition.

Veratrum.—Morphine and atropine antagonize the cardiac depression; also alcohol, ammonia, etc.

Tobacco.—Strychnine is the true physiological antagonist of nicotine, and *vice versâ.* Alcohol, ammonia, ergot, digitalis, belladonna, etc., antagonize its action on the circulation.

Lobelia.—Strychnine, picrotoxine, and thebaine antagonize its action on the nervous system. The vasomotor excitants, as alcohol, digitalis, belladonna, oppose its effects on the circulation.

Hydrocyanic Acid.—Atropine is antagonistic (but, practically, is too slowly diffused to be of any value).

Barium.—Amyl nitrite, nitroglycerine, and similarly acting agents are its physiological antagonists.

Carbolic Acid.—Atropine is said to be a very complete physiological antagonist, maintaining the heart and respiration until elimination occurs, which should be promoted by diluents used freely.

Ipecac.—The emetic action is antagonized by the narcotics generally; also by bismuth, carbolic and hydrocyanic acids.

EXPLANATIONS AND DIRECTIONS.

Figures following the name of the ingredients of preparations indicate the *percentage* of that ingredient in the preparation. See Official Preparations, pages 64–90.

Figures immediately preceding the name of a chemical substance indicate the solubility of that substance: 4, Lithii Benzoas, indicates that Benzoate of Lithia is soluble in 4 parts of water. See Inorganic Compounds, 90–126, etc.

It is recommended that the student use in his study the table of "Official Drugs with Natural Order and their Constituents," pages 134–142, in connection with the classification of official preparations found on pages 60–64. The figure placed immediately after the name of the drug (pages 134–142) indicates the number of preparations into which that drug enters. To find the *name* of that preparation it is only necessary to turn to pages 60–64, where it will be found under its proper head. Example:—On page 134 we find "Absinthium, Herba (1)." If now we turn to page 60 we will find *the name* of the official preparation into which absinthium enters (in the class of "drugs contained in one preparation only") to be *Aromatic Wine.*

Research Questions.—The questions are introduced at various points for the purpose of directing the student's attention to the Pharmacopœia, where answers to them are to be obtained. The student himself may multiply these questions, and, following out the scheme suggested by these questions, may find it an invaluable drill.

INDEX.

MEDICAL AND SURGICAL WORKS

PUBLISHED BY

W. B. SAUNDERS,

No. 925 Walnut Street, - - Philadelphia.

American Text-Book of Diseases of Children 6, 7
American Text-Book of Gynecology 8
American Text-Book of Practice 4, 5
American Text-Book of Surgery 2, 3
Ashton's Obstetrics 24
Ball's Bacteriology 30
Brockway's Physics 31
Cerna's Notes on the Newer Remedies 18
Chapman's Medical Jurisprudence and Toxicology . . . 16
Cohen & Eshner's Diagnosis 29
Cragin's Gynæcology 26
Da Costa's Manual of Surgery 14
De Schweinitz's Diseases of the Eye 10
Garrigues' Diseases of Women 20
Gross's Autobiography 12
Hare's Physiology 22
Hampton's Nursing: Its Principles and Practice 17
Jackson and Gleason's Diseases of Eye, Nose, and Throat . . 28
Keating's Pronouncing Dictionary of Medicine 11
Keating's How to Examine for Life Insurance 14
Keen's Operation Blanks 21
Martin's Surgery 22
Martin's Minor Surgery, Bandaging, and Venereal Diseases . 27
Morris' Materia Medica and Therapeutics 25
Morris' Practice of Medicine 25
Nancrede's Anatomy and Manual of Dissection 15
Nancrede's Anatomy 23
Norris' Syllabus of Obstetrical Lectures 20
Powell's Diseases of Children 28
Saunders' Pocket Medical Formulary 13
Saunders' Pocket Medical Lexicon 19
Sayre's Practice of Pharmacy 30
Semple's Pathology and Morbid Anatomy 24
Semple's Legal Medicine, Toxicology, and Hygiene . . . 27
Senn's Syllabus of Lectures on Surgery 18
Shaw's Nervous Diseases and Insanity 31
Stelwagon's Diseases of the Skin 26
Stevens' Practice of Medicine 16
Stevens' Materia Medica and Therapeutics 17
Stewart and Lawrance's Medical Electricity 32
Thornton's Manual of Prescription Writing 32
Vierordt and Stuart's Medical Diagnosis 9
Wilson's Deformities of the Bones and Joints 19
Wolff's Chemistry 23
Wolff's Examination of Urine 29

For Sale by Subscription only.

An American Text-Book of Surgery.

Forming One Handsome Royal Octavo Volume of over 1200 pages (10 x 7 inches), with nearly 500 Wood-cuts in Text, and 37 Colored and Half-tone Plates, many of them Engraved from Original Photographs and Drawings furnished by the Authors.

Price, Cloth, $7 net; Sheep, $8 net; Half Russia, $9 net.

BY

CHARLES H. BURNETT, M.D., Emeritus Professor of Otology, Philadelphia Polyclinic.

PHINEAS S. CONNER, M.D., LL.D., Professor of Surgery, Medical College of Ohio and Dartmouth Medical College.

FREDERIC S. DENNIS, M.D., Professor of Principles and Practice of Surgery, Bellevue Hospital Medical College.

WILLIAM W. KEEN, M.D., LL.D., Professor of the Principles of Surgery and of Clinical Surgery, Jefferson Medical College.

CHARLES B. NANCREDE, M.D., Professor of Surgery and of Clinical Surgery, University of Michigan.

ROSWELL PARK, M.D., Professor of Surgery, Medical Department of the University of Buffalo.

LEWIS S. PILCHER, M.D., Professor of Clinical Surgery in the New York Post-Graduate School and Hospital.

NICHOLAS SENN, M.D., PH.D., Professor of Practice of Surgery and of Clinical Surgery, Rush Medical College.

FRANCIS J. SHEPHERD, M.D., C.M., Professor of Anatomy and Lecturer on Operative Surgery, McGill University, Montreal, Canada.

LEWIS A. STIMSON, B.A., M.D., Professor of Surgery in the University of the City of New York.

WILLIAM THOMSON, M.D., Professor of Ophthalmology, Jefferson Medical College.

J. COLLINS WARREN, M.D., Associate Professor of Surgery, Harvard University.

J. WILLIAM WHITE, M.D., PH.D., Professor of Clinical Surgery, University of Pennsylvania.

EDITED BY

WILLIAM W. KEEN, M.D., LL.D., AND
J. WILLIAM WHITE, M.D., PH.D.

The want of a text-book which could be used by the practitioner and at the same time be recommended to the medical student has been deeply felt, especially by teachers of surgery. Hence, when it was suggested to a number of them that it would be well to unite in preparing a book of this description, great unanimity of opinion was found to exist, and the gentlemen before named gladly consented to join in its production. While there is no distinctive American Surgery, yet America has contributed very largely to the progress of modern surgery, and among the foremost of those who have aided in developing this art and science will be found the authors of the present volume. All of them are teachers of surgery in leading medical schools and hospitals in the United States and Canada.

Especial prominence has been given to Surgical Bacteriology; a feature which is believed to be unique in a surgical text-book in the English language. Asepsis and Antisepsis have received particular attention, and full details of the various methods of disinfecting instruments, hands, and the field of operations, sutures, etc., will be found. The text is brought well up to date in such important branches as cerebral, spinal, intestinal, and pelvic surgery, and the most important and newest operations in these departments are described and illustrated.

The text of the entire book has been submitted to all the authors for their mutual criticism and revision, also an entirely new and original feature in book-making. The book, as a whole, therefore, expresses on all the important surgical topics of the day the consensus of opinion of the eminent surgeons who have joined in its preparation.

One of the most attractive features of the book is its illustrations. Very many of them are original and faithful reproductions of photographs taken directly from patients or from specimens, and the modern improvements in the art of engraving have enabled the publishers to produce illustrations which it is believed are superior to those in any similar work.

For Sale by Subscription only.

A TREATISE

ON THE

Theory and Practice of Medicine.

BY

AMERICAN TEACHERS.

EDITED BY WILLIAM PEPPER, M.D., LL.D.,
Provost and Professor of the Theory and Practice of Medicine and of Clinical Medicine in the University of Pennsylvania.

To be Completed in Two Handsome Royal Octavo Volumes of about 1000 pages each, with Illustrations to Elucidate the Text wherever Necessary.

Price per vol., Cloth, $5 net; Sheep, $6 net; Half Russia, $7 net.

VOLUME I. contains:

Hygiene.

J. S. BILLINGS, Professor of Hygiene, University of Pennsylvania.

Fevers (Ephemeral, Simple Continued, Typhus, Typhoid, Epidemic Cerebro-spinal Meningitis, and Relapsing).

WM. PEPPER, M.D., Provost and Professor of the Theory and Practice of Medicine and of Clinical Medicine, University of Pennsylvania.

Scarlatina, Measles, Rotheln, Variola, Varioloid, Vaccinia, Varicella, Mumps, Whooping-cough, Anthrax, Hydrophobia, Trichinosis, Actinomycosis, Glanders, and Tetanus.

JAMES T. WHITTAKER, M.D., Professor of the Theory and Practice of Medicine and of Clinical Medicine, Medical College of Cincinnati, O.

Tuberculosis, Scrofula, Syphilis, Diphtheria, Erysipelas, Malaria, Cholera, and Yellow Fever.

W. GILMAN THOMPSON, M.D., Professor of Physiology, New York University Medical College.

Nervous, Muscular, and Mental Diseases (Including Opium Habit, etc.).

HORATIO C. WOOD, M.D., Professor of Materia Medica, Pharmacy, and General Therapeutics, and Clinical Professor of Nervous Diseases, University of Pennsylvania. And

WILLIAM OSLER, M.D., Professor of Practice of Medicine, Johns Hopkins *University*, Baltimore, Md.

VOLUME II. contains:

Urine (Chemistry and Microscopy).

JAMES W. HOLLAND, M.D., Professor of Medical Chemistry and Toxicology, Jefferson Medical College, Philadelphia.

Kidneys and Lungs.

FRANCIS DELAFIELD, M.D., Professor of Pathology and Practice of Medicine, College of Physicians and Surgeons, New York City.

Air-passages (Larynx and Bronchi) and Pleura.

JAMES C. WILSON, M.D., Professor of Practice of Medicine and of Clinical Medicine, Jefferson Medical College, Philadelphia.

Pharynx, Œsophagus, Stomach, and Intestines (Including Intestinal Parasites).

WILLIAM PEPPER, M.D., Provost and Professor of the Theory and Practice of Medicine and of Clinical Medicine, University of Pennsylvania.

Peritoneum, Liver, and Pancreas.

REGINALD H. FITZ, M.D., Hersey Professor of Physics, Harvard Medical School.

Diathetic Diseases (Rheumatism, Rheumatoid Arthritis, Gout, Lithæmia, and Diabetes).

HENRY M. LYMAN, M.D., Professor of Principles and Practice of Medicine, Rush Medical College, Chicago, Ill.

Heart, Aorta, Arteries, and Veins.

E. G. JANEWAY, M.D., Professor of Principles and Practice of Medicine, Bellevue Hospital Medical College, New York City.

Blood and Spleen.

WILLIAM OSLER, M.D., Professor of Practice of Medicine, Johns Hopkins University, Baltimore, Md.

Inflammation, Embolism, Thrombosis, Fever, and Bacteriology.

W. H. WELCH, M.D., Professor of Pathology, Johns Hopkins University, Baltimore, Md.

The articles are not written as though addressed to students in lectures, but are exhaustive descriptions of diseases with the newest facts as regards Causation, Symptomatology, Diagnosis, Prognosis, and Treatment, and will include a large number of approved Formulæ. The recent advances made in the study of the bacterial origin of various diseases are fully described, as well as the bearing of the knowledge so gained upon prevention and cure. The subjects of Bacteriology as a whole and of immunity are fully considered in a separate section.

Methods of diagnosis are given the most minute and careful attention, thus enabling the reader to learn the very latest methods of investigation without consulting works specially devoted to the subject.

For Sale by Subscription only.

AN AMERICAN TEXT-BOOK
OF THE
DISEASES OF CHILDREN.

INCLUDING

Special Chapters on Essential Surgical Subjects; Diseases of the Eye, Ear, Nose, and Throat; Diseases of the Skin; and on the Diet, Hygiene, and General Management of Children.

BY

AMERICAN TEACHERS.

EDITED BY

LOUIS STARR, M.D.,

Physician to the Children's Hospital and Consulting Pediatrist to the Maternity Hospital, Philadelphia; late Clinical Professor of Diseases of Children in the Hospital of the University of Pennsylvania, etc., etc.,

ASSISTED BY

THOMPSON S. WESTCOTT, M.D.,

Attending Physician to the Dispensary for Diseases of Children, Hospital of the University of Pennsylvania, etc.

Forming a handsome imperial 8vo vol. of more than 1200 pages, pro*fusely illustrated* with wood-cuts, half-tone and colored plates.

ANNOUNCEMENT.

An American Text-book of the Diseases of Children will be issued as a handsome imperial octavo volume of about 1200 pages, uniform with an American Text-book of Surgery, containing numerous wood-cuts, half-tone plates, and colored illustrations. The plan contemplates a series of original articles written by some sixty well-known pædiatrists, representing collectively the present teachings of the most prominent medical schools and colleges of America. The work is not intended to be encyclopædic in character, but to be a practical book suitable for constant and handy reference by the practitioner and advanced student.

One decided innovation for a book of its size is the large number of authors, nearly every article being contributed by a specialist in the line on which he writes. This, while entailing considerable labor upon the editors, has resulted in the publication of a work thoroughly new and abreast of the times. The entire work has been practically written in a few months, thus removing the usual objection to treatises of this class, that they are out of date before they are published.

Especial attention is given to the consideration of the latest accepted teaching upon the Etiology, Symptoms, Pathology, Diagnosis, and Treatment of the disorders of children, with the introduction of many special formulæ and therapeutic procedures.

Special chapters embrace at unusual length the diseases of the Eye, Ear, Nose and Throat, and the Skin; while the introductory chapters cover fully the important subjects of Diet, Hygiene, Exercise, Bathing, and the Chemistry of Food. Tracheotomy, Intubation, Circumcision, and such minor surgical procedures coming within the province of the medical practitioner are carefully considered.

NOW READY.

For Sale by Subscription only.

An American Text-Book of Gynecology

MEDICAL AND SURGICAL.

FOR THE USE OF

STUDENTS AND PRACTITIONERS.

BY

JOHN M. BALDY, M.D., HENRY T. BYFORD, M.D.,
EDWIN CRAGIN, M.D., J. H. ETHERIDGE, M.D.,
WILLIAM GOODELL, M.D., HOWARD A. KELLY, M.D.,
FLORIAN KRUG, M.D., E. E. MONTGOMERY, M.D.,
WILLIAM R. PRYOR, M.D., GEORGE M. TUTTLE, M.D.

Forming one handsome royal 8vo. volume, profusely illustrated.

Price, Cloth, $6 ; Sheep, $7 ; Half Russia, $8.

In this volume all anatomical descriptions, excepting those essential to a clear understanding of the text, have been omitted, the illustrations being largely depended upon to elucidate the anatomy of the parts. The work will be found thoroughly practical in its teachings, and is intended, as its title implies, to be a working text-book for physicians and students. A clear line of treatment has been laid down in every case, and although no attempt has been made to discuss mooted points, still the most important of these have been noted and explained. The operations recommended are fully illustrated, so that the reader may have under his eye a picture of the procedure described in the text, and cannot fail to grasp the idea.

All extraneous matter and discussions have been carefully excluded, the attempt being made to allow nothing to cumber the text.

The subject-matter has been brought fully up to date at every point, and the work is as nearly as possible the combined opinions of the ten specialists who figure as the authors.

The work is well illustrated throughout with wood-cuts, half-tone and colored plates, mostly selected from the authors' private collections.

Now Ready—Third and Revised Edition.

For Sale by Subscription only

MEDICAL DIAGNOSIS.

BY DR. OSWALD VIERORDT,
Professor of Medicine at the University of Heidelberg; formerly Privat Docent
at University of Leipzig; Professor of Medicine and Director
of the Medical Polyclinic at the Univ. of Jena.

Translated with additions, from the Second Enlarged German Edition, with the Author's Permission.

BY FRANCIS H. STUART, A.M., M.D.,
Member of the Medical Society of the County of Kings, N. Y.; Fellow of the
New York Academy of Medicine; Member of the
British Medical Association, etc.

In One Handsome Royal Octavo Volume of 700 Pages.

178 Fine Wood-cuts in Text, Many of Which are in Colors.

Price, Cloth, $4 net; Sheep, $5 net; Half Russia, $5.50 net.

This Valuable Work is now Published in German, English, Russian, and Italian.

In this work, as in no other hitherto published, are given full and accurate explanations of the phenomena observed at the bedside. IT IS DISTINCTLY A CLINICAL WORK, by a master teacher, characterized by thoroughness, fulness, and accuracy. IT IS A MINE OF INFORMATION UPON THE POINTS THAT ARE SO OFTEN PASSED OVER WITHOUT EXPLANATIONS. Especial attention has been given to the germ theory as a factor in the origin of disease.

The issue of a third edition within two years indicates the favor with which it has been received by the profession.

PROFESSIONAL OPINIONS.

"One of the most valuable and useful works in medical literature."
(Signed) ALEXANDER J. C. SKENE, M.D.,
Dean of the Long Island College Hospital, and Professor of the Medical and Surgical Diseases of Women.

"Indispensable to both 'students and practitioners.'"
(Signed) F. MINOT, M.D.,
Hersey Professor of Theory and Practice of Medicine, Harvard University.

"It is very well arranged and very complete, and contains valuable features not usually found in the ordinary books."
(Signed) J. H. MUSSER, M.D.,
Assistant Professor Clinical Medicine, University of Pennsylvania.

"A treasury of practical information which will be found of daily use to every busy practitioner who will consult it."
(Signed) C. A. LINDSLEY, M.D.,
Professor of Theory and Practice of Medicine, Yale University, New Haven, Conn.

For Sale by Subscription only.

NOW READY.

DISEASES OF THE EYE.

A Hand-Book of Ophthalmic Practice.

BY G. E. DE SCHWEINITZ, MD.,

Professor of Diseases of the Eye, Philadelphia Polyclinic; Professor of Clinical Ophthalmology, Jefferson Medical College, Philadelphia; Ophthalmic Surgeon to Children's Hospital and to the Philadelphia Hospital; Ophthalmologist to the Orthopædic Hospital and Infirmary for Nervous Diseases; late Lecturer on Medical Ophthalmoscopy, University of Pa., etc.

Forming a handsome royal 8vo. vol. of more than 680 pages.

Over 200 fine wood-cuts, many of which are original, and two chromo-lithographic plates.

Price, Cloth, $4 net; Sheep, $5 net; Half Russia, $5.50 net.

PROFESSIONAL OPINIONS.

"A work that will meet with the requirements not only of the specialist, but of the general practitioner in a rare degree. I am satisfied that unusual success awaits it." (Signed) WILLIAM PEPPER, M.D.,
Provost and Professor of Theory and Practice of Medicine and Clinical Medicine in the University of Pennsylvania.

"Contains in concise and reliable form the accepted views of Ophthalmic Science." (Signed) WILLIAM THOMSON, M.D.,
Professor of Ophthalmology, Jefferson Medical College, Philadelphia, Pa.

"One of the best hand-books now extant on the subject."
(Signed) J. O. STILLSON, M.D.,
Professor of Eye and Ear, Central College of Physicians and Surgeons, Indianapolis, Ind.

"Vastly superior to any book on the subject with which I am familiar."
(Signed) FRANCIS HART STUART, M.D.,
Brooklyn, N. Y.

"Contains in the most attractive and easily understood form just the sort of knowledge which is necessary to the intelligent practice of general medicine and surgery." (Signed) J. WILLIAM WHITE, M.D.,
Professor of Clinical Surgery in the University of Pennsylvania.

"A very reliable guide to the study of eye diseases, presenting the latest facts and newest ideas." (Signed) SWAN M. BURNETT, M.D.,
Prof. of Ophthalmology and Otology, Med. Department Univ. Georgetown, Washington, D. C.

Second Revised Edition. For Sale by Subscription only.

A NEW PRONOUNCING DICTIONARY OF MEDICINE.

WITH

Phonetic Pronunciation, Accentuation, Etymology, etc.

BY JOHN M. KEATING, M.D., LL.D.,
Fellow of the College of Physicians of Philadelphia; Vice-President of the American Pædiatric Society; Ex-President of the Association of Life Insurance Medical Directors; Editor "Cyclopædia of the Diseases of Children," etc.;

AND

HENRY HAMILTON,
Author of "A new Translation of Virgil's Æneid into English Rhyme;" Co-Author of "Saunders' Medical Lexicon," etc.

WITH AN APPENDIX

CONTAINING IMPORTANT TABLES OF BACILLI, MICROCOCCI, LEUCOMAÏNES, PTOMAÏNES; DRUGS AND MATERIALS USED IN ANTISEPTIC SURGERY; POISONS AND THEIR ANTIDOTES; WEIGHTS AND MEASURES; THERMOMETRIC SCALES; NEW OFFICINAL AND UNOFFICINAL DRUGS, ETC. ETC.

Forming One very Attractive Volume of over 800 pages.

Price, Cloth, $5 net; Sheep, $6 net; Half Russia, $6.50 net.

With Denison's Patent Index for Ready Reference.

"I am much pleased with Keating's Dictionary, and shall take pleasure in recommending it to my classes." (Signed) HENRY M. LYMAN, M.D.,
Professor of Principles and Practice of Medicine, Rush Medical College, Chicago, Ill.

"I am convinced that it will be a very valuable adjunct to my study table, convenient in size and sufficiently full for ordinary use."
(Signed) C. A. LINDSLEY, M.D.,
Professor of Theory and Practice of Medicine, Medical Dept. Yale University, Secretary Connecticut State Board of Health, New Haven, Connecticut.

"I will point out to my classes the many good features of this book as compared with others, which will, I am sure, make it very popular with students."
(Signed) JOHN CRONYN, M.D., LL.D.,
Professor of Principles and Practice of Medicine and Clinical Medicine; President of the Faculty, Medical Dept. Niagara University, Buffalo, N. Y.

"My examination and use of it have given me a very favorable opinion of its merit, and it will give me pleasure to recommend its use to my class."
(Signed) J. W. H. LOVEJOY, M.D.,
Professor of Theory and Practice of Medicine, and President of the Faculty, Medical Dept. Georgetown University, Washington, D. C.

Second Edition, for Sale by Subscription.

AUTOBIOGRAPHY

OF

SAMUEL D. GROSS, M.D.,

D. C. L. OXON., LL.D. CANTAB., EDIN., JEFFERSON COLLEGE, UNIV. PA.,
EMERITUS PROFESSOR OF SURGERY IN THE JEFFERSON MEDICAL
COLLEGE OF PHILADELPHIA.

WITH REMINISCENCES OF

HIS TIMES AND CONTEMPORARIES.

Edited by his Sons, SAMUEL W. GROSS, M.D., LL.D., late Professor of Principles of Surgery and of Clinical Surgery in the Jefferson Medical College, and A. HALLER GROSS, A.M., of the Philadelphia Bar.

Preceded by a Memoir of Dr. Gross by the late Austin Flint, M.D., LL.D.

In two handsome vols., each containing over 400 pages, demy 8vo., ex. cloth, gt. tops, with fine Frontispiece engraved on steel.

Price . . . $5.00 net.

This AUTOBIOGRAPHY, which was continued by the late eminent Surgeon until within three months before his death, contains a full and accurate history of his early struggles, trials, and subsequent successes, told in a singularly interesting and charming manner, and embraces short and graphic pen portraits of many of the most distinguished men—surgeons, physicians, divines, lawyers, statesmen, scientists, etc. etc.—with whom he was brought in contact in this country and in Europe; the whole forming a retrospect of more than three-quarters of a century.

SAUNDERS'

Pocket Medical Formulary

BY

WILLIAM M. POWELL, M.D.,

Attending Physician to the Mercer House for Invalid Women, at Atlantic City.

CONTAINING

1750 Formulæ, selected from several hundreds of the best known authorities.

Forming a handsome and convenient Pocket Companion of nearly 300 printed pages, and blank leaves for additions.

WITH AN APPENDIX

Containing Posological Table; Formulæ and Doses for Hypodermic Medication: Poisons and their Antidotes; Diameters of the Female Pelvis and Fœtal Head; Obstetrical Table; Diet List for various diseases; Materials and Drugs used in Antiseptic Surgery: Treatment of Asphyxia from Drowning; Surgical Remembrancer; Tables of Incompatibles; Eruptive Fevers; Weights and Measures, etc.

Third Edition, Revised and greatly Enlarged.

Handsomely bound in Morocco, with Patent Index, Wallet, and Flap.

Price, $1.75 net.

THERAPEUTIC GAZETTE, January, 1892.—"The prescriptions have been taken from the writings or practice of Physicians whose experience qualifies them to be worthy of trial. We heartily recommend this volume to all who desire to purchase such a work."

NEW YORK MEDICAL RECORD, February 27, 1892.—"This little book, that can be conveniently carried in the pocket, contains an immense amount of material. It is very useful, and, as the name of the author of each prescription is given, is *unusually reliable.*"

THIRD EDITION.

How to Examine for Life Insurance.

. By JOHN M. KEATING, M.D.,

Medical Director Penn Mutual Life Insurance Co.; Ex-President of the Association of Life Insurance Medical Directors; Consulting Physician for Diseases of Women at St. Agnes' Hospital, Phila.; Gynæcologist to St. Joseph's Hospital, etc.

With two large Phototype Illustrations, and a Plate prepared by Dr. McClellan from special Dissections; also, numerous cuts to elucidate the text,

Price, in Cloth, $2.00.

PART I. has been carefully prepared from the best works on physical diagnosis, and is a short and succinct account of the methods used to make examinations; a description of the normal condition, and of the earliest evidences of disease.

PART II. contains the instructions of twenty-four Life Insurance Companies to their medical examiners.

PRESS NOTICES.

"The most practical manual on this subject that has yet been offered as a guide to the medical examiner for life insurance. It contains much that is needful in the way of reference that cannot be found grouped elsewhere."—*Buffalo Medical and Surgical Journal.*

"Just such a book as the young and inexperienced medical examiner needs."—*The American Journal of the Medical Sciences.*

"By far the most useful book which has yet appeared on insurance examination. The book should be at the right hand of every physician interested in this special branch of medical science."—*The Medical News.*

"The volume is replete with information and suggestions, and is a valuable contribution to the literature of the medical department of life underwriters' work." —*The United States Review* (Insurance Journal).

In Active Preparation. Ready Shortly.

A

MANUAL OF SURGERY,

GENERAL AND OPERATIVE.

BY

JOHN CHALMERS DA COSTA, M. D.,

Instructor in Surgery, Jefferson Medical College.

A new manual of the Principles and Practice of Surgery, intended to meet the growing demand for students and others for a medium-sized work which will embody all the newer methods of procedure detailed in the larger text-books.

SAUNDERS'
SERIES OF MANUALS

FOR

STUDENTS AND PRACTITIONERS.

The aim of the Publisher is to furnish, in this Series of Manuals, a number of high-class works by prominent teachers who are connected with the principal Colleges and Universities of this country; the position and experience of each being a guarantee of the soundness and standard of text of the subject on which he writes.

Especial care has been exercised in the choice of large, clear, readable type; a high grade of slightly toned paper, of a shade particularly adapted for reading by artificial light; high class illustrations, printed in colors when necessary to a clear elucidation of the text; and strong, attractive, and uniform bindings.

The prices vary greatly ($1.00 to $2.50), it not being desirable to fix an arbitrary standard and pad the volumes accordingly.

Now Ready—Fourth Edition.

CONTAINING

"HINTS ON DISSECTION."

Essentials of Anatomy and Manual of Practical Dissection.

BY CHARLES B. NANCREDE, M.D.,

Professor of Surgery and Clinical Surgery in the University of Michigan, Ann Arbor; Corresponding Member of the Royal Academy of Medicine, Rome, Italy; late Surgeon Jefferson Medical College, etc. etc.

With Handsome Full-page Lithographic Plates in Colors. Over 200 Illustrations.

No pains or expense has been spared to make this work the most exhaustive yet concise Student's Manual of Anatomy and Dissection ever published, either in this country or Europe.

The colored plates are designed to aid the student in dissecting the muscles, arteries, veins, and nerves. For this edition the woodcuts have all been specially drawn and engraved, and an Appendix added containing 60 illustrations representing the structure of the entire human skeleton, the whole based on the eleventh edition of Gray's Anatomy, and forming a handsome post 8vo. volume of over 400 pages.

Price, Extra Cloth or Oilcloth for the Dissection-Room, $2.00 net.

JUST PUBLISHED—SECOND EDITION.

A Manual of the Practice of Medicine.

BY A. A. STEVENS, A.M., M.D.,

Instructor of Physical Diagnosis in the University of Pennsylvania, and Demonstrator of Pathology in the Woman's Medical College of Philadelphia.

Post 8vo., 502 pages, Illustrated. Price, Cloth, $2.50.

Contributions to the science of medicine have poured in so rapidly during the last quarter of a century, that it is well nigh impossible for the student, with the limited time at his disposal, to master elaborate treatises, or to cull from them that knowledge which is absolutely essential. From an extended experience in teaching, the author has been enabled by classification, the grouping of allied symptoms, and the judicious elimination of theories and redundant explanations, to bring within a comparatively small compass a complete outline of the Practice of Medicine.

NEW READY.

A Manual of Medical Jurisprudence
AND TOXICOLOGY.

BY HENRY CHAPMAN, M.D.,

Professor of Institutes of Medicine and Medical Jurisprudence in the Jefferson Medical College, Philadelphia; Member of the College of Physicians, Philadelphia, etc.

232 pp., post-octavo, with 36 Illustrations, some of which are in colors.

Price $1.25 Net.

For many years there has been a demand from members of the medical and legal professions for a medium-sized work on this most important branch of medicine. The necessarily prescribed limits of the work permit only the consideration of those parts of this extensive subject which the experience of the author as coroner's physician of the city of Philadelphia for a period of six years leads him to regard as the most material for practical purposes.

Particular attention is drawn to the illustrations, many being produced in colors, thus conveying to the layman a far clearer idea of the more intricate cases.

NURSING:

Its Principles and Practice,

FOR HOSPITAL AND PRIVATE USE.

BY ISABELLA A. HAMPTON,

Graduate of the New York Training School for Nurses attached to Bellevue Hospital Superintendent of Nurses and Principal of the Training School for Nurses, Johns Hopkins Hospital, Baltimore, Md.; Late Superintendent of Nurses, Illinois Training School for Nurses, Chicago, Illinois.

Price, $2.00 net.

An entirely new work on the important subject of nursing, at once comprehensive and systematic. It is written in a clear, accurate, and readable style, suitable alike to the student and lay reader. It is of especial value to the graduated nurse who desires to acquire a practical working knowledge of the care of the sick and hygiene of the sick room. Thoroughly tested and approved processes in practical nursing only have been given, particularly in antiseptic surgery. Illustrations have been freely used wherever necessary to elucidate the text.

Maryland Medical Journal.—"The newest and most advanced methods, in a clear, concise manner."

Ontario Medical Journal.—"Will enable each of us to become a *training school* in himself."

Inter-Ocean (Chicago).—"No better guide."

The Churchman.—"Valuable for those contemplating nursing as a profession."

IN ACTIVE PREPARATION. READY SHORTLY.

A MANUAL OF

Materia Medica and Therapeutics.

BY

A. A. STEVENS, A.M., M.D.,

Instructor of Physical Diagnosis in the University of Pennsylvania and Demonstrator of Pathology in the Woman's Medical College of Philadelphia.

NOW READY.

A SYLLABUS

OF

Lectures on the Practice of Surgery.

ARRANGED IN CONFORMITY WITH

THE AMERICAN TEXT-BOOK OF SURGERY.

BY N. SENN, M.D., PH.D.,

Professor of Surgery in Rush Medical College, Chicago, and in the Chicago Polyclinic.

PRICE . . . $2.00.

This the latest work of its eminent author, himself one of the contributors to the "American Text-Book of Surgery," will prove of exceptional value to the advanced student who has adopted that work as his text-book. It is not only the syllabus of an unrivalled course of Surgical Practice, but an epitome or supplement to the larger work.

NOW READY.

Notes on the Newer Remedies,

THEIR

Therapeutic Applications and Modes of Application

BY DAVID CERNA, M.D., PH.D.

Demonstrator of and Lecturer on Experimental Therapeutics in the University of Pennsylvania.

Forming a small octavo volume of about 175 pages (7 x 5) inches.

PRICE - - - $1.25.

The work will take up in alphabetical order all the Newer Remedies, giving their physical properties, solubility, therapeutic applications, administration, and chemical formula. It will in this way, form a very valuable addition to the various works on Therapeutics now in existence.

Chemists are so multiplying compounds that if each compound is to be thoroughly studied, investigations must be carried far enough to determine the practical importance of the new agents.

Brevity and conciseness compel the omission of all bibliographical references.

SAUNDERS'
POCKET MEDICAL LEXICON;

OR,

Dictionary of Terms and Words used in Medicine and Surgery.

BY JOHN M. KEATING, M.D.,
Editor of "Cyclopædia of Diseases of Children," etc.; Author of the "New Pronouncing Dictionary of Medicine,"

AND

HENRY HAMILTON,
Author of "A New Translation of Virgil's Æneid into English Verse;" Co-author of a "New Pronouncing Dictionary of Medicine."

Price, 75 Cents, Cloth. $1.00, Leather Tucks.

"Saunders' Pocket Medical Lexicon—a very complete little work, invaluable to every student of medicine. It not only contains a very large number of words, but also tables of etymological factors common in medical terminology; abbreviations used in medicine, poisons and antidotes, etc."—*Annals of Gynæcology*, Philadelphia.

IN ACTIVE PREPARATION.

METHODS OF
PREVENTING AND CORRECTING
Deformities of the Bones and Joints.

A Handbook of Practical Orthopædic Surgery.

BY H. AUGUSTUS WILSON, M.D.,
Professor of General and Orthopædic Surgery, Philadelphia Polyclinic; Clinical Professor of Orthopædic Surgery, Jefferson Medical College, Philadelphia, etc., etc.

The aim of the author will be to provide a book of moderate size, containing comprehensive details that will enable general practitioners to thoroughly understand the mechanical features of the many forms of congenital and acquired deformities of the bones and joints.

Mechanical and operative procedures will be given in detail, and prominence will be given to the mechanical requirements for braces and artificial limbs, etc., with description of their methods of construction. A large number of original illustrations will be used to make descriptions clearer.

IN PRESS. READY SHORTLY.

DISEASES OF WOMEN.

BY HENRY J. GARRIGUES, A.M., M.D.,

Professor of Obstetrics in the New York Post-Graduate Medical School and Hospital; Gynæcologist to St. Mark's Hospital, New York City; Gynæcologist to the German Dispensary in the City of New York; Consulting Obstetrician to the New York Infant Asylum; Obstetric Surgeon to the New York Maternity Hospital; Fellow of the American Gynæcological Society; Fellow of the New York Academy of Medicine; President of the German Medical Society of New York, etc. etc.

In One Very Handsome Octavo Volume, of about 700 pages, profusely Illustrated by Woodcuts and Colored Plates.

PRICE, CLOTH, $4.00. SHEEP, $5.00.

A practical work on Gynæcology for the use of students and practitioners, written in a terse and concise manner. The importance of a thorough knowledge of the anatomy of the female pelvic organs has been fully recognized by the author, and considerable space has been devoted to the subject. The chapters on operations and treatment will be thoroughly modern, and are based upon the large hospital and private practice of the author. The text is elucidated by a large number of illustrations and colored plates, many of them being original.

SYLLABUS OF OBSTETRICAL LECTURES

In the Medical Department University of Pennsylvania

BY RICHARD C. NORRIS, A.M., M.D.,

Demonstrator of Obstetrics in the University of Pennsylvania.

Third Edition, thoroughly revised and enlarged.

PRICE, CLOTH, INTERLEAVED FOR NOTES, $2.00 Net.

The New York *Medical Record* of April 19, 1890, referring to this book, says: "This modest little work is so far superior to others on the same subject that we take pleasure in calling attention briefly to its excellent features. Small as it is, it covers the subject thoroughly, and will prove invaluable to both the student and the practitioner as a means of fixing in a clear and concise form the knowledge derived from a perusal of the *larger* text-books.

NOW READY. SECOND EDITION.

AN OPERATION BLANK,

With List of Instruments, etc.,
REQUIRED IN VARIOUS OPERATIONS.

PREPARED BY W. W. KEEN, M.D., LL.D.,
Professor of the Principles of Surgery in the Jefferson Medical College, Philadelphia.

Price per Pad, containing Blanks for 50 Operations, 50 Cents, net.

A convenient blank, suitable for all operations, giving complete instructions regarding necessary preparation of patient, etc., with full list of dressings and medicines to be used.

Saunders' Question Compends.

Now the Standard Authorities in Medical Literature

WITH

Students and Practitioners in every City of the United States and Canada.

THE REASON WHY!

They are the advance guard of "Student's Helps"—that DO HELP; they are the leaders in their special line, *well and authoritatively written by able men, who, as teachers in the large colleges, know exactly what is wanted by a student preparing for his examinations.* The judgment exercised in the selection of authors is fully demonstrated by their professional elevation. CHOSEN FROM THE RANKS OF DEMONSTRATORS, QUIZ-MASTERS, AND ASSISTANTS, MOST OF THEM HAVE BECOME PROFESSORS AND LECTURERS IN THEIR RESPECTIVE COLLEGES.

Each book is of convenient size (5 by 7 inches), containing on an average 250 pages, profusely illustrated and elegantly printed in clear, readable type, on fine paper.

The entire series, numbering twenty-three subjects, has been kept thoroughly revised and enlarged when necessary, many of them being in their third and fourth editions.

TO SUM UP.

Although there are numerous other Quizzes, Manuals, Aids, etc., in the market, none of them approach the "Blue Series of Question Compends," and the claim is made for the following points of excellence:—

1. Professional standing and reputation of authors.
2. Conciseness, clearness, and standard of text.
3. Size of type, quality of paper and binding.

No. 1.

ESSENTIALS OF PHYSIOLOGY.

By H. A. HARE, M.D.,

Professor of Therapeutics and Materia Medica in the Jefferson Medical College of Philadelphia; Physician to St. Agnes' Hospital and to the Medical Dispensary of the Children's Hospital; Laureate of the Royal Academy of Medicine in Belgium, of the Medical Society of London, etc.; Secretary of the Convention for the Revision of the Pharmacopœia, 1890.

Crown 8vo., 230 pages, numerous illustrations.

Third Edition, revised and enlarged by the addition of a series of handsome plate illustrations taken from the celebrated "Icones Nervorum Capitis" of Arnold.

Price, Cloth, $1.00 net. Interleaved for notes, $1.25 net.

"Dr. Hare has admirably succeeded in gathering together a series of Questions which are clearly put and tersely answered."—*University Medical Magazine.*

No. 2.

ESSENTIALS OF SURGERY.

CONTAINING, ALSO,

Venereal Diseases, Surgical Landmarks, Minor and Operative Surgery, and a Complete Description, together with full illustrations, of the Handkerchief and Roller Bandage.

By EDWARD MARTIN, A.M., M.D.,

Clinical Professor of Genito-Urinary Diseases, Instructor in Operative Surgery, and Lecturer on Minor Surgery, University of Pennsylvania; Surgeon to the Howard Hospital; Assistant Surgeon to the University Hospital, etc. etc.

Fifth edition. Crown 8vo., 334 pages, profusely illustrated.

Considerably enlarged by an Appendix containing full directions and prescriptions for the preparation of the various materials used in ANTISEPTIC SURGERY; also several hundred recipes covering the medical treatment of surgical affections.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"Dr. Martin has admirably succeeded in selecting and retaining just what is necessary for purposes of examination, and putting it in most excellent shape for reference and memorizing."—*University Medical Magazine.*

No. 3.

ESSENTIALS OF ANATOMY,

Including the Anatomy of the Viscera.

BY CHARLES B. NANCREDE, M.D.,

Professor of Surgery and Clinical Surgery in the University of Michigan, Ann Arbor;
Corresponding Member of the Royal Academy of Medicine, Rome, Italy;
Late Surgeon Jefferson Medical College, etc. etc.

Fourth edition. Crown 8vo., 380 pages, 180 illustrations.

Enlarged by an Appendix containing over Sixty Illustrations of the Osteology of the Human Body.

The whole based upon the last (eleventh) edition of GRAY'S ANATOMY.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"Truly such a book as no student can afford to be without."—*American Practitioner and News,* Louisville, Kentucky.

No. 4.

Essentials of Medical Chemistry

ORGANIC AND INORGANIC.

CONTAINING, ALSO,

Questions on Medical Physics, Chemical Physiology, Analytical Processes, Urinalysis, and Toxicology.

BY LAWRENCE WOLFF, M.D.,

Demonstrator of Chemistry, Jefferson Medical College; Visiting Physician to German
Hospital of Philadelphia; Member of Philadelphia College of Pharmacy, etc. etc.

Fourth and revised edition, with an Appendix. Crown 8vo., 212 pages.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"We could wish that more books like this would be written, in order that medical students might thus early become more interested in what is often a difficult and uninteresting branch of medical study."—*Medical and Surgical Reporter.*

"The author is thoroughly familiar with his subjects. A useful addition to the medical and pharmaceutical library."—*Registered Pharmacist,* Chicago.

No. 5.

ESSENTIALS OF OBSTETRICS.

By W. EASTERLY ASHTON, M.D.,

Professor of Gynæcology in the Medico-Chirurgical College of Philadelphia; Obstetrician to the Philadelphia Hospital.

Third Edition, thoroughly revised and Enlarged.

Crown 8vo., 244 pages, 75 illustrations.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"An excellent little volume containing correct and practical knowledge. An admirable compend, and the best condensation we have seen."—*Southern Practitioner.*

"Ashton's Obstetrics. Of extreme value to students, and an excellent little book to freshen up the memory of the practitioner."—*Chicago Medical Times.*

"A work thoroughly calculated to be of service to students in preparing for examination."—*Medical and Surgical Reporter.*

"Ashton's Obstetrics should be consulted by the medical student until he can answer every question at sight. The practitioner would also do well to glance at the book now and then, to prevent his knowledge from getting rusty."—*New York Medical Abstract*

No. 6.

ESSENTIALS OF Pathology and Morbid Anatomy.

BY

C. E. ARMAND SEMPLE, B.A., M.B., Cantab., L.S.A., M.R.C.P., Lond.,

Physician to the Northeastern Hospital for Children, Harkney; Professor of Vocal and Aural Physiology and Examiner in Acoustics at Trinity College, London, etc. etc.

Crown 8vo., illustrated, 174 pages.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"An excellent compend of the subject from the points of view of Green and Payne."—*Indiana Medical Journal.*

"A valuable little volume—truly a *multum in parvo.*"—*Cincinnati Medical News.*

No. 7.

ESSENTIALS OF MATERIA MEDICA, THERAPEUTICS, AND PRESCRIPTION WRITING.

By HENRY MORRIS, M.D.,
Late Demonstrator, Jefferson Medical College; Fellow College of Physicians, Philadelphia; Co-editor Biddle's Materia Medica; Visiting Physician to St. Joseph's Hospital, etc. etc.

Second Edition. Crown 8vo., 250 pages.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"One of the best compends in this series. Concise, pithy, and clear, well suited to the purpose for which it is prepared."—*Medical and Surgical Reporter.*

"The very essence of Materia Medica and Therapeutics boiled down and presented in a clear and readable style."—*Gaillard's Medical Journal.*

"A well-arranged quiz-book, comprising the most important recent remedies."—*Sanitarium,* New York.

"The subjects are treated in such a unique and attractive manner that they cannot fail to impress the mind and instruct in a lasting manner."—*Buffalo Medical and Surgical Journal.*

Nos. 8 and 9.

Essentials of Practice of Medicine.

By HENRY MORRIS, M.D.,
Author of "Essentials of Materia Medica," etc. etc.

With an Appendix on the Clinical and Microscopical Examination of Urine.

By LAWRENCE WOLFF, M.D.,
Author of "Essentials of Medical Chemistry," etc.

Colored (Vogel) Urine Scale and numerous fine Illustrations.

Third Edition, enlarged by some THREE HUNDRED Essential Formulæ, selected from the writings of the most eminent authorities of the Medical Profession.

COLLECTED AND ARRANGED BY WILLIAM M. POWELL, M.D.,
Author of "Essentials of Diseases of Children."

Post 8vo., 460 pages. Price, Cloth, $2.00. Medical Sheep, $2.50.

"Of material aid to the advanced student in preparing for his degree, and to the young practitioner in diagnosing affections or selecting the proper remedy."—*Southern Practitioner.*

"The teaching is sound, the presentation graphic, matter as full as might be desired, and the style attractive."—*American Practitioner and News.*

No. 10.

ESSENTIALS OF GYNÆCOLOGY.

By EDWIN B. CRAGIN, M.D.,
Attending Gynæcologist, Roosevelt Hospital, Out-Patients' Department;
Assistant Surgeon, New York Cancer Hospital, etc. etc.

SECOND EDITION.

Crown 8vo., 186 pages, 58 fine illustrations.

Price, Cloth, $1.00. Interleaved for Notes, $1.25

"This is a most excellent addition to this series of question compends, and properly used will be of great assistance to the student in preparing for examination. Dr. Craigin is to be congratulated upon having produced in compact form the Essentials of Gynæcology. The style is concise, and at the same time the sentences are well rounded. This renders the book far more easy to read than most compends, and adds distinctly to its value."—*Medical and Surgical Reporter.*

"Students and practitioners, general or special, even derive information and benefit from the perusal and study of a carefully written work like this."—*College and Clinical Record.*

No. 11.

Essentials of Diseases of the Skin.

By HENRY W. STELWAGON, M.D.,
Clinical Lecturer on Dermatology in the Jefferson Medical College, Philadelphia;
Physician to the Skin Service of the Northern Dispensary; Dermatologist
to Philadelphia Hospital; Physician to Skin Department of the
Howard Hospital; Clinical Professor of Dermatology in
the Woman's Medical College, Philadelphia, etc. etc.

SECOND EDITION.

Crown 8vo., 262 pages, 74 illus., many of which are original

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"We are indebted to Philadelphia for another excellent book on Dermatology. The little book now before us is well entitled 'Essentials of Dermatology,' and admirably answers the purpose for which it is written. The experience of the reviewer has taught him that just such a book is needed. We are pleased with the handsome appearance of the book, with its clear type, good paper, and fine woodcuts."—*New York Medical Journal.*

No. 12.

ESSENTIALS OF

Minor Surgery, Bandaging,

AND

Venereal Diseases.

BY EDWARD MARTIN, A.M., M.D.,
Author of "Essentials of Surgery," etc.

SECOND EDITION, REVISED AND ENLARGED.

Crown 8vo., 158 pages, 78 illustrations, mostly specially prepared for this work.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"The best condensation of the subjects of which it treats yet placed before the profession. The chapter on Genito-Urinary Diseases, though short, is sufficiently complete to make them thoroughly acquainted with the most advanced views on the subject."—*Medical News*, Philadelphia.

No. 13.

ESSENTIALS OF

Legal Medicine, Toxicology, and Hygiene.

BY C. E ARMAND SEMPLE, M.D.,
Author of "Essentials of Pathology and Morbid Anatomy."

Crown 8vo., 212 pages, 130 illustrations.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"At the present time, when the field of medical science, by reason of rapid progress, becomes so vast, a book which contains the essentials of any branch or department of it, in concise, yet readable form, must of necessity be of value. This little brochure, as its title indicates, covers a portion of medical science that is to a great extent too much neglected by the student, by reason of the vastness of the entire field and the voluminous amount of matter pertaining to what he deems more important departments. The leading points, the essentials, are here summed up systematically and clearly."—*Southern Practitioner*, Nashville.

"A fair sample of Saunders' valuable compends for the student and practitioner It is handsomely printed and illustrated, and concise and clear in its teachings."—*Medical Brief*, St. Louis.

No. 14.

ESSENTIALS OF

Refraction and Diseases of the Eye.

By EDWARD JACKSON, A.M., M.D.,
Professor of Diseases of the Eye in the Philadelphia Polyclinic and College for Graduates in Medicine, etc. etc.

AND

Essentials of Diseases of the Nose and Throat.

By E. BALDWIN GLEASON, M.D.,
Surgeon in charge of the Nose, Throat, and Ear Department of the Northern Dispensary; Assistant in the Ear Department of the Philadelphia Polyclinic and College for Graduates in Medicine, etc. etc.

Two vols. in one, crown 8vo., 268 pages, profusely illustrated.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"A valuable book to the beginner in these branches, to the student, to the busy practitioner, and as an adjunct to more thorough reading. The authors are capable men, and as successful teachers know what a student most needs."—*New York Medical Record.*

No. 15.

ESSENTIALS OF

DISEASES OF CHILDREN.

By WILLIAM M. POWELL, M.D.,
Attending Physician to the Mercer House for Invalid Women, at Atlantic City, N. J.; Late Physician to the Clinic for the Diseases of Children in the Hospital of the University of Pennsylvania and St. Clement's Hospital, etc. etc.

CROWN 8vo., 216 PAGES.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"This work is gotten up in the clear and attractive style that characterizes the Saunders' Series. It contains in appropriate form the gist of all the best works in the department to which it relates."—*American Practitioner and News*, Louisville, Ky.

"Dr. Powell's little book is a marvel of condensation. Handsome binding, good paper, and clear type add to its attractiveness."—*Southern Practitioner*, Nashville, Tenn.

"The book contains a series of important questions and answers, which the student will find of great utility in the examination of children."—*Annals of Gynæcology*, Philadelphia.

No. 16.

ESSENTIALS OF

EXAMINATION OF URINE.

BY LAWRENCE WOLFF, M.D.,
Author of "Essentials of Chemistry," etc.

COLORED (VOGEL) URINE SCALE AND NUMEROUS ILLUSTRATIONS.

Crown 8vo. Price, Cloth, 75 Cents.

"A little work of decided value."—*University Medical Magazine.*

"A good manual for students, well written, and answers, categorically, many questions beginners are sure to ask."—*Medical Record*, New York.

"The book is practical in character, comprehensive as is desirable, and a useful aid to the student in his studies."—*Memphis Medical Monthly*, Memphis, Tenn.

No. 17.

ESSENTIALS OF DIAGNOSIS.

BY SOLOMON SOLIS COHEN, M.D.,
Professor of Clinical Medicine and Applied Therapeutics in the Philadelphia Polyclinic,

AND

AUGUSTUS A. ESHNER, M.D.,
Instructor in Clinical Medicine, Jefferson Medical College, Philadelphia.

Post 8vo., 382 pages. 55 Illustrations, some of which are Colored, and a Frontispiece.

Price, $1.50 net.

"A good book for the student, properly written from their standpoint, and confines itself well to its text."—*Medical Record*, New York.

"Concise in the treatment of the subject, terse in expression of fact. . . The work is reliable, and represents the accepted views of clinicians of to-day."—*American Journal of Medical Sciences.*

"The subjects are explained in a few well-selected words, and the required ground has been thoroughly gone over."—*International Medical Magazine.*

"We can heartily recommend this work; it is modern and complete, and will give more satisfaction than many other works which are perhaps too prolix as well as behind the times."—*Medical Review*, St. Louis.

No. 18.

ESSENTIALS OF

PRACTICE OF PHARMACY.

BY LUCIUS E. SAYRE,

Professor of Pharmacy and Materia Medica in the University of Kansas.

Crown 8vo., 171 pages.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"Covers a great deal of ground in small compass. The matter is well digested and arranged. The research questions are a valuable feature of the book."—*Albany Medical Annals*, Albany, N. Y.

"This very valuable little manual covers the ground in a most admirable manner. It contains practical pharmacy in a nutshell."—*American Doctor*, Richmond, Va.

"The best quiz on pharmacy we have yet examined."—*National Drug Register*, St. Louis, Mo.

"A book of only 180 pages, but pharmacy in a nutshell. It is not a quiz-compend compiled to enable a grocery clerk to 'down' a board of pharmacy; it is a finger-post guiding a student to a completer knowledge."—*Western Drug Record.*

No. 20.

Second and Revised Edition.

ESSENTIALS OF BACTERIOLOGY.

A CONCISE AND SYSTEMATIC INTRODUCTION TO THE STUDY OF MICRO-ORGANISMS.

BY M. V. BALL, M.D.,

Assistant in Microscopy, Niagara University, Buffalo, N. Y.; Late Resident Physician German Hospital, Philadelphia, etc.

Crown 8vo., 150 pp. 77 Illus. and five Plates, some in Colors.

Price, Cloth, $1.00. - - Interleaved for Notes, $1.25.

"The amount of material condensed in this little book is so great, and so accurate are the formulæ and methods, that it will be found useful as a laboratory hand-book."—*Medical News*, Philadelphia.

"Bacteriology is the keynote of future medicine, and every physician who expects success must familiarize himself with a knowledge of Germ-life—the agents of disease.

"This little book with its beautiful illustrations will give the students, in brief, the results of years of study and research unaided."—*Pacific Record of Medicine and Surgery*, San Francisco.

No. 21.

ESSENTIALS OF

Nervous Diseases and Insanity.

THEIR

SYMPTOMS AND TREATMENT.

By JOHN C. SHAW, M.D.,

Clinical Professor of Diseases of the Mind and Nervous System, Long Island College
Hospital Medical School; Consulting Neurologist to St. Catharine's Hospital,
and Long Island College Hospital; Formerly Medical Superintendent King's County Insane Asylum.

SECOND EDITION.

Crown 8vo., 186 pages. 48 Original Illustrations.

Mostly selected from the Author's private practice.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"Clearly and intelligently written."—*Boston Medical and Surgical Journal.*

"A valuable addition to this series of compends, and one that cannot fail to be appreciated by all physicians and students."—*Medical Brief*, St. Louis.

"Dr. Shaw's Primer is excellent as far as it goes, the illustrations are well executed and very interesting."—*Times and Register*, New York and Philadelphia.

No. 22.

ESSENTIALS OF PHYSICS.

By

FRED. J. BROCKWAY, M.D.,

Assistant Demonstrator of Anatomy at the College of Physicians and Surgeons, New York.

Crown 8vo., 320 pages, 155 fine illustrations.

Price, Cloth, - - - - - - $1.00 net.
Interleaved for Notes, - - - - $1.25 net.

"The publisher has again shown himself as fortunate in his editor as he ever has been in the attractive style and make-up of his compends."—*American Practitioner and News*, Louisville, Ky.

"Contains all that one need know of the subject, is well written, and is copiously illustrated."—*Medical Record*, New York.

"The author has dealt with the subject in a manner that will make the theme not only comparatively easy, but also of interest."—*Medical News*, Philadelphia.

No. 23.

Essentials of Medical Electricity.

By D. D. STEWART, M.D.,

Demonstrator of Diseases of the Nervous System and Chief of the Neurological Clinic in the Jefferson Medical College; Physician to St. Mary's Hospital, and to St. Christopher's Hospital for Children, etc.

AND

E. S. LAWRANCE, M.D.,

Chief of the Electrical Clinic and Assistant Demonstrator of Diseases of the Nervous System in the Jefferson Medical College, etc.

Crown 8vo., 148 pages, 65 illustrations.

Price, Cloth, $1.00. Interleaved for Notes, $1.25.

"Clearly written, and affords a safe guide to the beginner in this subject."—*Medical and Surgical Journal*, Boston.

"The subject is presented in a lucid and pleasing manner."—*Medical Record*, New York.

"A little work on an important subject, which will prove of great value to medical students and trained nurses who wish to study the scientific as well as the practical points of electricity."—*The Hospital*, London, England.

In Preparation. Ready Shortly.

A DOSE BOOK

AND

Manual of Prescription Writing.

By E. Q. THORNTON, M.D.,

Demonstrator of Therapeutics, Jefferson Medical College, Philadelphia.

The volume, in size and general appearance, will be uniform with "Saunders' Pocket Medical Formulary."

IN PREPARATION.

METHODS
OF
PREVENTING AND CORRECTING DEFORMITIES OF THE BONES AND JOINTS.

A Handbook of Practical Orthopedic Surgery.

By H. AUGUSTUS WILSON, M.D.,

PROFESSOR OF GENERAL AND ORTHOPEDIC SURGERY, PHILADELPHIA POLYCLINIC; CLINICAL PROFESSOR OF ORTHOPEDIC SURGERY, JEFFERSON MEDICAL COLLEGE, PHILADELPHIA, ETC., ETC.

The aim of the author will be to provide a book of moderate size containing comprehensive details that will enable general practitioners to thoroughly understand the mechanical features of the many forms of congenital and acquired deformities of the bones and joints.

Such a book might well be called Orthopedic Therapeutics, as it will adopt as a basis the description, symptoms, signs, and diagnosis upon which to elaborate the appropriate details of treatment.

The mechanical functions that are impaired will be considered first as to prevention, as of primary importance, and following this will be described the methods of correction that have been proved practical by the author. Operative procedures will be considered from a mechanical standpoint as well as surgically. Prominence will be given to the mechanical requirements for braces and artificial limbs, etc., with description of the methods for constructing the simplest forms, whether made of plaster of Paris, felt, leather, paper, steel, or other materials, together with the methods of readjustment to suit the changes occurring during the progress of the case.

An important feature of the book will be the practical application of remedial gymnastics and movements in the prevention or recovery of lost mechanical functions of the muscles when they have produced or tend to produce bone or joint deformities.

A very large number of original illustrations will be used to make descriptions clearer. The elimination of theoretical matters still in doubt will make the book one of practical value to busy physicians, from whom such cases generally receive first attention, and by whom they may be successfully treated.

IN PREPARATION.

A

DOSE MANUAL

PRES

Demons

The te

a sma up

to da

tion

G

part

mad

liab

will be uniform with

Formulary."