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Part I

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A TREATISE ON

MATERIA MEDICA AND THERAPEUTICS

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A TREATISE ON
MATERIA MEDICA AND THERAPEUTICS

INCLUDING PHARMACY, DISPENSING, PHARMACOLOGY AND ADMINISTRATION OF DRUGS

BY THE LATE

RAKHALDAS GHOSH

TENTH EDITION

BY

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DEDICATED TO THE

PRINCIPAL OF THE CALCUTTA MEDICAL COLLEGE

IN GRATEFUL REMEMBRANCE OF THE

EDUCATION RECEIVED THEREIN

BY AN OLD ALUMNUS

THE AUTHOR

PREFACE TO THE TENTH EDITION

Owing to the retirement of Major General B. H. Deare, who was associated with me as joint editor of the previous editions, the revision of the present edition reverts to me entirely, and I have therefore availed myself of the opportunity to revise the whole text in every detail. Actions of many drugs have been re-written on the basis of recent pharmacological works. The use of Bismuth in Syphilis, Antimony in Leishmaniasis, Quinidine in Auricular Fibrillation, and the action of drugs on the Sympathetic and Para-sympathetic Systems have been discussed. Many non-pharmacopœial drugs and preparations of less value have been eliminated, and special articles on Vitamins, Punarnava (*Bœrhaavia diffusa*), Carbon Tetrachloride and Insulin have been added. To facilitate reference the doses of the United States Pharmacopœia have been given whenever such exist.

In the revision of this edition I have received valuable help from most of the recent works, including the new editions of Martindale and Westcott's Extra Pharmacopœia and the British Pharmaceutical Codex; and I am particularly indebted to Professors Cushny, Clark, Dixon and Sollmann, whose standard works I have consulted freely.

I am also grateful to Dr. Santosh Kumar Mukerji, M.B., for kindly revising the proofs and thus helping me in my labours.

Calcutta, 1925

B. N. GHOSH

PREFACE TO THE FIRST EDITION

MATERIA MEDICA is not an attractive subject, but it must be learnt. I have therefore endeavoured to minimise the labour of the student by condensing the subject-matter, and treating the same on simple methods.

Drugs have been alphabetically arranged in order to maintain harmony with the British Pharmacopœia of 1898, and many useful subjects have been introduced. Particular attention has been paid to the description of the non-official preparations, of pharmacy, and of dispensing, with a view to enable the student to overcome the difficulties he encounters in practical pharmacy and dispensing. In compiling this portion I have consulted most of the standard treatises on these subjects, and have received valuable assistance from Whitla's "Elements of Pharmacy, Materia Medica and Therapeutics," Martindale's "Extra Pharmacopœia," Squire's "Companion to the British Pharmacopœia," Lucas's "Practical Pharmacy," and MacEwan's "Art of Dispensing and Pharmaceutical Formulas." The classification of drugs according to their pharmacology and therapeutics has been so nicely made by Dr. Hale-White that I could not resist the temptation of adopting his plan with some modification, and for this I express my acknowledgments to him. Besides the authors already alluded to, I am grateful to many others, especially to Drs. T. Lauder Brunton, J. Mitchell Bruce, William Murrell, and Sydney Ringer.

I have spread no pains to make the treatise thoroughly reliable, and up to date. I thank many of my friends for their valuable advice and encouragement, especially Professor Thomas R. Fraser of Edinburgh.

R. GHOSH

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MATERIA MEDICA

PART I

MATERIA Medica in its widest sense, means the description of *materials or agents* employed in the treatment of disease. But properly speaking, it includes the following branches :—

1. **Materia Medica Proper** is the science which treats of the natural history, as well as the physical and chemical characters, of drugs.

2. **Pharmacy** is the science and art of preparing and combining drugs, so as to make them fit for administration. It can be divided again as follows :—

(*a*) **Extemporaneous Pharmacy** is the making up or the compounding of formulæ or prescriptions of medical practitioners. **Dispensing** refers to the mode of putting up, labelling, and despatching.

(*b*) **Official Pharmacy** consists in the preparation of drugs and formulæ according to such processes as are recognised by, or prescribed in, an official pharmacopœia. The British Pharmacopœia is the official pharmacopœia of the British Empire.

3. **Pharmacology** is the science which describes the actions of drugs on the general system, or on the individual parts of the body, in health. **Pharmacodynamics** is but another name for Pharmacology.

Toxicology or the toxic action of medicines comes under Pharmacology. It treats of the actions of drugs when given in doses large enough to endanger life.

4. **Therapeutics** relates to the remedial measures employed in the treatment of disease. It may be either **empirical** or **rational.**

(*a*) **Empirical Therapeutics** means the treatment of disease from experience only, and conforms to no pharmacological law yet known. In empirical treatment no explanation can be given for the success or otherwise of the use of a ***particular drug*** for a ***particular disease.*** We merely prescribe a certain

drug because it has been found successful in a certain disease. A familiar example is the use of colchicum in gout. With our improved knowledge on the actions of drugs and the pathology of the diseases, we can explain the actions of many drugs that were used empirically before. Thus we can explain the action of mercury in syphilis which was formerly used purely empirically.

(*b*) **Rational Therapeutics.**—By rational treatment we mean a mode of treatment suggested by our knowledge of the chemistry, physiology, pathology, and pharmacology of a given drug. Thus, when we prescribe $\frac{1}{100}$ gr. of atropine sulphate to check the night-sweats of phthisis we can explain (*see* Belladonna) how the perspiration is controlled. The use of chloral hydrate for checking tetanic convulsions and of digitalis for the cure of cardiac dropsies are other instances of rational therapeutics.

Accessory Therapeutics.—By accessory therapeutics is meant the treatment of disease, not by administration of drugs, but by other methods; such as, **change of climate, regulation of food, clothing, exercise, baths, massage,** and the like.

MATERIA MEDICA PROPER

DRUGS

By "crude drug" is meant the commercial forms of the animal or vegetable drugs as are brought to the market and utilised for the preparation of different medicinal products. Their value depends upon the presence of more or less definite chemical bodies known as "active constituents." These constituents are found in different parts of the plant, so that the particular part is used as the crude drug. Sometimes however they are found in all parts of the plant. In other instances no part of the plant is used as crude drugs; for instance *aloe*, where the juice of the leaves contains the active constituent and forms the crude drug.

A. **Source.**—Drugs may be divided, according to their source, into the following groups:—

1. *Inorganic.*—As sulphur, ozone, mineral acids, ammonia, etc.

2. *Metallic.*—As iron, copper, silver, bismuth, zinc, etc.

3. *Organic.*—(*a*) From the **vegetable kingdom** are obtained aconite, hyoscyamus, opium, etc.; (*b*) from the **animal kingdom,** cantharidin, cod-liver oil, etc.

4. *Synthetic.*—As chloroform, chloral, ether, amyl nitrite, etc. These are prepared synthetically in a chemical labora-

tory. Some of these drugs are gradually replacing organic ones ; thus, the synthetic salicylic acid is being used for the natural salicylic acid derived from the oil of wintergreen.

B. **Habitat.**—By habitat is meant the natural abode or locality of a plant or animal from which a drug is obtained. In other words, the drug is said to be **indigenous** to the said country or locality. Thus, Indian Hemp is indigenous to India, Aloes to Socotra or Barbados, Aconite to Britain, Quassia to Mexico, Ipecacuanha to Brazil, etc.

C. **Collection.**—The medicinal activity of a drug depends greatly upon the habitat and the season of the year when it is gathered. Thus, rhubarb is useless until it is six years old. China and Turkey rhubarb are richer than those grown in India. The old cinchona bark is richer in quinine than the new. The wild digitalis is more active than the cultivated variety.

CHARACTERS OF DRUGS

This part of Materia Medica is the most useful, but the least interesting to a student. To learn characters direct from a book is a useless waste of time and energy as the student is sure to forget them. He should therefore **study them practically from specimens,** and describe them in his own words. The following points are worthy of note :—

A. **Physical.**—Taking the B.P. or a text-book as his guide, the student should carefully examine each specimen with respect to the following :—

1. **General appearance.**—Whether it is (*a*) *solid*, (*b*) *liquid*, or (*c*) *a powder*. If solid, its *shape*, *length*, *thickness*, *consistence*, etc. If a powder, whether *amorphous* or *crystalline*. If crystalline, the nature of the crystals.

2. **Colour.**—Whether it is *yellow*, like sulphur ; *white*, like quinine ; *red*, like mercuric iodide ; *black*, like charcoal ; *grey*, like grey-powder ; *blue*, like copper sulphate ; *green*, like oil of cajuput ; or colourless, like ether ; and so on.

3. **Weight.**—Whether it is *heavy* as litharge, or *light* as magnesia. Specific gravity of liquid drugs.

4. **Odour** is very difficult to define. B.P. has used various comparative terms in describing it. Thus, *fishy*, like cod-liver oil ; *aromatic*, like caraway fruit or cardamom seeds ; *fragrant*, like rose ; *disagreeable*, like iodoform ; *characteristic*, when it cannot be defined or compared, as opium ; and so on. The smells of some drugs are so characteristic, that they can be easily recognised by their odour alone ; as ammonia, ether, chloroform, acetic acid, hydrocyanic acid, carbolic acid, creosote, asafetida, iodoform, amyl nitrite, opium, valerian, many essential oils, etc.

5. **Taste** also is not easy to define. The article may be *sweet*, like sugar ; *acid*, like sulphuric acid dilute or vinegar ; *fishy*, like cod-liver oil ; *saline*, like common salt ; *bitter*, like chirata or quinine sulph. ; *pungent*, like mustard or capsicum ; *acrid*, like balsam of Peru ; *astringent*, like kino or tannic acid ; *nauseous*, like aloes ; *metallic*, like corrosive sublimate ; and so on. Sometimes more than one term is used to denote taste. Thus, lead acetate has a sweet astringent taste, and copaiba a persistent acrid, somewhat bitter taste.

6. **Solubility.**—The knowledge of the solubility of drugs is essential to every medical man without which no prescription can be elegant and free from incompatibility. A drug may be soluble in cold water, or insoluble in cold but soluble in hot or boiling water. It may not be soluble in water at all, but soluble in alcohol, chloroform, ether, oil or glycerin. No rule can be laid down as to the solubility of drugs, except this simple one ; that, *nearly all alkaline salts, and all normal neutral metallic nitrates, chlorates and acetates are soluble in water ; vegetable alkaloids are mostly insoluble.*

Some drugs absorb water when exposed to air and liquefy ; these are said to be **deliquescent** ; as, potassium hydroxide, potassium acetate, and calcium chloride. On the other hand, many lose their water of crystallisation, and a white powdery crust forms on their surface ; as, ammonium and sodium carbonates. These are said to be **efflorescent.**

B. **Chemical Tests.**—The students must be familiar with the tests for the (1) *salts*, (2) *acids*, and (3) any special test for a *compound.* The chemical reactions of some of the *organic bodies* such as morphine, strychnine, etc., should not be lost sight of.

COMPOSITION OF DRUGS

Inorganic drugs have a definite composition which is well expressed by their names and chemical formulæ. The composition of organic drugs, on the other hand, is always complex and is ascertained after considerable analytical labour. They consist chiefly of acids, bases, salts, albuminous substances, alkaloids, balsams, cellulose, colouring-matters, extractive matters, ferments, glucosides, gums, gum-resins, neutral principles, fixed and volatile oils, oleo-resins, starch, sugar, etc. Some of them require a brief explanation.

Alkaloids are the active nitrogenous principles formed for the most part in the tissues of plants or animals. They may occasionally be prepared synthetically, According to Hale White, their characteristics are as follows :—

" (1) They are the active nitrogenous principles of organid bodies.

" (2) They are compound ammonias : that is to say, one or more atoms of hydrogen in ammonia (NH) are replaced by various radicals.

" (3) They combine with acids to form crystalline salts without the production of water.

" (4) They are alkaline, turning red litmus paper blue.

" (5) Very few are liquid, such as pilocarpine, coniine, nicotine, sparteine, lobeline. Liquid alkaloids nearly always contain only carbon, hydrogen and nitrogen.

" (6) The solid ones are colourless, crystalline, and contain oxygen.

" (7) They are sparingly soluble in water, readily so in alcohol.

" (8) The solutions are intensely bitter.

" (9) Most of them are closely related to pyridine, and some may be synthetically prepared from pyridine bases."

The following are the common pure alkaloids of the B.P. :—

Aconitine	Codeine	Physostigmine
Atropine	Hyoscyamine	Quinine
Caffeine	Morphine	Pelletierine
Cocaine	Pilocarpine	Strychnine

It should be noted that the names of alkaloids in Latin terminate in **ina,** and in English **ine.** As *Atropina* (Latin), *Atropine* (English).

Vegetable alkaloids occur in almost all parts of plants, but are most abundant in the seeds and roots, especially of dicotyledonous plants. A few are found in the lower plants, e.g., muscarine and ergotoxine. *Bases* found in the animal kingdom are commonly known as leukomains and ptomains. The former are produced by the body cells and are products of metabolism, e.g., *adrenalin*, while the latter result from microbic decomposition of dead material, especially the amino-acids. These *bases* are known as **amines,** and are derived from ammonia by replacing H by alkyl groups.

Some plants contain many alkaloids, *e.g.* cinchona, in others one alkaloid is found in one part of the plant and another in a different part of the same plant.

Alkaloids are also prepared artificially, *e.g.* theophylline, suprarenin.

Incompatibles.—(*a*) alkalies, which precipitate the less soluble pure alkaloid.

(*b*) Tannin, forming insoluble tannates.

(*c*) Iodides and bromides, forming insoluble iodides or bromides, or double salts, etc.

(*d*) Mercuric chloride, forming insoluble double salt.

Acids are salts of hydrogen. Numerous organic acids are found in plants, either in combination with inorganic bases such as potassium or calcium, or in a free state.

Bases are substances which react with acids and form salts. They are of two kinds :—1. *Elementary*, to which metals belong. 2. *Compound*, such as ammonium and the alkaloids.

Glucosides are crystalline compounds found in plants and liberate sugar which is often glucose. They contain carbon, hydrogen and oxygen, a few have nitrogen in addition, and one or two sulphur. They differ greatly in their solubility in water and alcohol, being mostly insoluble in ether. Some are powerful poisons while others are almost inert. Salicin, saponin jalapin, digitalin, digitoxin, senegin, strophanthin, glycyrrhizin, are some of the glucosides.

Saponins are non-nitrogenous substances generally glucosides, which emulsify oils and lake red blood-cells. They are neutral in reaction and form froth when mixed with water. They have the general formula $C_n H_{2n-8} C_{10}$. The toxic ones are known as **sapotoxins.**

Neutral Principles are indifferent crystalline proximate principles whose chemical composition is not known. They resemble alkaloids in action. Many of them have a bitter taste, as quassin, and are called " *amroids or bitter principles.*" As aloin, santonin, picrotoxin, quassin, etc.

Note.—Whereas the names of all alkaloids end in " *ine*," those of glucosides and neutral principles end in " in."

Balsams.—These are oleo-resins or resins containing either benzoic or cinnamic acid or both. *Benzoin*, *balsam of Peru* and *tolu*, *prepared storax*, are the balsams of the B.P. Copaiba and canada balsam do not come under this group, though they are named balsams.

Oils are of two kinds. A. Fixed, and B. Volatile or essential oils.

A. **Fixed Oils** and **Fats** are mixtures of olein (liquid), palmitin (semisolid) and stearin (solid), with small amount of other bodies in addition. With alkalies they form soap and glycerin, *e.g.*, castile soap, which is made by the action of sodium hydroxide on olive oil, which is practically pure olein, thus :—

$$C_3H_5(C_{18}H_{33}O_2)_3 + 3NaOH = C_3H_5(OH)_3 + 3NaC_{18}H_{33}O_2.$$

Oleate of Glyceryl or Olein (Vegetable oil)	(Caustic soda)	Hydrate of Glyceryl (Glycerin)	Oleate of Sodium (Hard soap)

This process is known as saponification.

Fats differ from the oils only in the relative proportions of these basal ingredients, the fats having more of the stearin and palmitin, making them solid or semi-solid, and the oils more of the liquid olein. They are

(*a*) non-volatile, and so leave a permanent grease spot ;

(*b*) they cannot be distilled ; and

(*c*) under the influence of heat decompose and become rancid.

A few of the fats and oils are of animal origin, *e.g.*, butter, lard, suet and cod-liver oil, but the majority are of vegetable origin, as almond, linseed, olive, castor oils and cocoa butter.

Castor oil and croton oil differ from the others in being soluble in alcohol and in possessing cathartic properties.

Waxes are of firmer consistence than the fats, have a higher melting point, and cannot be saponified by boiling with an alkali.

B. **Volatile Oils.**—As plants often owe their characteristic odour to these oils they are often spoken of as *essential* oils. The following are the differences between them and the fixed oils :—

(*a*) They are volatile and can be distilled, and do not leave a permanent grease spot.

(*b*) They do not form soaps with alkalies.

(*c*) They do not become rancid, but tend to resinify on exposure to light and air ; and

(*d*) They are sufficiently soluble in water to impart to it their taste and odour.

Some of the volatile oils which are non-existent in the living plants are formed either by destructive distillation or by the action of ferments on glucosides in the presence of water. The former are spoken of as **Empyreumatic Oils.**

Bastedo has conveniently grouped the volatile oils as follows :—

A. Existing in plant as such :	1. Terpenes, C_xH_x (oils of turpentine, juniper, etc.). 2. Terpenes + stearoptenes (oils of lemon, peppermint, etc.).
B. Not existing in plant as such, but developed from plant constituents :	3. From enzyme action (oil of mustard). 4. Empyreumatic oils (oil of cade, oil of tar, creosote).

In group 2 we have a mixture of terpene holding in solution oxygenated bodies of variable chemical nature. The terpene portion is spoken of as *eleoptene*, the oxygenated portion as *stearoptene*. This stearoptene can be separated from the eleoptene by cold or fractional distillation, and are usually solid. They are therefore oxidised hydrocarbons of a crystalline nature, or solid volatile oils. The best known examples of stearoptenes are camphor, menthol and thymol.

Gums are complex carbohydrates having a viscid consistence. They are exudations from the stems, or branches, or both, of plants, and are composed of :

(1) *Arabin*, soluble in water ; as gum arabic.

(2) *Bassorin*, partially soluble in water ; as tragacanth.

(3) *Cerasin*, or insoluble gum.

Pectin or vegetable jelly occurs in some medicinal plants and is allied to gum.

Resins are solid, brittle, non-volatile, complex substances derived from the oxidation of volatile oils. They are soluble in alkalies forming resin soaps, and in alcohol, but insoluble in water. The resins of the B.P. are resin, guaiacum, jalap, scammony, and podophyllin. When they are found dissolved in volatile oils they are known as **oleo-resins**, *e.g.*, copaiba, canada turpentine. Sometimes they are found in combination with gums and volatile oils, and are then known as **gum-resins.** They form emulsions when mixed with water ; ammoniacum and asafetida are examples of gum-resins.

Salts are compounds of acids and bases.

IMPURITIES OF DRUGS

The impurities in a drug arise from various causes, as follows :—

1. **Imperfect Selection.**—This is due to the ignorance of collectors of crude vegetable drugs, who are imperfectly acquainted with their botanical characters, and therefore fail to distinguish them from allied species ; hence the **substitution** of an inferior or allied article for the genuine one. Many B.P. preparations, as ordinarily sold, are prepared from inferior ingredients and therefore do not produce the desired results. This is often the case with cascara sagrada.

2. **Imperfect Preservation** is one of the causes of **deterioration** of many drugs. Several drugs are materially affected by light and air, others by the lapse of time. Deliquescent salts and scale iron preparations quickly undergo physical change unless they are kept in carefully stoppered bottles. Syrup. Ferri Iodidi and Easton's syrup are decomposed by light.

Ergot, unless carefully dried and packed in an air-tight receptacle, soon becomes mouldy and loses strength. All extracts deteriorate unless securely put in sealed pots.

3. **Imperfect Preparation.**—Impurities are of two kinds, (*a*) those which exist in the crude drug, (*b*) those which arise as by-products during the process of manufacture. They can be avoided only by scrupulous care on the part of the manufacturing pharmacist. Tests are the only means of ascertaining the purity of inorganic drugs.

4. **Adulteration** is the intentional and fraudulent admixture of foreign substances with a drug. Many drugs are tampered with by traders. All highly priced drugs are liable to adulteration. Musk is often mixed with catechu, earth, dried blood, etc. Quinine was at one time systematically adulterated, and Murrell mentions that once a large consignment of quinine was sent out to India containing not a trace of cinchona alkaloids. Powders, extracts, and liquid preparations are easily adulterated and should therefore be bought from reliable and respectable manufacturers.

The purity of an **inorganic** drug is ascertained by its chemical **tests,** which the students are expected to be familiar with.

THE BRITISH PHARMACOPŒIA AND PHARMACEUTICAL PROCESSES

By a pharmacopœia is meant a book published under the authority of a recognised body, generally constituted by law, for the purpose of securing uniformity of composition and strength of medicines used in the treatment of disease. The General Medical Council of the United Kingdom, authorised by the Medical Act of 1858, issues and revises from time to time the British Pharmacopœia. The first B.P. was published in 1864, and the last in 1914. One of the principal changes in the present edition is the introduction of the Metric System in the place of Imperial weights and measures. Other countries, as the United States, Germany, France, etc., also publish their own pharmacopœias, but they differ in many respects from the British. Even hospitals have their own special pharmacopœias for speedy dispensing. Although the B.P. is the legal standard, no medical man is bound to follow it.

The processes that are mentioned in the B.P. are called *official* or *officinal.* In the following pages we shall give a brief description of some of these processes. Many of them, such as infusion, maceration, percolation, etc., belong to practical pharmacy, while many others, such as distillation, crystallisation, etc., come within the range of chemistry.

Bruising or **Contusion** is the process by which tough, hard and woody, soft, elastic and juicy substances are smashed or broken up in a roller-mill, or disintegrator, or on a small scale, in an iron mortar, so as to reduce them to a form suitable for being acted upon by a solvent, either by maceration, infusion, or decoction. As belladonna and hyoscyamus leaves, colchicum corms, broom tops, ergot, cloves, krameria root, etc.

Calcination or **Incineration** is the operation by which drugs are exposed to a high temperature in order that watery and volatile matters may be driven off. This is best effected by putting the drugs in a crucible over a furnace. Magnesia and lime are prepared from their carbonates by this process.

Crystallisation is the process by which substances are made to assume the form of crystals. This is effected by (*a*) *evaporation* of a solution containing the substances to be crystallised, as in the case of alum and sulphate of iron ; (*b*) *fusion*, as in the case of certain metals and sulphur ; (*c*) *sublimation*, as in the case of corrosive sublimate ; and (*d*) *precipitation*, as in the case of iodide of mercury.

Decoction is another name for *boiling*.

Decolouration is the process by which we remove the colouring-matters from alkaloidal substances, such as atropine, morphine, etc. This is effected by treating their solutions or mixtures with dried and purified animal charcoal, and subsequent filtration.

Despumation is the process by which an organic fluid is boiled until the impurities rise to the surface as a scum, which is then removed by skimming or straining. Syrups made by this process keep longer.

Dialysis is the process of separating crystalloids from colloids by passing them through an animal membrane. This is the method of preparing dialysed iron which is no longer official.

Digestion is a prolonged maceration at a temperature higher than that of the air.

Distillation is the method by which a liquid is first converted into a vapour by heat, and the vapour is then condensed by cold in another vessel, called a *receiver*. This is effected by a still and condenser. There are two other methods of distillation :—(*a*) **Destructive** or **dry distillation,** in which heat is applied to decompose a substance into volatile products, which did not exist in it originally, and which are then collected in a receiver. Acetic acid, and wood tar are made by this process. (*b*) **Fractional distillation,** in which heat is applied to separate out from a mixture of substances which volatilise at different temperatures.

Elutriation is the process by which a substance is pulverised and mixed with water, the coarser grains falling down to the bottom, while the lighter and finer ones are poured off with

the water into another vessel, where deposition takes place slowly. By this process creta præparata is made. Sometimes impurities, such as sand, gravel, etc., are got rid of by this method.

Expression is the process by which we press out juices and oils from vegetable substances, as in the preparation of succi, or squeeze out the liquid from the marc as in the preparation of tinctures. For this process suitable presses are required.

Filtration means the separation of insoluble matter from a liquid by passing it through calico, flannel, felt or filtering paper. When the solution is bright and clear, the filtration is good ; when muddy, it is bad.

Fusion, Liquefaction or **Melting** is the process by which we melt or liquefy any solid body by heat. This is effected by putting it into a suitable vessel or crucible over a heated furnace, or on a water, steam or sand bath. We employ this process in the preparation of plasters, ointments, suppositories, caustic sticks, etc.

Granulation is the process by which a coarsely crystalline salt is converted into a granular powder by dissolving the former in water, and evaporating the solution to dryness with continuous stirring. Carbonate and citrate of potassium are made in this way, sal ammoniac and nitre, both of which are very difficult to powder, are occasionally treated in a similar fashion.

Infusion is the process of soaking drugs in either hot or cold water. *They must not be boiled.*

Levigation is the pulverisation of a solid in the presence of water, or any other liquid which does not dissolve it ; the finely comminuted particles being gathered with the washings, and allowed to deposit slowly, whilst the coarser particles are again ground with the water or liquid, and so on, until the whole of the solid is reduced to a condition of fine powder. Red precipitate may be thus reduced. It differs from elutriation in this respect, that the refuse or residue is not thrown away.

Lixiviation means the separation of a soluble salt, from a mixed or compound solid, by dissolving the latter in water, decanting the supernatant liquid into another vessel, and evaporating it to dryness, leaving the insoluble residue behind. The solution is called a "*Lye.*" Pearlash is thus prepared from wood ashes.

Maceration is the process of steeping a substance in alcohol, or some similar menstruum without the application of heat, in order to dissolve out its soluble matters. The insoluble residue is called the "*marc.*" Many tinctures are made in this way.

Percolation is the process of extracting soluble matters by filtration of a liquid menstruum through a porous column of

powdered material. A special instrument, called a Percolator, is required.

Scaling is the process by which the scale preparations of drugs are made. It consists in spreading out in a thin layer, the concentrated solution of a drug on a glass, and allowing it to dry. The dried film is then separated and broken up. The scale iron preparations are made by this process.

Sifting is the method by which we separate finer powders from coarser ones, by means of a sieve, which is made of either wire, horse-hair or muslin, of varying degrees of closeness The B.P. directs a drug in No. 5, 10, 20, 30, or 40 powder, and thereby means a degree of disintegration, as represented by the number of parallel wires in either transverse direction contained within the linear inch of a sieve.

When the soft pulp of fruits like figs, baels, prunes or tamarinds is required to be sifted, the operation is called **"pulping"** which requires a great force in squeezing the pulp through the sieve.

Solution.—When a substance is dissolved in a liquid, the process is known as solution. The liquid that dissolves is called, a *solvent*, and the substance so dissolved a *solute*. It is *simple* when the substance can be recovered from the solvent, without any change, and *chemical* when it cannot be so recovered.

Standardisation is the method adopted to obtain a definite uniformity in the strength of certain vegetable preparations containing active or alkaloidal principles, such as the extract of nux vomica, physostigma, strophanthus, etc.

Standardisation of drugs may be accomplished by chemical or pharmacological methods, generally expressed as **pharmaceutical assaying.** This secures a means of measuring therapeutic activity and makes it possible to furnish uniform preparations. Drugs requiring biological assay are not many. Chemical drugs have a definite chemical composition and are standardised by means of chemical assay. This method of standardisation is also utilised for opium, belladonna, nux-vomica, etc., where the active constituents can be isolated in the pure form. But quite a number of drugs and their preparations cannot be assayed by chemical methods, either because their active ingredients are not known, or perhaps they cannot be isolated quantitatively in a pure form by any chemical methods. These are assayed by biological methods. The following are the principal methods :—

1. *Toxic Method.*—Guineapigs, frogs, cats or other animals are generally used, and the value of the drug or preparation is calculated on the amount required to cause the death of the animal.

2. The amount required to produce certain definite effects on the intact animal, *e.g.*, cock's comb method for ergot.

3. The amount required to produce a definite effect on an isolated organ, *e.g.*, effect of ergot or pituitary extract on isolated uterus.

Sublimation is the operation by which a solid is first vaporised by heat, and then the vapour is condensed as a deposit on the surface of another vessel, either *en masse*, in which case it is called a **sublimate,** as corrosive sublimate ; or in a small feathery pulverulent state, known as **flowers,** as flowers of sulphur.

Trituration is the grinding of solids into powders. All salts and crystalline bodies are best powdered in a wedge-wood mortar. Vegetable substances, such as roots, barks, leaves, etc., should be thoroughly dried before they are ground in an iron mortar or in a roller-mill.

WEIGHTS AND MEASURES OF THE BRITISH PHARMACOPŒIA

METRIC SYSTEM

Measures of Mass (weights)

1 Milligram	(Mg)	=	the 1000th part of 1 gramme	or 0.001 G
1 Centigram	(Cg)	=	the 100th ,, ,,	or 0.01 G
1 Decigram	(Dg)	=	the 10th ,, ,,	or 0.1 G
1 Gramme	(G)	=	the 1000th part of the Standard International Kilogram (Kg).	or

Measures of Capacity (Volumes)

1 Centimil	(Cl)	=	the vol. at 4° of 1 centigram of water
1 Decimil	(Dl)	=	,, ,, 1 decigram of water
1 Millilitre or Mil	(Ml)	=	,, ,, 1 gramme of water
1 Litre	(Lit)	=	,, ,, 1 kilogram of water

Measures of Length

1 Micron	(μ)	=	the 1000th part of 1 millimetre	or 0.001 mm
1 Millimetre	(mm)	=	the 1000th part of 1 metre	or 0.001 m
1 Centimetre	(cm)	=	the 100th ,,	,, or 0.01 m
1 Decimetre	(dm)	=	the 10th ,,	,, or 0.1 m
1 Metre	(m)			1.0 m

IMPERIAL SYSTEM

Measures of Mass (Weights)

1 Grain	(gr.)		
1 Ounce (Avoir.)	(oz.)	=	437.5 grains
1 Pound (Avoir.)	(lb.)	=	7000.0 grains

Measures of Capacity (Volumes)

1 Minim	(min.)		
1 Fluid Drachm	(fl. dr.)	=	60 min.
1 Fluid Ounce	(fl. oz.)	=	8 fl. dr.
1 Pint	(O.)	=	20 fl. oz.

Relation of Capacity to Mass (Imperial)

1 Minim	=	the vol. at 16.7° (62° F.) of 0.9114583 gr. of water
1 Fluid Drachm	=	the vol. at 16.7° (62° F.) of 54.6875 gr. of water
1 Fluid Ounce	=	the vol. at 16.7° (62° F.) of 1 oz. or 437.5 gr. of water
109.7143 Minims*	=	the vol. at 16.7° (62° F.) of 100 gr. of water.

Relations of Metric and Imperial Measures

Mass

1 Milligram	(Mg)	=	0.015 grain nearly
1 Centigram	(Cg)	=	0.154 grain nearly
1 Decigram	(Dg)	=	1.543 grains nearly
1 Gramme	(G)	=	15.4323564 grains
1 Kilogram	(Kg)	=	15432.3564 grains, or 35.274 ounces nearly, or 2.2046 pounds nearly

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1 Grain	(gr.)	=	0.0648 gramme nearly
1 Ounce (Avoir.)	(oz.)	=	28.350 grammes nearly
1 Pound (Avoir.)	(lb.)	=	453.59 grammes nearly

Capacity

1 Centimil	(Cl)	=	0.169 minim nearly
1 Decimil	(Dl)	=	1.69 minims nearly
1 Millilitre or Mil	(Ml)	=	16.9 minims nearly
1 Litre	(Lit)	=	1.75980 pints, or 35.196 fluid ounces nearly

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1 Minim	(min.)	=	0.0592 mil nearly
1 Fluid Drachm	(fl. dr.)	=	3.5515 mils nearly
1 Fluid Ounce	(fl. oz.)	=	28.4123 mils nearly
1 Pint	(O.)	=	568.2454 mils nearly, or 0.5682 litre nearly

Length

1 Micron	(μ)	=	0.00003937 inch
1 Millimetre	(mm)	=	0.039370 inch
1 Centimetre	(cm)	=	0.39370 inch
1 Decimetre	(dm)	=	3.9370 inches
1 Metre	(m)	=	39.370113 inches

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1 Inch	(in.)	=	25.3999 millimetres

* Taken as 110 minims throughout the Pharmacopœia.

TABLE OF APPROXIMATE EQUIVALENCES ADOPTED IN STATING DOSES (IMPERIAL AND METRIC) IN THE BRITISH PHARMACOPŒIA

WEIGHTS

Imperial	*Metric*
Grains	Milligrams
1/200	0.3
1/100	0.6
1/64	1
1/40	1.5
1/32	2
1/25	2.5
1/20	3
1/16	4
1/10	6
1/8	8
1/5	12
1/4	16
1/2	30
Grains	Centigrams
1	6
2	12
3	20
4	25
5	30
8	50
10	60

Imperial	*Metric*
Grains	Decigrams
3	2
5	3
8	5
10	6
15	10
20	12
30	20
60	40
Grains	Grammes
15	1
30	2
45	3
60	4
120	8
150	10
180	12
240	16
480	32

VOLUMES

Minims	Centimils
1/2	3
1	6
2	12
3	18
5	30
8	50
Minims	Decimils
5	3
10	6
15	10
20	12
30	18
60	36

Minims	Mils
15	1
30	2
45	3
60	4
90	6
Fluid drachms	Mils
1/2	2
1	4
2	8
6	24
Fluid ounces	Mils
1/2	15
1	30
2	60
4	120

Formulæ for Converting from one Scale to another

To convert grammes into grains	.. ..	×	15.432
,, ,,	ounces (Avoir.)	×	0.03527
,, kilograms into pounds	.. ..	×	2.2046
,, grains into grammes	.. ..	×	0.0648
,, avoir. ounces into grammes	..	×	28.35
,, troy ounces into grammes	..	×	31.104
,, cubic centimetres into fluid ounces imperial			0.0352
,, litres into fluid ounces imperial	..	×	35.2
,, fluid ounces into cubic centimetres	..	×	28.42
,, pints into litres	.. ..	×	0.568
,, metres into inches	.. ..	×	39.37
,, inches into metres	.. ..	×	0.0254

Indian Domestic Weights

1 Rupee or	1 tola	=	180 grains
½ ,,	½ ,,	=	90 ,,
¼ ,,	¼ ,,	=	45 ,,
⅛ ,,	⅛ ,,	=	22.5 ,,
1 copper pice		=	100 ,,

OFFICIAL OR PHARMACOPŒIAL PREPARATIONS

The official preparations are sometimes called Galenical, after the celebrated physician Galen, but this term is now a misnomer, as with the advance of pharmacy, many drugs have come into use which were unknown in Galen's days.

Few drugs can be administered in their natural state. They are either too nauseous, too bulky, or contain some principles which are injurious to life or health. They are, therefore, submitted to certain processes prescribed by the British Pharmacopœia, in order to render them fit for administration, and also to help their preservation and storing, so as to maintain an uninterrupted supply during all seasons of the year. In the following pages we have given all the *official preparations* of the B.P. of 1914 in a tabular form, with their compositions, strengths, doses, and in many instances, their actions and uses, so as to enable a student to commit them to memory with as little trouble as possible. But it is only by repeated references that he will be able to master this, the most difficult part of Materia Medica.

Aceta.—Vinegars are solutions of drugs in acetic acid, *not in Vinegar*. They are three in number :—

Acetum	Preparation	Strength	Dose	Action
Cantharidini	Cantharidin 1 gm., glacial acetic acid 200 mils., acetic acid to 2000 mils.	0.5 p.c.	Used externally	Epispastic, for blistering
Scillæ	Squill bruised 10, acetic acid 10, distilled water 32	1 in 5	5 to 15 ms. (3 to 10 dl.)	Expectorant, diuretic
Urgineæ	Substitute urginea to above	1 in 5	5 to 15 ms. (3 to 10 dl)	Expectorant, diuretic

Acida Diluta.—Diluted Acids are strong acids diluted with distilled water. They are nine in number :—

Acidum	Preparation	Dose	Action and use
Aceticum Dil.	Acetic acid 152.6 gms., water to 1000 mils.	½ to 1 dr. (2 to 4 mils.)	Refrigerant and diuretic
Hydriodicum Dil.	An aqueous liquid 10 p.c. by weight of hydrogen iodide	5 to 10 ms. (3 to 6 dls.)	Antisyphilitic and alterative
Hydrobromicum Dil.	A solution containing 10 p.c. of hydrogen bromide by weight	15 to 60 ms. (1 to 4 mils.)	Sedative. Used with quinine to prevent cinchonism
Hydrochloricum Dil.	Hydrochloric acid 330 gms., water to 1000 mils. 10 p.c. hydrogen chloride	5 to 20 ms. (3 to 12 dls.)	In acid dyspepsia, chronic gastric complaints, etc.
Hydrocyanicum Dil.	A solution containing 2 p.c. of hydrogen cyanide by weight	2 to 5 ms. (12 to 30 cls.)	Sedative. A deadly *poison*. In vomiting, painful gastric disorders, hiccough, &c.
Nitricum Dil.	Nitric acid 151 gms., water to 1000 mils.	5 to 20 ms. (3 to 12 dls.)	Tonic. In phosphatic calculi and dyspepsia
Nitro-hydrochlor. Dil.	Nitric acid 60, hydrochloric acid 80, water 500	5 to 20 ms. (3 to 12 dls.)	Tonic and refrigerant. In dyspepsia, congestion of liver
Phosphoricum Dil.	Phosphoric acid 159.5 gms., water to 1000 mils.	5 to 20 ms. (3 to 12 dls.)	Tonic, refrigerant
Sulphuricum Dil.	Sulphuric acid 112.5 gms., water 940.0 mils.	5 to 20 ms. (3 to 12 dls.)	Tonic, astringent. To check hæmorrhages, diarrhœa, sweating of phthisis

The dosage of all varies from 5 to 20 minims, except—Acid. Hydrocyanic. Dil. **2 to 5 ms.**; Acid. Hydrobromic. Dil. 15 to 60 ms.; Acid. Hydriodic. Dil. 5 to 10 ms.; and Acid. Acetic. Dil. ½ to 1 dr.

Acidum Aromaticum. Aromatic Acid.—An acid liquid containing aromatics. There is only one preparation in the B.P.:—

Acidum Sulphuricum Aromaticum. *Syn.—Elixir of Vitriol.*—Mix gradually sulphuric acid 70 mils. with alcohol (90 p.c.) 600 mils., add tr. zingiberis 250 mils. and sp. cinnamomi 15 mils, and alcohol to 1000 mils. *Dose.*—5 to 20 ms. or 3 to 12 dls.

Adeps Præparatus and **Adeps Lanæ. Prepared Lard** and **Wool Fat.** Two preparations, as follows:—

Adeps Benzoatus.—Prepared lard 1000 gms., powdered benzoin 30 gms.; melt the lard in a water-bath, mix and strain.

Adeps Lanæ Hydrosus. *Syn.—Lanolin.*—Wool fat 7 gms., distilled water 2 mils. Mix by trituration in a warm mortar.

Aquæ. Waters.—With the exception of distilled water and Aq. Chloroformi all aquæ are weak and simple solutions of volatile oils in distilled water obtained either by distillation or by simple solution. They are thirteen in number:—

Aqua	Preparation	Dose	Action
Anethi	Dill fruit 1 gm., and water 20 mils. distilled to 10 mils.	½ to 2 ozs.	Carminative. Efficacious in infantile colic
Anisi	Anise fruit 1 gm. and water 20 mils. distilled to 10 mils.	½ to 2 ozs.	An antispasmodic and carminative vehicle
Aurantii Floris	Commercial water as obtained by distillation of flowers of bitter-orange. It is a saturated solution of the volatile oil of fresh flowers	1 to 2 ozs.	A flavouring agent
Camphoræ	Camphor 1 gm., alcohol (90 p.c.) 2 mils., and distilled water 1000 mils. By solution. Strength 1 in 1000	1 to 2 ozs.	Stimulant and antispasmodic. As a vehicle
Carui	Caraway fruit 1 gm. and water 20 mils., distilled to 10 mils.	1 to 2 ozs.	A carminative vehicle
Chloroformi	Chloroform 2.5 mils. and distilled water to 1000 mils, by solution. Its strength is 0.25 in 100 of water.	1 to 2 ozs.	A flavouring agent

Aquæ	Preparation	Dose	Action
Cinnamomi	Cinnamon bark bruised 1 gm. and water 20 mils., distilled to 10 mils.	1 to 2 ozs.	A carminative vehicle
Destillata	Distilled from good natural potable water	..	A vehicle
Fœniculi	Fennel fruit 1 gm. and water 20 mils., distilled to 10 mils.	1 to 2 ozs.	Antispasmodic for infantile colic
Laurocerasi	Fresh Cherry Laurel leaves 8 gms., and water 25 mils. Contains 0.1 p.c. by weight of hydrocyanic acid	½ to 2 drs. B.P. (2 to 8 mils.)	Nervine, gastric and cutaneous sedative
Menthæ Pip.	Oil of peppermint 1 mil. and water 1500 mils., distil to 1000 mils.	1 to 2 ozs.	An antispasmodic and carminative vehicle
Menthæ Viridis	Oil of Spearmint 1 mil., and water 1500 mils., distil to 1000 mils.	1 to 2 ozs.	An antispasmodic and carminative vehicle
Rosæ	Commercially distilled from the flowers of *Rosa damascena*. It is a saturated solution of the volatile oil	1 to 2 ozs.	A flavouring agent

The following points should be remembered :—

1. All aquæ are distilled except two, viz. :—Aq. Camphoræ and Aq. Chloroformi.

2. Aq. Aurantii Flor. and Aq. Rosæ are saturated solutions and must be diluted with twice their volume of water immediately before use.

3. The doses of all aquæ are from ½ to 2 fl. ozs., except **Aq. Laurocerasi,** the dose of which is only **½ to 2 drs.** because it contains hydrocyanic acid.

Collodia.—Collodions are solutions of drugs in collodion, or solution of pyroxylin in ether and alcohol. They are three in number :

Collodium	Ingredients	Action and use
Collodium	Pyroxylin 21 gms., ether 750 mils., alcohol (90 p.c.) 250 mils.	A protective to wounds, etc.
Flexile	Collodion 940 mils, canada balsam 40 gms., castor oil 20 gms.	Does not crack. An excellent application for fissured nipples, scalp wounds, sprains, etc.
Vesicans	Pyroxylin 25 gms., powdered cochineal 10 gms., blistering liquid to 1000 mils.	An effective vesicant

Confectiones.—Confections, Electuaries or Conserves are soft preparations of drugs, made into a paste with sugar or honey, either to give them a pleasant and agreeable taste or to preserve them. There are only four in the B.P.—

Confectio	Ingredients	Strength	Dose	Action and use
Piperis	Powdered black pepper 10 gms., caraway fruit 15 gms., honey 75 gms.	10 p.c.	60 to 120 grs. (4 to 8 gms.)	Stimulant, carminative. In hæmorrhoids
Rosæ Gallicæ	Fresh red-rose petals 25 gms., refined sugar 75 gms.	25 p.c.	—	As a basis for pill mass and linctus
Sennæ	Powdered senna 10 gms., powdered coriander 4 gms., figs 16 gms., tamarinds and cassia pulp each 12 gms., prunes 8 gms., extract of liquorice 1½ gms., sugar 40 gms., water *q.s.* to 100 gms.	10 p.c.	60 to 120 grs. (4 to 8 gms.)	A safe and elegant laxative in chronic constipation
Sulphuris	Precipitated sulphur 450 gms., acid, pot. tartrate 110 gms., tragacanth 5 gms., syrup 210 mils., tincture of orange 55 mils., glycerin 170 mils.	45 p.c.	Do.	A gentle laxative

Decocta. Decoctions.—Seven in number, They are vegetable solutions prepared by boiling with distilled water and straining. The decoction of aloes is the only one made in a covered pot. The **dose** is from ½ to 2 ozs. or 15 to 60 mils.

Decoctum	Ingredients	Strength	Action and use
Acaciæ Corticis	Acacia bark bruised 6 gms., water to 100 mils.	6 p.c.	Astringent
Agropyri	Couch grass cut small 5 gms., water to 100 mils.	5 p.c.	Demulcent and diuretic
Aloes Co.	Extract of aloes 10 gms., myrrh and potass. carbonate of each 5 gms., extract of liquorice 40 gms., compound tincture of cardamoms 300 mils., water to 1000 mils.	1 p.c.	Cathartic and emmenagogue

Decoctum	Ingredients	Strength	Action and use
Gossypii Radicis Corticis	Cotton root bark 20 gms., water to 100 mils.	20 p.c.	Emmenagogue and ecbolic
Hæmatoxyli	Logwood in chips 5 gms., cinnamon bark bruised 1 gm., water to 100 mils.	5 p.c.	An astringent vehicle
Ispaghulæ	Ispaghula bruised 15 gms., water to 1000 mils.	1½ p.c.	Demulcent
Sappan	Sappan in chips 5 gms., cinnamon bark bruised 1 gm., water to 100 mils.	5 p.c.	Colouring agent

Effervescents Granular, or those preparations that effervesce when mixed with water. All are granular except effervescent tartarated soda powder, which being a powder is given under the head of powders in the B.P. They are prepared by the admixture of acids and alkalies with or without sugar. Caffeine citrate, magnesium sulphate, and sodium citro-tartrate contain sugar, while sodium phosphate, sodium sulphate, and lithium citrate do not.

All effervescing preparations are agreeable to take.

The following are the B.P. granular effervescing preparations, the quantities of which are given in grammes :—

Effervescent	Composition	Dose	Action and use
Caffeine Citrate	Sodium bicarb. 51, tartaric acid 27, citric acid 18, sugar 14, caffeine citrate 4	60 to 120 grs. (4 to 8 gms.)	Cardiac tonic, diuretic.
Lithium Citrate	Sod. bicarb. 58, tartaric acid 31, citric acid 21, lithium citrate, 5	60 to 120 grs. (4 to 8 gms.)	Diuretic
Magnesium Sulphate	Mag. sulph. 50, sodium bicarb. 36, tartaric acid 19, citric acid 12½, sugar 10½	60 to 180 grs. (4 to 12 gms.) or ¼ to 1 oz. (16 to 32 gms.)	Cathartic
Sodium Citro-tartrate	Sod. bicarb. 51, tartaric acid 27, citric acid 18, sugar 15	60 to 120 grs. (4 to 8 gms.)	Refrigerant and laxative
Sodium Phosphate	Sod. phosphate 50, sod. bicarb. 50, tartaric acid 27, cirtic acid 18	60 to 120 grs. (4 to 8 gms.), or 150 to 240 grs. (10 to 16 gms.)	A mild aperient.

Effervescent	Composition	Dose	Action and use
Sodium Sulphate	Sod. bicarb. 50, sod. sulph. 50, tartaric acid 27, citric acid 18	60 to 120 grs. (4 to 8 gms.), or 150 to 240 grs. (10 to 16 gms.)	Hydragogue purgative
Tartarated Soda powder	Described in the table of powders (*q.v.*)	..	Purgative

Emplastra. Plasters.—Eight in number. They are made of adhesive substances spread upon cloth or leather so as to adhere to the skin. They are applied for the purpose of holding medicinal substances in contact with the body, of acting as a protective and support, or of bringing the edges of a wound together. Excepting cantharidin and menthol all contain lead in some form.

Emplastrum	Materials used	Strength	Action and use
Belladonnæ	Liquid extract of belladonna 50 mils, resin plaster 137.5 gms.	0.25 p.c. of alkaloids	A local anodyne. In lumbago, neuralgia, swollen and painful glands
Calefaciens	Cantharidin 0.2 gm., chloroform 20 mils., olive oil 40 mils, resin plaster 940 gms.	0.02 p.c. of cantharidin	A local stimulant
Cantharidini	Cantharidin 2 gms., chloroform 100 mils., yellow beeswax 450 gms., wool fat *q.s.* to 1000 gms.	0.2 p.c. of cantharidin	Vesicant.
Hydrargyri	Mercury 328 gms., olive oil 18 gms., sublimed sulphur 2 gms., lead plaster 652 gms.	1 in 3	Resolvent
Menthol	Menthol 15, yellow beeswax 10, resin 75	3 in 20	A local analgesic.
Plumbi	Lead oxide 4 gms., olive oil 8 grms., water 4 mils. or *q.s.*	—	Sedative and protective
Resinæ	Resin 10, lead-plaster 85, hard soap 5	1 in 10	Adhesive. For strapping wounds.
Saponis	Hard soap 14, lead plaster 83½, resin 2½	14 p.c.	Protective. In bedsores, boils and corns

In tropical and subtropical parts of the Empire, more or less hard soap, resin, or yellow beeswax, may be employed in the preparation of the Plasters of the Text of the Pharma-

copœia, when prevailing high temperatures otherwise render the basis too soft for convenient use ; but the official proportion of the active ingredient must in all cases be maintained.

Extracta. Extracts.—Thirty-five in number. Prepared mostly by evaporating fresh juice or soluble ingredients of plants. According to their mode of preparation, the Extracts can be grouped under six heads, viz. :—1. Fresh Extracts. 2. Aqueous Extracts. 3. Liquid Extracts. 4. Alcoholic Extracts. 5. Ethereal Extracts. 6. Dry Extracts. But, if we are to divide them according to their physical characters, they come under three groups, viz. :—**Dry or Solid, Semisolid or Soft,** and **Liquid.**

Fresh Extracts are prepared by heating the expressed juice to 100° C. to coagulate the albumin, and by filtering and evaporating the filtrate at 70° C. to a soft extract. They are two in number :—

Extractum	Source	Process	Menstruum	Dose
Colchici	Juice of fresh corms	Ex. & E.	nil.	¼ to 1 gr. (16 to 60 mg.)
Taraxaci	Juice of fresh roots	Do.	nil.	5 to 15 grs. (3 to 10 dg.)

Semisolid or Soft Extracts are prepared by dissolving, macerating, infusing or boiling drugs in cold and hot distilled water, and evaporating the solution, infusion or decoction, as the case may be, to the consistence of a soft extract. They are four in number. Extracts of colchicum and taraxacum are prepared from fresh juice and are described under **Fresh Extracts.** Ergot and Cannabis Indica contain alcohol.

Extractum	Source	Process	Menstruum	Dose
Cannabis Indicæ	The dried flowering tops	P. & E.	Alcohol	¼ to 1 gr. (16 to 60 mg.)
Ergotæ	Ergot crushed 10 gms., water 75 mils., alcohol (90 p.c.) 6½ mils.	M. & E.	Alcohol	2 to 8 grs. (12 to 50 cg.)
Gentianæ	Sliced root dried	I.D. & E.	Water	2 to 8 grs. (12 to 50 cg.)
Glycyrrhizæ	Dried root	M. & E.	Chloroform water	—

The B.P. has given no dose for Ext. Glycyrrhizæ though in the form of "stick liquorice" large quantities of it are consumed as a domestic remedy for coughs and colds.

Note. D.=Decoction. E.=Evaporation. I.=Infusion. M.=Maceration. P.=Percolation. R=Repercolation.

Liquid Extracts are prepared either from *concentrated infusions* of drugs, with alcohol added for their preservation, or alcoholic extracts dissolved in diluted alcohol. Opium alone is made from its dry extract. They are seventeen in number :

Extractum	Ingredients	Alcohol P.C. in the menstruum	Process	Strength	Dose
Agropyri Liq.	Couch grass 1 gm., water 10 mils.	90	D. & E.	1 in 1	1 to 2 drs. (4 to 8 mils.)
Belæ Liq.	Bael fruit 1 gm., chloroform water 15 mils.	90	M. & E.	1 in 1	1 to 2 drs. (4 to 8 mils.)
Belladonnæ Liquid	Belladonna root	90	R.	¼ gr. in 110 ms. (alkaloids)	—
Cascaræ Sagradæ Liq.	Bark 1000 gms., water to 1000 mils.	90	P. & E.	1 in 1	½ to 1 dr. (2 to 4 mils.)
Cinchonæ Liq.	Red Cinchona bark 1000 gms., hydrochloric acid 31 mils., glycerin 125 mils., and water *q.s.*	90	M.P.&E.	5 grs. in 110 ms. (alkaloid)	5 to 15 ms. (3 to 10 dls.)
Ergotæ Liq.	Ergot 10 gms., and water 75 mils.	90	M. & E.	1 in 1	10 to 30 ms. (6 to 18 dls).
Glycyrrhizæ Liq.	Root 1 gm., chloroform water 5 mils.	90	M. & E.	s. g. 1.200 1 in 1	½ to 1 dr. (2 to 4 mils.)
Gossypii Radicis Corticis Liq.	Bark 100 gms., glycerin 25 mils.	90	P.	1 in 1	½ to 1 dr. (2 to 4 mils.)
Grindeliæ Liq.	Grindelia 10 gms., sodii bic. 1 gm., water 5 mils.	90	P.	1 in 1	10 to 20 ms. (6 to 12 dls.)
Hamamelidis Liq.	Leaves	45	P.	1 in 1	5 to 15 ms. (3 to 10 dls.)
Hydrastis Liq.	Hydrastis	60	P.	2 grs. in 110 ms.	5 to 15 ms. (3 to 10 dls.)

Note D.=Decoction. E.=Evaporation. I.=Infusion. M.=Maceration. P.=Percolation. R.=Repercolation.

Extractum	Ingredients	Alcohol P.C. in the menstruum	Process	Strength	Dose
Ipecacuanhæ Liq.	Root	90	P.	2 grs. in 110 ms. (alkaloids)	½ to 2 ms. (3 to 12 cls.)
Kavæ Liq.	Kava rhizome	90 and 45	M. & P.	1 in 1	½ to 1 dr. (2 to 4 mls.)
Nucis Vomicæ Liq.	Seeds	90	R.	1½ grs. in 110 ms. (strychnine)	1 to 3 ms. (6 to 18 cls.)
Opii Liq.	Dry extract of opium 37.5 gms. and water to 1000 mls.	90	M.	¾ gr. in 110 ms. (morphine)	5 to 30 ms. (3 to 18 dls.)
Picrorhizæ Liq.	Picrorhiza	60	P.	1 in 1	15 to 60 ms. (1 to 4 mls.)
Viburni Liq.	Black haw.	70	P.	1 in 1	1 to 2 drs. (4 to 8 mls.)

From the above table it will be gathered that all the liquid extracts require alcohol of various strengths, either for their preparation or for their preservation. Liquid extract of male fern being prepared with ether is given in the table of **Ethereal Extracts.** Unless when standardised the strength of all liquid extracts is the same, *i.e.* 1 in 1.

In India and tropical countries, any liquid extract containing less than one-fourth of its weight of alcohol (90 p.c.) may have the same increased to one-fourth for better preservation.

Ethereal Extracts are prepared by percolating dry drugs with ether. There is only one in the B.P. :—

Extractum	Ingredient	Process	Menstruum	Strength	Dose
Filicis Liq.	Dry rhizome	P.	Ether	20 p. c. Filicin.	45 to 90 ms. (3 to 6 mils.)

Dry Extracts, sometimes called **abstracts,** are alcoholic or watery extracts mixed with an inert powdered substance and then dried and powdered. They are eleven in number. Of these extracts of aloe, cascara, krameria, and opium are **aqueous,** the rest contain alcohol more or less.

Note. M.=Maceration. P.=Percolation. R.=Repercolation.

Extractum	Ingredients	Process	Menstruum	Dose
Aloes	Aloes in small fragments	S. & E.	Water	1 to 4 grs. (6 to 25 cg.)
Belladonnæ siccum	Belladonna leaves	P. & E.	Alcohol 70 p.c. (1 p.c. alkaloid)	¼ to 1 gr. (16 to 60 mg.)
Cascaræ Sagradæ Siccum	Powdered bark	P. & E.	Water	2 to 8 grs. (12 to 50 cg.)
Colocynth. Co.	Colocynth pulp 15, extract of aloes 30, scammony resin 10, curd soap in powder 7½, and cardamom in powder 2½	M. & E.	Alcohol 60 p.c. 400 mils.	2 to 8 grs. (12 to 50 cg.)
Euonymi	Powdered bark	P. & E.	Alcohol 45 p.c. *q.s.* (Calc. phosp. *q.s.*)	1 to 2 grs. (6 to 12 cg.)
Hyoscyami	Powdered leaves	P. & E.	Alcohol 70 p.c. (0.3 p.c. alkaloid)	2 to 8 grs. (12 to 50 cg.)
Krameriæ	Powdered root	P. & E.	Water	5 to 15 grs. (3 to 10 dg.)
Nucis Vomicæ Sic.	Liquid extract of nux vomica (5 p.c. strychnine)	E.	Calc. phosph. *q.s.* (standardised)	¼ to 1 gr. (16 to 60 mg.)
Opii Siccum	Opium	E.	Water and calc. phosph. (20 p.c. morph.)	¼ to 1 gr. (16 to 60 mg.)
Rhei	Dried powdered root	P. & E.	Alcohol 60 p.c.	2 to 8 grs. (12 to 50 cg.)
Strophanthi	Dried strophanthus seeds	P. & E.	Ether, alcohol 90 p.c. *q.s.* (milk-sugar *q.s.*)	¼ to 1 gr. (16 to 60 mg.)

Phosphate of lime and sugar of milk are used to bring them to a standard strength.

The following extracts are standardised and contain a definite percentage of actual alkaloid, total alkaloids or active principle.

Ext. Belladonnæ Liq., 0.75 p.c.
Ext. Belladonnæ Sic., 1 p.c.
Ext. Cinchonæ Liq., 5 p.c.
Ext. Filicis Liq., 20 p.c.
Ext. Hydrastis Liq., 2 p.c.
Ext. Hyoscyami, 0.3 p.c.
Ext. Ipecac. Liq., 2 p.c.
Ext. Nucis Vom. Liq., 1.5 p.c.
Ext. Nucis Vom. Sic., 5 p.c.
Ext. Opii Liq., 0.75 p.c.
Ext. Opii Sic., 20 p.c.

Note.—E.=Evaporation, M.=Maceration, P.=Percolation, S.=Solution.

Glycerina.—Glycerins are solutions of drugs in plain glycerin or glycerin and water. They are nine in number :—

Glycerinum	Ingredients	Strength by weight	Strength by volume	Action and use
Acidi Borici	Boric acid 30 gms., glycerin *q.s.* to 100 gms. by weight	6 in 20	—	A local antiseptic
Acidi Carbolici	Phenol 2 gms., glycerin *q.s.* to 10 mils.	—	1 in 5	A local antiseptic
Acidi Tannici	Tannic acid 2 gms., glycerin *q.s.* to 10 mils.	—	1 in 5	A local astringent. In sore-throat and tonsillitis
Aluminis	Alum in powder 20 gms., water 7.5 mils., glycerin *q.s.* to 120 mils.	—	1 in 6 (nearly)	A local astringent. In enlarged tonsils
Amyli	Starch 2 gms., glycerin 13 mils., water 3 mils.	—	1 in 9	A local emollient
Boracis	Borax 2 gms., glycerin 12 mils.	—	1 in 7	A local antiseptic and emollient
Pepsini	Pepsin 100 gms., hydrochloric acid 11.5 mils, glycerin 600 mils, water *q.s.* to 1000 mils.	—	5.5 grs. in 1 dr.	A digestive adjuvant. (*Dose.* —1 to 2 drs.)
Plumbi Subacetatis	Strong solution of lead subacetate 5, glycerin 5. Water *q.s.*	—	sp. gr. 1.48	A local astringent and sedative
Tragacanthæ	Tragacanth 1 gm., glycerin 3 mil., distilled water 1 mil.	—	1 in 5	A good pill excipient

Though the official glycerins are intended to be simple solutions, yet Glyc. Tragacanthæ is not so. It is a pseudo-solution. Glyc. Acidi Tannici is now prepared by simple trituration without the aid of heat ; consequently the product is pale. Glyc. Amyli cannot be made on a water-bath, because the heat is not high enough to burst the starch granules. Use a procelain dish with a piece of wire gauze between it and the flame, and do not stop stirring until the solution becomes perfectly clear, when the process is complete. Glyc. Boracis is now only triturated instead of being triturated or heated according to the dispenser's choice as formerly ordered.

With the exception of Glyc. Pepsini all other glycerins are intended for local use and have no dose.

Infusa.—Infusions are watery solutions of vegetable principles, prepared by soaking in cold or boiling water, coarsely powdered or bruised crude drugs for a certain time in a covered vessel, and then straining the liquid. They are twenty in number. Eighteen are prepared in boiling distilled water. **Quassia and calumba** alone being infused in **cold water.** The product should not measure any particular quantity. All of them are made with 1 litre of water. All infusions become inky with persalts of iron, except those of quassia and calumba. They should always be prepared fresh. To a student, the infusion of **digitalis** is the most important. It contains 7 parts in 1000, and the **dose** is only **2 to 4 drs.** The dose of the rest varies from ½ to 1 or 2 ozs. (15 to 30 or 60 mils).

Infusum	Ingredients	Strength	Time in hour	Dose
Alstoniæ	Bruised alstonia bark and boiling water	1 in 20	½	½ to 1 oz.
Aurantii	Dried bitter-orange peel cut small and boiling water	1 in 20	½	½ to 1 oz.
Aurantii Co.	Dried bitter-orange peel cut small 25 gms., lemon peel cut small 10 gms., cloves bruised 5 gms., boiling water 1000 mils.	1 in 40	½	½ to 1 oz
Buchu	Buchu leaves broken and boiling water	1 in 20	½	1 to 2 ozs.
Calumbæ	Calumba root thinly sliced and cold water	1 in 20	½	½ to 1 oz.
Caryophylli	Cloves bruised and boiling water	1 in 40	½	½ to 1 oz.
Cascarillæ	Powdered cascarilla, boiling water	1 in 20	½	½ to 1 oz.
Chiratæ	Chiretta cut small and boiling water	1 in 20	½	½ to 1 oz.
Cinchonæ Acidum	Red bark powdered 50 gms., aromatic sulphuric acid 12½ mils., and boiling water 1000 mils.	1 in 20	1	½ to 1 oz.
Digitalis	Digitalis leaves powdered 7 gms., and boiling water 1000 mils.	0.7 p.c.	½	2 to 4 drs. (7 to 15 mils.)
Ergotæ	Ergot freshly crushed, boiling water	1 in 20	½	1 to 2 ozs.
Gentianæ Co.	Gentian root thinly sliced 12½gms. dried bitter orange peel cut small 12½ gms., lemon peel small 25 gms., boiling water 1000 mils.	1 in 80	½	½ to 1 oz.

Infusum	Ingredients	Strength	Time in hour	Dose
Krameriæ	Krameria root bruised, boiling water	1 in 20	¼	½ to 1 oz.
Quassiæ	Quassia wood rasped, cold water	1 in 100	¼	½ to 1 oz.
Rhei	Rhubarb in thin slices boiling water	1 in 20	¼	½ to 1 oz.
Rosæ Acidum	Red-rose petals broken 25 gms., acid. sulph. dil. 12½ mls., boiling water 1000 mls.	1 in 40	¼	½ to 1 oz.
Scoparii	Broom tops dried and bruised and boiling water	1 in 10	¼	1 to 2 ozs.
Senegæ	Senega root powdered and boiling water	1 in 20	½	½ to 1 oz.
Sennæ	Senna 100 gms., ginger sliced 5 gms., boiling water 1000 mls.	1 in 10	¼	½ to 1 oz. or 2 ozs. (single dose)
Uvæ Ursi	Bearberry leaves bruised and boiling water	1 in 20	¼	½ to 1 oz.

Injectiones Hypodermicæ.—Hypodermic injections are solutions of drugs for injection under the skin. They are five in number. In order to prevent infection with septic organisms all water for the preparation of hypodermic injections must be sterilised by boiling before the drug is dissolved in it. Inj. Apomor. Hyp. and Inj. Ergotæ Hyp. must always be made at the time of using.

Injectio Hypodermica	Composition	Strength	Dose
Apomorphinæ	Hydrochloride of apomorphine 1 gm., diluted hydrochloric acid 1 mil., water to 100 mils.	1 gr. in 110 ms.	5 to 10 ms. (3 to 6 dls.)
Cocainæ	Cocaine hydrochloride 5 gms., salicylic acid 0.15 gm., water to 100 mils.	5 grs. in 110 ms.	5 to 10 ms. (3 to 6 dls.)
Ergotæ	Extract of ergot 33 gms., phenol 1 gm., water to 100 mils.	33 grs. in 110 ms.	5 to 10 ms. (3 to 6 dls.)
Morphinæ	Morphine tartrate 2.5 gms., water *q.s.* to 100 mils.	2.5 grs. in 110 ms.	5 to 10 ms. (3 to 6 dls.)
Strychninæ	Strychnine hydroch. 0.75 gm., water to 100 mils.	¾ gr. in 110 ms.	5 to 10 ms. (3 to 6 dls.)

Lamellæ.—Eye-discs are thin plates or discs of medicated gelatin with glycerin used in ophthalmic practice. These are prepared by dissolving transparent gelatin in glycerin and water. They are four in number:—

Lamellæ	Composition	Strength in each	Action
Atropinæ	Discs of gelatin with glycerin weighing about $\frac{1}{30}$ gr. each	$\frac{1}{300}$ gr.	Mydriatic
Cocainæ	Discs of gelatin with glycerin weighing about $\frac{1}{20}$ gr. each	$\frac{1}{30}$ gr.	A local anæsthetic
Homatropinæ	Discs of gelatin with glycerin weighing about $\frac{1}{30}$ gr. each	$\frac{1}{100}$ gr.	Mydriatic
Physostigminæ	Discs of gelatin with glycerin weighing about $\frac{1}{50}$ gr. each	$\frac{1}{500}$ gr.	Myotic

Linimenta.—Liniments or **Embrocations** are preparations used for rubbing or painting over the skin. The majority of them are limpid liquids. Lin. Pot. Iodidi c. Sapone is a soft solid like shaving cream. All of them contain either a fixed oil, a volatile oil, or a soap. Camphor enters into the composition of eleven of them, for its local stimulant action, and also to lessen the risk of its being taken internally as it has a characteristic strong smell. Lin. Aconiti and Lin. Belladonnæ are strong solutions of active principles in alcohol (90 p.c.) with camphor. It must be remembered that Linimentum Terebinthinæ Aceticum should not be mixed with Linimentum Ammoniæ, as by this admixture a chemical combination takes place which neutralises the effects of both the ammonia and acetic acid. They are fifteen in number:—

Linimentum	Preparation	Strength	Action and use
Aconiti	Powdered root 500 gms., camphor and alcohol (90 p.c.) *q.s.* to contain 0,2 p.c. of the ether-soluble alkaloids and 3 p.c. of camphor; by digestion and percolation	0,2 p.c. alkaloid	A powerful local sedative and anodyne.
Ammoniæ	Solution of ammonia 25, almond oil 25, and olive oil 50; by mixture	1 in 4	A local stimulant and rubefacient
Belladonnæ	Liquid extract 50 mils., camphor 5 gms., water 10 mils., and alcohol (90 p.c.) to 100 mils.; by maceration	1 in 2	A powerful local anodyne. In neuralgia, &c.

Linimentum	Preparation	Strength	Action and use
Calcis	Lime water 5, and olive oil 5 ; shaken together	1 in 2	An emollient and sedative application to burns
Camphoræ	Camphor in flowers 2 and olive oil 8 ; by maceration.	1 in 5	A local stimulant
Camphoræ Ammoniatum	Camphor 125 gms., oil of lavender 5 mils,, strong solution of ammonia 250 mils,, and alcohol (90 p.c.) to 1000 mils. ; by maceration	1 in 8	Rubefacient and counter-irritant
Chloroformi	Chloroform 2 and camphor liniment 2 ; by mixture	1 in 2	Rubefacient, and anodyne
Crotonis	Croton oil 6, oil of cajuput 22 and alcohol (90 p.c.) 22 ; by mixture	12 p.c.	Rubefacient, pustulant, and counter-irritant.
Hydrargyri	Ointment of mercury 5, solution of ammonia 4, and liniment of camphor 8 ; by trituration and mixture	9 p.c. Hg.	Stimulant, and absorbent,.
Opii	Tincture of opium 5 and liniment of soap 5 ; by mixture	1 in 2	Anodyne
Potassii Iodidi cum Sapone	Curd soap recently prepared 40 gms., potassium iodide 30 gms., glycerin 20 mils., oil of lemon 2 mils., and water 200 mils. ; by trituration	54½ grs. in 1 fl. oz. ; or 1 in 10 by weight	Alterative and resolvent. Does not stain or irritate the skin
Saponis	Soft soap 80 gms., camphor 40 gms., oil of rosemary 15 mils., alcohol (90 p.c.) *q.s.* to 1000 mils., and water 170 mils. ; by maceration and filtration	1 in 12½	A stimulant application to sprains and bruises
Sinapis	Volatile oil of mustard 35 mils., camphor 55 gms., castor oil 125 mils., and alcohol (90 p.c.) *q.s.* to 1000 mils., by mixture	3.5 p.c.	Stimulant and rubefacient
Terebinthinæ	Soft soap 75 gms., camphor 50 gms,, and oil of turpentine 650 mils. ; water *q.s.* to1000 mils., by maceration and trituration.	65 p.c.	Irritant and rubefacient

Linimentum	Preparation	Strength	Action and use
Terebinthinæ Aceticum	Glacial acetic acid 110 mils., liniment of camphor 445 mils., oil of turpentine *q.s.* to 1000 mils. ; by mixture	1 in 9	Powerful rubefacient

Liquores.—Solutions are solutions of vegetable, animal or inorganic substances in distilled water, either alone or with other solvents. Three preparations, namely, Liqr. Pancreatis, Liqr. Adrenalini Hydrochlor. and Liqr. Epispasticus are obtained from the animal kingdom. Liqr. Epispasticus is prepared with acetic ether. Most of the vegetable solutions are made with the aid of alcohol of various strengths. They are forty-one in number :—

Liquor	Composition	Strength	Dose
Acidi Chromici	Chromic anhydride and water ; by solution	25 p.c. anhydrous acid	Used externally
Adrenalini Hydroch.	Adrenalin 1 gm., chloroform 5 mils., sodium chloride 9 gms., acid hydroch. dil. 3 mils., water boiled and cooled to 1000 mils.	1 in 1000 or 0.1 p.c.	10 to 30 ms. (6 to 18 dls.)
Ammoniæ	Strong solution of ammonia 5 mils., and water 10 mils., by mixture	1 in 3 or 10 p.c. by wt.	Used externally
Ammoniæ Fortis	——	32.5 p.c. by weight	Used externally
Ammonii Acetatis	Acetic acid 162.5 mils., ammonium carbonate 50 gms., or *q.s.* (to neutralise) and water to 1000 mils. ; by solution	6½ p.c. nearly	2 to 6 drs. (8 to 24 mils.)
Ammonii Citratis	Citric acid 125 gms., ammon. carbonate 87.5 gms. or *q.s.* (to neutralise), water to 1000 mils.	16 p.c. (nearly)	2 to 6 drs. (8 to 24 mils.)
Arsenicalis	Arsenious anhydride in powder, potass. carb. each 1 gm., compound tincture of lavender 3 mils., and water to 100 mils.	1 gr. in 110 ms.	2 to 8 ms. (12 to 50 cls.)
Arsenici Hydrochloricus	Arsenious anhydride in powder 10 gms., hydrochloric acid 12 mils., and water to 1000 mils.	1 gr. in 110 ms.	2 to 8 ms. (12 to 50 cls.)

Liquor	Composition	Strength	Dose
Arsenii et Hydrargyri Iodidi	Arsenious iodide, mercuric iodide each 1 gm., and water to 100 mils.; by trituration and solution	1 gr. of each in 110 ms.	5 to 20 ms. (3 to 12 dls.)
Atropinæ Sulphatis	Atropine sulphate and water; by solution	1 gr. in 110 ms.	½ to 1 m. (3 to 6 cls.)
Bismuthi et Ammonii Citratis	Bismuth oxynitrate 70 gms., citric acid 52 gms., solution of ammonia and water *q.s.* to 1000 mils.; by solution and filtration	3 grs. of bismuth oxide in 1 dr.	½ to 1 dr. (2 to 4 mils.)
Calcis	Calcium hydroxide 5 gms. and water *q.s.* to 500 mils.	0.1 p.c. or $\frac{1}{10}$ gr. in 110 ms.	1 to 4 ozs. (30 to 120 mils.)
Calcis Chlorinatæ	Chlorinated lime 1 gm. and water 10 mils.; by mixture and filtration	About 3 p.c. chlorine when fresh	—
Calcis Saccharatus	Calcium hydroxide 5 gms., refined sugar in powder 10 gms., and water 100 mils.; by mixture and decantation	2 grs. in 110 ms	15 to 60 ms. (1 to 4 mils.)
Cresol Saponatus	Cresol 50 gms., castor oil 35 gms., pot. hydroxide 8 gms., water to 100 mils.	1 in 2	Used externally
Epispasticus	Cantharidin 4 gms., castor oil 25 mils., resin 12 gms., acetone *q.s.* to 1000 mils.	0.4 p.c.	Used externally
Ethyl Nitritis	——	2½ to 3 p.c.	15 to 60 ms. (1 to 4 mils.)
Ferri Perchloridi	Strong solution of ferric chloride and water; by mixture.	1 in 4	5 to 15 ms. (3 to 10 dls.)
Ferri Perchloridi Fortis	Iron 70 gms., hydrochloric acid 410 mils., nitric acid 30 mils., and water *q.s.* to 350 mils.	20 grs. of iron in 110 ms.	—
Ferri Persulphatis	Ferrous sulphate 400 gms., sulphuric acid, nitric acid each 37.5 mils., and water *q.s.* to 550 mils.	36½ p.c.	—
Formaldehydi	An aqueous solution	36 to 38 p.c.	Used externally
Formaldehydi Saponatus	Soft soap 4 gms., alcohol (90 p.c.) 3 mils., solution of formaldehyde 2 mils., water *q.s.* to 10 mils.	1 in 5	Used externally

Liquor	Composition	Strength	Dose
Hamamelidis	Fresh leaves 100 gms., water 200 mils., and alcohol (90 p.c.) 16 mils.; by maceration and distillation to one-half	1 in 1	Used externally
Hydrargyri Nitratis Acidus	Mercury 120 gms., nitric acid 150 mils., water 45 mils.; by solution by heat	33 p.c. Hg.	Used externally
Hydrargyri Perchloridi	Mercuric chloride 1 gm., and water 1000 mils.; by solution	$\frac{1}{10}$ gr. in 110 ms.	½ to 1 dr. (2 to 4 mils.)
Hydrogenii Peroxidi	An aqueous solution of hydrogen peroxide.	10 of oxygen in 1	½ to 2 drs. (2 to 8 mils.)
Magnesii Bicarbonatis	Magnesium sulphate 40 gms., sodium carbonate 50 gms., and water *q.s.* to 800 mils.	10 grs. in 1 oz.	1 to 2 ozs. (30 to 60 mils.)
Morphinæ Acetatis	Morphine acetate 1 gm., diluted acetic acid 2 mils., alcohol (90 p.c.) 25 mils., and water *q.s.* to 100 mils.; by solution	1 gr. in 110 ms.	10 to 60 ms. (6 to 36 dls.)
Morphinæ Hydrochloridi	Morphine hydrochloride 1 gm., diluted hydrochloric acid 2 mils., alcohol (90 p.c.) 25 mils., and water *q.s.* to 100 mils.	1 gr. in 110 ms.	10 to 60 ms. (6 to 36 dls.)
Morphinæ Tartratis	Morphine tartrate 1 gm., alcohol (90 p.c.) 25 mils., and water *q.s.* to 100 mils.	1 gr. in 110 ms.	10 to 60 ms. (6 to 36 dls.)
Pancreatis	A liquid preparation containing the digestive principles of fresh pancreas of the pig	1 in 4 (nearly)	1 to 2 drs. (4 to 8 mils.)
Picis Carbonis	Prepared coal tar 2 gms., quillaia bark in powder 1 gm., and alcohol (90 p.c.) *q.s.* to 10 mils.; by percolation and digestion	1 in 5	Used externally
Plumbi Subacetatis Dil.	Strong lead subacetate solution 12.5 mils., water *q.s.* to 1000 mils.	1 in 80 liquor	Used externally
Plumbi Subacetatis Fortis	Lead acetate 250 gms., lead oxide in power 175 gms., and water *q.s.* to 1000 mils., by boiling	25 p.c.	Used externally

Liquor	Composition	Strength	Dose
Potassæ	An aqueous solution containing 5 gms., of potassium hydroxide in 100 mils.	5 grs. in 110 ms.	10 to 30 ms. (6 to 18 dls.)
Potassii Permanganatis	Potassium permanganate 1 gm. and water *q.s.* to 100 mils.; by solution	1 gr. in 110 ms.	2 to 4 drs. (7 to 15 mils.)
Sodæ Chlorinatæ	Chlorinated lime 10 gms., sodium carbonate 15 gms., and water 100 mils.; by solution with trituration, and filtration	2½ p.c. Cl.	10 to 20 ms. (6 to 12 dls.)
Sodii Arsenatis	Sodium arsenate anhydrous 1 gm., and water *q.s.* to 100 mils. by solution	1 gr. in 110 ms.	2 to 8 ms. (12 to 50 cls.)
Strychninæ Hydrochloridi	Strychnine hydrochloride 1 gm., alcohol (90 p.c.) 25 mils., and water *q.s.* to 100 mils.; by solution	1 gr. in 110 ms.	2 to 8 ms. (12 to 50 dls.)
Trinitrini	Trinitroglycerin of commerce 1 gm., alcohol (90 p.c.) *q.s.* to 100 mils.	1 gr. in 110 ms.	½ to 2 ms. (3 to 12 cls.)
Zinci Chloridi	Granulated zinc 4 gms., hydrochloric acid 11 mils., and water 10 mils.	40 p.c.	Used externally

The following eleven are of the same strength, containing 1 grain in 110 minims :—

Liq. Arsenicalis
,, Arsenici Hydrochlor.
,, Arsenii et Hydrarg. Iodidi
,, Atropinæ Sulph.
,, Morphinæ Acetat.
,, Morphinæ Hydrochlor.
Liq. Morphinæ Tart.
,, Pot. Permanganatis
,, Sodii Arsenatis
,, Strychninæ Hydrochlorid.
,, Trinitrini

Lotions.—Lotions are solutions or mixtures of active ingredients for external application only. They are two in number :—

Lotio	Composition	Strength	Action and use
Hydrargyri Flava	Mercuric chloride 4.6 gms. and solution of lime 1000 mils.; by mixture	2 grs. in 1 oz. (Mercuric oxide precipitates)	A stimulating application to syphilitic sores

Lotio	Composition	Strength	Action and use
Hydrargyri Nigra	Mercurous chloride 6,85 gms., glycerin. 50,0 mils., solution of lime *q.s.* to 1000 mils.; by trituration and mixture	3 grs. in 1 oz.	A stimulating alterative application to syphilitic sores

Mella.—Mellita. Honeys are liquid preparations containing mostly honey as a vehicle. They are five in number:—

Mel Depuratum is honey melted and strained through flannel.

Mel	Preparation	Strength	Dose	Action
Boracis	Powdered borax 10 gms., clarified honey 85 gms., and glycerin 5 gms.	1 in 10	Used locally	An alterative to diseased mucous surface
Oxymel	Clarified honey 5 mils., acetic acid 1 mil., and water 1 mil.	sp. gr. 1.27	½ to 2 drs. (2 to 8 mils.)	Expectorant. Used as a vehicle
Oxymel Scillæ	Vinegar of squill 2 mils., purified honey 5 mils.	sp. gr. 1.29	½ to 1 dr. (2 to 4 mils.)	Expectorant
Oxymel Urgineæ	Vinegar of urginea 20 mils., purified honey 50 mils.	sp. gr. 1.29	½ to 1 dr. (2 to 4 mils.)	Expectorant

Misturæ.—Mixtures are preparations in which drugs are simply dissolved in water or suspended in it. Insoluble substances are usually suspended by the aid of mucilage, syrup, etc. The official mixtures are only seven in number, the ingredients of which are mostly suspended. Mist. sennæ co. is an official substitute for "Black Draught." The dose is the same for all—½ to 1 or 2 ozs.

Mistura	Preparation	Strength	Dose	Action
Ammoniaci	Powdered ammoniacum 30 gms., syrup of tolu 60 mils., and water *q.s.* to 1000 mils.	13 grs. in 1 oz. or 3 p.c.	½ to 1 oz. (15 to 30 mils.)	Stimulating expectorant

Mistura	Preparation	Strength	Dose	Action
Amygdalæ	Compound powder of almonds 125 gms., water *q.s.* to 1000 mils.	60 grs. in 1 oz. or 12·5 p.c.	½ to 1 oz. (15 to 30 mils.)	Used as a vehicle
Cretæ	Prepared chalk 3 gms., tragacanth in powder ½ gm., refined sugar 6 gms., and cinnamon water to 100 mils.	13 grs. in 1 oz. or 3 p.c.	½ to 1 oz. (15 to 30 mils.)	Antacid and astringent
Ferri Co.	Ferrous sulphate 6 gms., potassium carbonate 8 gms., myrrh, gum acacia, glucose each 15 gms., spirit of nutmeg 10 mils, and rose water *q.s.* to 1000.	2½ grs. in 1 oz. or 0·6 p.c.	½ to 1 oz. (15 to 30 mils.)	Hæmatinic and emmenagogue
Guaiaci	Guaiacum resin 25 gms., refined sugar 25 gms., powdered tragacanth 5 gms., and cinnamon water *q.s.* to 1000 mils.	11 grs. in 1 oz or 2·5 p.c.	½ to 1 oz. (15 to 30 mils.)	Stimulant, alterative and diaphoretic
Olei Ricini	Castor oil 37½ mils., powdered gum acacia 10 gms., undiluted commercial orange flower water 15 mils., and cinnamon water to 100 mils.	3 drs. in 1 oz. or 37·5 p.c.	1 to 2 ozs. (30 to 60 mils.) as a draught	Cathartic
Sennæ Co.	Magnesium sulphate 25 gms., liquid extract of liquorice 5 mils., tinct. card. co. 10 mils., spt. ammon. aromat. 5 mils., and inf. sennæ *q.s.* to 100 mils.	2 dr. in 1 oz. or 25 p.c. mag. sulph.	1 to 2 ozs. (30 to 60 mils.) as a draught	Hydragogue cathartic

Mucilagines.—Mucilages are solutions of gummy substances in water. They are three in number, viz.:—

Mucilago Acaciæ, prepared by dissolving gum acacia 10 gms., in distilled water 15 mils. after rinsing.

Mucilago Gummi Indici, Indian gum 5 gms. in water 15 mils.

Mucilago Tragacanthæ, prepared by dissolving powdered tragacanth 1.25 gms., in alcohol (90 p.c.) 2.50 mils., and distilled water to make 100 mils.

Mucilages are used chiefly as vehicles or excipients with a view to assist suspension of insoluble powders in a mixture, or in pill-making and pill-coating. They have little therapeutical value except as demulcents to inflamed mucous surfaces.

Oleata.—Oleates are preparations of bases with oleic acid, having a solid or semi-solid consistence. Only one preparation is in the B.P., viz. :—

Hydrargyrum Oleatum.—Mercuric oxide yellow 20 gms., liquid paraffin 5 gms., oleic acid 75 gms.

Olea. Oils.—There are thirty-eight oils in the B.P. They can be grouped under two classes—fixed and volatile. The former being obtained by expression, and the latter by distillation except in the case of lemon oil which is a volatile oil though obtained by expression, and oleum phosphoratum, which is a solution of phosphorus in almond oil. Oil of cade is obtained by dry or destructive distillation.

Of the eleven fixed oils, cod-liver oil is an animal product, being extracted by heat not exceeding 85°C., and the rest are expressed at ordinary temperatures. Ol. theobrom. is solid in cold weather and semi-solid or fluid in hot weather. The colour of cajuput is deep-green and that of cade is almost black. Ol. terebinthinæ is almost colourless. The rest display various shades of straw, yellow and pale-brown. The doses of **croton oil** and **phosphorated oil** are ½ **to 1 m.** and 1 **to 5 ms.** respectively ; while the remaining can be given in large doses.

Croton oil and castor oil form a special subdivision, both having cathartic properties.

FIXED OR EXPRESSED OILS

Oleum	Source	Dose	Action
Amygdalæ	Bitter or sweet almonds	Used externally	Demulcent and emollient
Arachis	Seeds	Used externally	Emollient
Chaulmoograe	Seeds	5 to 10 ms. (3 to 6 dls.)	Alterative in leprosy
Crotonis	Seeds	½ to 1 m. (3 to 6 cls.)	Hydragogue purgative

Oleum	Source	Dose	Action
Lini	Linseed	Used externally	Demulcent, and emollient
Morrhuæ	Fresh liver; extracted by heat under 85°C.	1 to 4 drs. (4 to 6 mils.)	Nutritive, tonic and alterative
Olivæ	Ripe fruit	—	Emollient
Phosphoratum	Oil of almonds 98 gms., oil of lemon 1 gm. and phosphorus 1 gm.	1 to 5 ms. (6 to 30 cls.)	Tonic and alterative
Ricini	Fresh seeds	1 to 8 drs. (4 to 30 mils.)	Cathartic
Sesami	Seeds	Used externally	Emollient
Theobromatis	Crushed seeds; expressed by heat	Used externally	For making suppositories

Volatile, Essential or Distilled Oils

Oleum	Source	Dose	Action
Abietis	Fresh leaves	—	Rubefacient
Ajowan	Fruit	½ to 3 ms.	Carminative, antispasmodic
Anethi	Dill fruit	½ to 3 ms.	Do.
Anisi	Anise or star-anise fruits	½ to 3 ms.	Do.
Anthemidis	Chamomile flowers	½ to 3 ms.	Aromatic, stimulant
Cadinum	Woody portions; by destructive distillation	Used externally	A stimulating application
Cajuputi	Leaves	½ to 3 ms.	Antispasmodic
Carui	Caraway fruit	½ to 3 ms.	Carminative, antispasmodic
Caryophylli	Cloves	½ to 3 ms.	Do.
Cinnamomi	Cinnamon bark	½ to 3 ms.	Do.
Copaibæ	Copaiba	5 to 20 ms. (3 to 12 dls.)	Urinary antiseptic
Coriandri	Coriander fruit	½ to 3 ms.	Antispasmodic
Cubebæ	Cubebs	5 to 20 ms. (3 to 12 dls.)	Urinary antiseptic
Eucalypti	Fresh leaves	½ to 3 ms.	Antiseptic
Gaultheriæ	Leaves	5 to 15 ms. (3 to 10 dls.)	Anti-rheumatic

Oleum	Source	Dose	Action
Graminis Citrati	Lemon grass	½ to 3 ms.	Rubefacient and carminative
Juniperi	Unripe green fruit	½ to 3 ms.	Diuretic
Lavandulæ	Flowers	½ to 3 ms.	Antispasmodic
Limonis	Fresh lemon peel	½ to 3 ms.	Aromatic
Menthæ Piperitæ	Fresh flowering plant	½ to 3 ms.	Antispasmodic and carminative
Menthæ Viridis	Fresh flowering plant	½ to 3 ms.	Do
Myristicæ	Dried seeds	½ to 3 ms.	Carminative and narcotic
Rosæ	Fresh flowers	—	Powerful fragrant
Rosmarini	Flowering tops	—	Rubefacient
Santali	Wood of *Santalum album*	5 to 30 ms. (3 to 18 dls.)	Urinary antiseptic
Sinapis Volatile	Black mustard seeds	—	Vesicant
Terebinthinæ Rect.	From oleo-resin by aid of steam	2 to 10 ms. (12 to 60 cls.) As anthelmintic 3 to 4 drs. (12 to 15 mls.)	Rubefacient, diuretic, and anthelmintic

The oils of cloves, cinnamon, gaultheria and mustard sink in water. The dose of most of the volatile oils is from ½ to 3 minims or 3 to 18 centimils, with the exception of copaiba, cubebs, gaultheria, sandal-wood and turpentine.

The oil of mustard is a powerful irritant poison, and is only used externally in the shape of Lint. Sinapis.

Volatile oils are combined with many B.P. pills either as carminatives or to serve as a means of distinction between various pill masses of similar appearance.

In India, and in the Eastern, African, and Australasian divisions of the Empire, arachis oil or seasme oil, but no other oil or fat, may be employed in making the official liniments, plasters, ointments, and soaps for which olive oil is directed to be used.

Pilulæ.—Pills are solid or semisolid globular masses containing medicinal agents intended to be swallowed whole without chewing. Pills are always popular for easy administration, being portable, easily swallowed and containing a

definite and correct dose. They should not be too hard unless intended to dissolve slowly, or so soft as to lose shape and stick together. To prevent this and to cover the nauseous taste they are coated or gilded. In India and tropical countries, pills get too hard or too soft according to the variations of the weather; being liable to become soft and to run together during the rains. To avoid this, they should be kept in well stoppered bottles. Pills, as a rule, should not weigh more than 5 grains each. A mass of the consistence of firm clay is first made by pounding and kneading the drugs together in a mortar; and subsequently this mass is either rolled and divided by a pill-making machine, or when the quantity is small, the same process is done over a pill-tile by the spatula. The pills should be perfectly round and firm. An excipient is always necessary to make a pill-mass.

The B.P. pills are eighteen in number. They are :—

Pilula	Composition	Strength	Dose	Action
Aloes	Aloes 58 gms., hard soap 29 gms., oil of caraway 3 mils., syr. of glucose 10 gms. or *q.s.*	58 p.c.	4 to 8 grs. (25 to 50 cgm.)	Cathartic
Aloes et Asafetidæ	Aloes, asafetida, hard soap each 3 gms., syr. of glucose 1 gm. or *q.s.*	1 in 3½	4 to 8 grs. (25 to 50 cgm.)	Cathartic and antispasmodic
Aloes et Ferri	Exsiccated ferrous sulphate 10 gms., aloes 20 gms., compound powder of cinnamon 35 gms., syrup of glucose 35 gms. or *q.s.*	1 & 2 in 10	4 to 8 grs. (25 to 50 cgm.)	Cathartic and emmenagogue
Aloes et Myrrhæ	Aloes 44 gms., myrrh 22 gms., syrup of glucose 34 gms. or *q.s.*	2 & 1 in 4½	4 to 8 grs. (25 to 50 cgm.)	Do.
Colocynth. Co.	Colocynth pulp 20 gms., aloes 35 gms., scammony resin 35 gms., pot. sulph. 5 gms., oil of cloves 5 mils., and water *q.s.*	1 in 5	4 to 8 grs. (25 to 50 cgm.)	Cathartic
Colocynth. et Hyos.	Pil. colocynth. co. 50 gms., extract of hyoscyam. 25 gms. water *q.s.*	2 & 1 in 3½	4 to 8 grs. (25 to 50 cgm.)	Cathartic

Pilula	Composition	Strength	Dose	Action
Ferri	Exsiccated ferrous sulphate 33 gms., exsiccated sodium carbonate 21 gms., gum acacia 8 gms., tragacanth 2 gms., glucose 31 gms., and water 2 mils. or *q.s.*	22.5 p.c. (Ferrous Carb.)	5 to 15 grs. (3 to 10 dgm.)	Tonic and emmenagogue
Hydrargyri	Mercury 4 gms., confection of roses 6 gms., liquorice root powdered 2 gms.	1 in 3	4 to 8 grs. (25 to 50 cgm.)	Alterative and laxative
Hydrargyri Subchlor. Co.	Mercurous chloride 20, sulphurated antimony 20, guaiacum resin 40, gum acacia and tragacanth each 1, syrup of glucose 10 or *q.s.*	1 in 4½	4 to 8 grs. (25 to 50 cgm.)	Alterative and a feeble cathartic
Ipecacuanhæ c. Scilla	Compound powder of ipecac. 3, squill 1, ammoniacum 1, syrup of glucose *q.s.*	1 in 20 5 p.c. (opium)	4 to 8 grs. (25 to 50 cgm.)	Expectorant and narcotic
Ipecac. c. Urginea	Same as above. Use urginea for squill	1 in 20 5 p.c. (opium)	4 to 8 grs. (25 to 50 cgm.)	Do.
Phosphori	Phosphorus 1, kaolin 16, wool fat 11, oil of theobroma 40, sod. sulphate 22, and carbon disulphide 20	1 in 110	1 to 4 grs. (6 to 25 cgm.)	Tonic and restorative
Plumbi cum Opio	Lead acetate 80, opium 12, syrup of glucose 8 or *q.s.*	12 p.c. (opium)	2 to 4 grs. (12 to 25 cgm.)	Astringent and narcotic
Quininæ Sulphatis	Quinine sulphate 82, tartaric acid 3, glycerin 12, tragacanth 3	82 p.c.	2 to 8 grs. (12 to 50 cgm.)	Tonic and antiperiodic
Rhei Co.	Rhubarb 25, powder aloes 20, myrrh 14, hard soap 14, oil of peppermint 2, syrup of glucose 25 or *q.s.*	1 in 4	4 to 8 grs. (25 to 50 cgm.)	Stomachic, tonic, and a gentle cathartic
Saponis Co.	Opium 20, hard soap 60, syrup of glucose 20 or *q.s.*	1 in 5 or 20 p.c. (of opium)	2 to 4 grs. (12 to 25 cgm.)	Astringent, narcotic ;

Pilula	Composition	Strength	Dose	Action
Scillæ Co.	Squill 25, ginger 20, ammoniacum 20, hard soap 15, and syrup of glucose 20 or *q.s.*	1 in 4	4 to 8 grs. (25 to 50 cgm.)	Expectorant and diuretic
Urgineæ Co.	Same as above. Use urginea for squill	1 in 4	4 to 8 grs. (25 to 50 cgm.)	Do.

All the cathartic pills in the above table contain aloes except the mercurial pills. All pills are given in 1 to 8 grain doses, except Pil. Phosph., Pil. Plumbi c. Opio, Pil. Saponis Co., and Pil. Ferri (which see).

The colour of the B.P. pill-masses is blackish-brown or black, with the exception of Pil. Quin. Sulph., which is *white*; Pil. Hydrarg., which is *blue*; and Pil. Hyd. Subchlor. Co., which is *orange-red*. Many of the pills can be recognised by their smell, for instance, Pil. Rhei Co. by the smell of peppermint; Pil. Saponis Co. by that of opium; and Pil. Aloes et Asafetida by that of asafetida.

The student should familiarise himself with the colour and smell of the above preparations.

Pulveres.—Powders are mixtures of dry substances reduced to a fine powder and intimately mixed together. Powders should be mixed in a very clean mortar (a glass one being the best). The method of mixing greatly affects the miscibility of powders. It is the practice of many mothers to administer powders to their children mixed with jam, but it should be borne in mind that the acid present in the jam will combine with and alter the action of any alkalies that may be present. The best and simplest method is to give them mixed with sugar and water, or milk.

The B.P. powders are seventeen in number, and they are as under:—

Pulvis	Composition	Strength	Dose	Action
Amygdalæ Co.	Sweet almonds 6, refined sugar 3, and powdered gum acacia 1	3 in 5	—	Demulcent, nutritive
Anti-monialis	Antimonious oxide and calcium phosphate	1 in 3	3 to 6 grs. (2 to 4 dg.)	Diaphoretic, emetic in large doses

Pulvis	Composition	Strength	Dose	Action
Buteæ Seminum	Dry powdered kernels recently blanched	—	10 to 20 grs. (6 to 12 dg.)	Anthelmintic
Catechu Co.	Catechu 4, kino 2, krameria root 2, cinnamon bark 1, and nutmeg 1	1 in 2½	10 to 60 grs. (6 to 40 dg.)	Aromatic and astringent
Cinnamomi Co.	Cinnamon bark, cardamom seeds, and ginger each equal parts	1 in 3	10 to 60 grs. (6 to 40 dg.)	Aromatic, carminative
Cretæ Aromaticus	Cinnamon bark 10, nutmeg 8, cloves 4, cardamom seeds 3, refined sugar 50, and prepared chalk 25	1 in 4	10 to 60 grs. (6 to 40 dg.)	Aromatic, astringent, and antacid
Cretæ Aromat. cum Opio	Aromatic chalk powder and opium	1 in 40 2.5 p.c. (opium)	10 to 60 grs. (6 to 40 dg.)	Aromatic, astringent
Glycyrrhizæ Co.	Senna 16, liquorice root 16, fennel fruit 8, sublimed sulphur 8, and sugar 52	1 in 6½	60 to 120 grs. (4 to 8 gms.)	A mild cathartic
Ipecac. Co.	Ipecac. root 1, opium powder 1, and potassium sulphate 8	10 p.c. (Opium)	5 to 15 grs. (3 to 10 dg.)	Diaphoretic, anodyne
Jalapæ Co.	Jalap 3, acid potassium tartrate 6, ginger 1	1 in 3½	10 to 60 grs. (6 to 40 dg.)	Hydragogue purgative
Kaladanæ Co.	Kaladana 3, cream of tartar 6, ginger 1	1 in 3½	10 to 60 grs. (6 to 40 dg.)	Do.
Kino Co.	Kino 75, opium 5, and cinnamon bark 20	5 p.c. (opium)	5 to 20 grs. (3 to 12 dg.)	Astringent, anodyne, narcotic
Opii Co.	Opium powder 10, black pepper 15, ginger 30, caraway 42, tragacanth 3	10 p.c. (opium)	5 to 15 grs. (3 to 10 dg.)	Carminative and narcotic
Rhei Co.	Rhubarb 22, light magnesia 66, and ginger 12	1 in 4½	10 to 60 grs. (6 to 40 dg.)	Antacid, stomachic Cathartic
Scammoniæ Co.	Scammony resin 50, jalap 35, and ginger 15	1 in 2	10 to 20 grs. (6 to 12 dg.)	Hydragogue purgative

Pulvis	Composition	Strength	Dose	Action
Sodæ Tart. Efferves.	Sodium potassium tartrate 7.5 gms., sodium bicarbonate 2.5 gms., mix, and wrap in blue paper; tartaric acid in dry powder 2.5 gms., wrap in white paper	116 & 38½ grs.	193 grs.	Hydragogue cathartic
Tragacanthæ Co.	Tragacanth 15, gum acacia 20, starch 20, and sugar 45	15 p.c.	10 to 60 grs. (6 to 40 dg).	Demulcent

With the exception of Pulv. Antimonialis, Buteæ Semin., Cretæ Aromat., Cretæ Aromat. c. Opio, and Sodæ Tart. Effervescens, all powders are called "Compound." In fact, all of them are compound having more than one ingredient. With a little care and trouble they can generally be distinguished by their colour and smell.

Spiritus. Spirits.—A spirit, as ordinarily understood, is a distilled product obtained from fermented vinous liquors. But the B.P. spirits, with the exception of rectified spirit, are alcoholic solutions of volatile oils and ethers. They can be divided into two classes—**simple** and **compound.** The simple spirits are solutions of essential oils, ethers and chloroform in alcohol (90 p.c.) which often get turbid when diluted with water. The compound spirits contain more than one ingredient. The B.P. spirits are sixteen in number, of which twelve are simple and four compound.

SIMPLE SPIRITS

Spiritus	Composition	Strength	Dose	Action
Ætheris	Ether and alcohol (90 p.c.)	1 in 3	20 to 40ms. or 60 to 90ms.	A diffusible stimulant, antispasmodic and carminative
Anisi	Oil of anise and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	Carminative and antispasmodic
Cajuputi	Oil of Cajuput and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	Carminative and antispasmodic
Camphoræ	Camphor and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	Stimulant and antispasmodic

Spiritus	Composition	Strength	Dose	Action
Chloroformi	Chloroform and alcohol (90 p.c.)	1 in 20	5 to 20 ms. or 30 to 40ms.	A diffusible stimulant and antispasmodic
Cinnamomi	Oil of cinnamon and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	Carminative and stomachic
Juniperi	Oil of juniper and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	A stimulating diuretic
Lavandulæ	Oil of lavender and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	Carminative and antispasmodic
Menthæ Pip.	Oil of peppermint and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	Carminative and antispasmodic
Myristicæ	Oil of nutmeg and alcohol (90 p.c.)	1 in 10	5 to 20 ms.	Carminative
Rectificatus	Alcohol with 10 p.c. of water	90 p.c.	—	Same as alcohol
Rosmarini	Oil of rosemary and alcohol (90 p.c.)	1 in 10	..	A local stimulant

Compound Spirits

Spiritus	Composition	Strength	Dose	Action
Ætheris Nitrosi	Nitric acid 15 mils., sulphuric acid 10 mils., copper 10 gms., and alcohol (90 p.c.) *q.s.*	1.52 to 2.66 p.c. ethyl nitrite	15 to 60 ms. (1 to 4 mils.)	Diaphoretic, diuretic, stimulant, antispasmodic
Ammoniæ aromat.	Carbonate of ammonia 100 gms., strong solution of ammonia 200 mils., oil of nutmeg 15 mils., oil of lemon 20 mils., alcohol (90 p.c.) 3000 mils., and distilled water 1500 mils.	1 in 40 (carbonate) 1 in 20 (Liq. ammonia fort.)	20 to 40 ms. (12 to 25 dls.) or 60 to 90 ms. (4 to 6 mils.)	Cardiac stimulant, antispasmodic and carminative
Ammoniæ Fetidus	Asafetida 7½ gms., strong solution of ammonia 10 mils., alcohol (90 p.c.) *q.s.* to 100 mils.	7½ p.c. asafetida	Do.	Stimulant and antispasmodic
Armoraciæ Co.	Horseradish root, bitter-orange peel each 125 gms., nutmeg 3 gms., alcohol (90 p.c.) 625 mils., and distilled water 750 mils.	1 in 8	1 to 2 drs. (4 to 8 mils.)	Stimulant, diuretic

Succi. Juices.—The B.P. juices are three in number. In making these preparations, the juice is first expressed from the fresh plant; one-third of its volume of alcohol (90 p.c.) is then added as a preservative, and it is set aside for seven days before filtration and use. **Succus Limonis,** properly speaking, cannot be called a preparation, and contains no alcohol. It is used for making lemon syrup.

Succus Scoparii, juice of fresh broom tops. *Dose*, 1 to 2 drs. (4 to 8 mils.).

Succus Taraxaci, juice of fresh root. *Dose*, 1 to 2 drs. (4 to 8 mils.).

Suppositoria.—**Suppositories** are solid conical-shaped masses containing some active ingredients, for rectal medication. With the exception of the glycerin suppository, all of them are blended with cacao-butter which melts at 25°C. They consequently dissolve slowly as soon as they are introduced into the rectum. They weigh about 15 grains (1 gramme) each and are made in conical moulds of massive gun-metal. They are seven in number :—

Suppositoria	Composition	Strength in each	Action
Acidi Carbolici	Phenol 0.8 gm., white beeswax 0.5 gm., oil of theobroma *q.s.* for 12	1 gr.	Antiseptic and a local anæsthetic
Acidi Tannici	Tannic acid 2.4 gms., oil of theobroma *q.s.* for 12	3 grs.	A local astringent and styptic
Belladonnæ	Liquid extract of belladonna 1.7 mils., and oil of theobroma *q.s.* for 12	$\frac{1}{60}$ gr. (alkaloids)	A local anodyne
Glycerini	Gelatin 14 gms. glycerin 70 gms., and distilled water *q.s.*	70 p.c. (by weight)	
Iodoformi	Iodoform 2.4 gms. and oil of theobroma *q.s.* for 12	3 grs.	A local antiseptic
Morphinæ	Morphine hydrochloride 0.2 gm. and oil of theobroma *q.s.* for 12	½ gr.	A local anodyne
Plumbi Co.	Lead acetate 2.4 gms., opium 0.8 gm., and oil of theobroma *q.s.* for 12	3 grs. and 1 gr.	Anodyne and astringent

There is an unofficial cocaine suppository which is made hollow to fit on the end of the finger. This is intended to be introduced into the cervix uteri during the first stage of labour for the purpose of lessening the pains.

Each glycerin suppository, the basis of which is gelatin, is made to weigh either 30, 60, or 120 grs. It opens the bowels by inducing reflex action. Suppositoria Plumbi Co. contains 1 grain of opium, though the name dose not indicate it.

Suppositories are used either to produce a local action on the rectum, or on the adjacent pelvic organs such as the uterus and the bladder, or when we wish to produce their general effect on the system without upsetting the stomach. Thus, morphine suppository may be used either to soothe pain and irritation in the rectum or pelvic organs, or to induce sleep. The compound lead suppository acts in a similar manner.

More or less white beeswax, according to prevailing temperatures, may be used in place of an equivalent amount of Oil of Theobroma in tropical and subtropical parts of the Empire, where otherwise the suppositories of the text of the Pharmacopœia would be too soft for convenient use.

Syrupi.—Syrups are fluid preparations of drugs containing a sufficient quantity of refined sugar, either to preserve them or to make their administration more agreeable. In the case of Syr. Ferri Iodidi and Syr. Ferri Phosph. sugar prevents oxidation. They are twenty-three in number :—

Syrupus	Composition	Strength by volume	Dose in drachm	Action
Syrupus	Refined sugar 10 gms. and boiling water *q.s.* to 15 gms.	1 in 1½ by weight	—	A sweetening agent
Acidi Hydriodici	Hydriodic acid 10 gms., water 5 mils., syrup *q.s.* to 100 mils.	1 in 10	½ to 1	Anti-syphilitic
Aromaticus	Tincture of orange 25, cinnamon water 25, and syrup 50	—	½ to 1	A flavouring agent
Aurantii	Syrup and tincture of orange	1 in 8	½ to 1	A flavouring agent
Aurantii Floris	Commercial orange flower water 15 mils., sugar 30 gms., syrup *q.s.* to 100 mils.	15 p.c.	½ to 1	A flavouring agent
Calcii Lactophosphatis	Calcium lactate 75 gms., concentrated phosphoric acid 45 mils., sugar 700 gms., commercial orange flower water 25 mils., and water *q.s.* to 1000 mils.	7½ p.c.	½ to 1	Nervine tonic

Syrupus	Composition	Strength by volume	Dose in drachm	Action
Cascaræ Aromaticus	Liquid extract of cascara 40, tincture of orange 10, alcohol (90 p.c.) 5, cinnamon water 15, and syrup *q.s.* to 100	1 in 2½	½ to 2	Stomachic, tonic and laxative
Chloral	Chloral hydrate 2 gms., water 2 mils., and syrup *q.s.* to 10 mils.	1 in 5 or 10.9 grs. in 1 dr.	½ to 2	Hypnotic
Codeinæ Phosph.	Codeine phosphate 5 gms., water 15 mils., and syrup *q.s.* to 1000 mils.	1 in 200 or 0.27 gr. in 1 dr.	½ to 2	Hypnotic
Ferri Iodidi	Iron wire 15 gms., iodine 41.4 gms., distilled water 75 mils., glucose 100 gms., syrup *q.s.* to 1000 mils.	3.75 grs. of ferrous iodide in 1 dr.	½ to 1	Hæmatinic, tonic and alterative
Ferri Phosphatis	Iron wire 8.6 gms., concentrated phosphoric acid 62.5 mils., syrup 700 mils., and water *q.s.* to 1000 mils.	1 gr. of ferrous phosphate in 1 dr.	½ to 1	Hæmatinic, nervine tonic
Ferri Phosph. c. Quin. et Strychnina	Iron wire 8.6 gms., concentrated phosphoric acid 62.5 mils., strychnine powdered 0.57 gm., quinine sulphate 14.8 gms., syrup 700 mils., and water *q.s.* to 1000 mils.	1 gr. ferrous phosphate, ⅘ gr. of quin. sulph. and $\frac{1}{3\frac{1}{2}}$ gr. of strychnine in 1 dr.	½ to 1	A general and nervine tonic
Glucosi	Glucose and syrup	1 in 3	—	An excipient for pills
Limonis	Sliced lemon peel 2 gms., alcohol (90 p.c.) *q.s.* lemon juice 50 mils., and sugar 76 gms.	1 of peel and 25 of juice in 65	½ to 1	A flavouring agent
Pruni Virginianæ	Virginian prune bark 150 gms., sugar 750 gms., glycerin 65 mils., and water *q.s.* to 1000 mils.	15 p.c.	½ to 1	Nervine sedative and a sweetening agent
Rhei	Rhubarb 70 gms., ol. coriander 0.5 mil., sugar 840 gms., alcohol (90 p.c.) 280 mils., and water *q.s.* to 1000 mils.	7 p.c.	½ to 2	A mild laxative for children

Syrupus	Composition	Strength by volume	Dose in drachm	Action
Rhœados	Red poppy petals 26 gms., sugar 72 gms., alcohol (90 p.c.) 5 mils., and water *q.s.* to 100 mils.*	26 p.c.	½ to 1	A colouring agent for mixtures
Rosæ	Dried red-rose petals 5 gms., sugar *q.s.* and boiling water 50 mils.	6 p.c.	½ to 1	A bright colouring agent
Scillæ	Vinegar of squill 175 mils., sugar 650 gms., water *q.s.* to 1000 mils.	17.5 p.c.	½ to 1	Expectorant and emetic
Sennæ	Senna 440 gms., oil of coriander 0.2 mils., alcohol (90 p.c.) 2 mils., sugar 540 gms. and alcohol (20 p.c.) 760 mils.	1 in 2½	½ to 2	A mild cathartic
Tolutanus	Balsam of tolu 25 gms., sugar 660 gms., and water *q.s.* to 1000 gms.; by weight	1 in 40	½ to 1	A sweetening agent for cough mixtures
Urgineæ	Same as squill using vinegar of urginea	17.5 p.c	½ to 1	Expectorant
Zingiberis	Ginger 25 gms., alcohol (90 p.c.), syrup of each *q.s.* to produce 1000 mils.	1 in 40	½ to 1	Carminative and antispasmodic

If the student will take the trouble to familiarise himself with the colour, smell and taste of the different syrups he will have no difficulty in distinguishing them from one another. Syrups which resemble each other in colour always have either a characteristic smell or taste. He should group them according to the following table of colours, and then smell and taste them until all doubt is removed.

* In India and the Colonies when prevailing high temperatures render this preparation liable to ferment the proportion of alcohol (90 p.c.) may be increased to not more than double the proportion stated in the text of the Pharmacopœia, an equivalent quantity of distilled water being omitted.

Syr. Aurantii Flor.	Colourless	Syr. Sennæ	Dark-brown
,, Calcii Lactophosph.		,, Aurantii	Straw-coloured
,, Chloral		,, Aromat.	
,, Codeniæ		,, Limonis	
,, Ferri Iodidi		,, Scillæ	
,, ,, Phosph.		,, Urgineæ	
,, Acidi Hydriodici		,, Zingiberis	
,, Tolutanus		,, Rhœados	Red
,, Cascaræ Aromat.	Brown	,, Rosæ	
,, Pruni Virginianæ		Syrup of ginger is somewhat cloudy	
,, Rhei		Syrup. Ferri Iodidi is very liable to discoloration	

Tabellæ. Tablets.—According to the B.P. tablets are small flat pieces of chocolate containing minute doses of medicinal agents. Tablet-preparations are very popular now, but are often useless since when made by compression they may become so hard and insoluble as to be recovered quite undissolved from the fæces. According to their mode of preparation, they may be divided into three classes, viz. :—(1) those made by compression ; (2) those made without compression but by moulding, commonly known as tablet-triturates ; and (3) those prepared from a chocolate basis, as ordered by the B.P. The manufacture of compressed tablets has of late developed into a special industry in practical pharmacy and is done by special machinery.

There is only one tablet in the B.P., *viz.* :—

Tabellæ Trinitrini.—Made of chocolate, each weighing 5 grains (0.300 gm.) and containing $\frac{1}{100}$ gr. (0.5 mg.) of commercial trinitroglycerin. *Dose.*—1 or 2 tablets.

Tincturæ.—Tinctures are alcoholic solutions containing all the active ingredients of the drugs of which they are compounded. In this respect they differ from the official spirits which are merely alcoholic solutions of essential oils. They are seventy-one in number ; of these, two are from the animal kingdom, *viz.* :—Tr. Cocci and Tr. Cantharidini ; three are prepared from inorganic substances, *viz.* :—Tr. Ferri, Tr. Iodi Fort. and Tr. Iodi Mitis ; whilst the remaining sixty-six are of vegetable origin. Seventeen tinctures are made by plain solution, twenty-one by maceration, thirty-one by percolation, and two by both maceration and percolation.

Alcohol of various strengths is used to make sixty-nine tinctures, such as alcohol (90 p.c.) in twenty-two, alcohol (70 p.c.) in fifteen, alcohol (60 p.c.) in twenty-one, alcohol (45 p.c.) in eleven ; whilst water in addition is put in seven.

One tincture is made with ether, *e.g.*, Tr. Lobel. **Ætheris,** and one with tincture of orange-peel, *e.g.*, Tr. Quininæ.

Forty-nine tinctures are "*simple*," having only one ingredient and one solvent. Ten tinctures are called "*Compound*," having more than one ingredient. Another group of twelve tinctures are not called compound in the B.P. though they contain more than one ingredient and a solvent. They may more appropriately be named "*Complex*."

We shall group the Tinctures under three heads, *viz.* :— (1) **Simple,** (2) **Compound** and (3) **Complex.**

SIMPLE TINCTURES

Tinctura	Ingredients	Degree of comminution	Alcohol p.c. in menstruum	Process	Strength	Dose
Aconiti	Root	40	70	P.	0.04 p.c. alkaloids	2 to 5 ms.
Alstoniæ	Dried bark	20	60	M.	1 in 8	½ to 1 dr.
Arnicæ Florum	Dried flowers	20	45	P.	1 in 10	½ to 1 dr.
Asafetidæ	Gum-resin	—	70	M.	1 in 5	½ to 1 dr.
Aurantii	Fresh peel	—	90	M.	1 in 4	½ to 1 dr.
Belladonnæ	Leaves, dried	20	70	P.	0.035 p.c. (alkaloid)	5 to 15 ms.
Berberidis	Berberis	60	60	P.	1 in 10	½ to 1 dr.
Buchu	Leaves	20	60	P.	1 in 5	½ to 1 dr.
Calumbæ	Root	20	60	M.	1 in 10	½ to 1 dr.
Cannabis Ind.	Extract	—	90	S.	1 in 20	5 to 15 ms.
Capsici	Fruit	20	60	M.	1 in 20	5 to 15 ms.
Cascarillæ	Bark	40	70	P.	1 in 5	½ to 1 dr.
Chiratæ	Chiretta	20	60	P.	1 in 10	½ to 1 dr.
Cinchonæ	Red bark (Standardised)	40	70	P.	1 p.c. alkaloids	½ to 1 dr.
Cinnamomi	Bark	40	70	P.	1 in 5	½ to 1 dr.
Cocci	Cochineal	—	45	M.	1 in 10	5 to 15 ms.
Colchici	Seeds	30	70	P.	1 in 10	5 to 15 ms.
Cubebæ	Cubebs	20	90	P.	1 in 5	½ to 1 dr.
Daturæ Seminum	Datura seeds	20	70	P.	1 in 4	5 to 15 ms
Digitalis	Leaves	20	70	P.	1 in 10	5 to 15 ms.
Ferri Perchlor.	Strong solution 25 gms., alcohol 25 gms., and water *q.s.*	—	90	S.	1 in 4	5 to 15 ms.

Note. M.=Maceration. P.=Percolation. S.=Solution.

Tinctura	Ingredients	Degree of comminution	Alcohol p.c. in menstruum	Process	Strength	Dose
Gelsemii	Root	40	60	P.	1 in 10	5 to 15 ms.
Hamamelidis	Bark	20	45	P.	1 in 10	½ to 1 dr.
Hydrastis	Liquid extract	—	60	S.	1 in 10	½ to 1 dr.
Hyoscyami	Leaves	20	70	P.	1 in 10	½ to 1 dr.
Jalapæ	Jalap (standardised)	40	70	P.	1·5 p.c. resin	½ to 1 dr.
Kaladanæ	Kaladana	40	70	P.	1 in 5	½ to 1 dr.
Krameriæ	Root	40	60	P.	1 in 5	½ to 1 dr.
Limonis	Fresh peel	—	90	M.	1 in 4	½ to 1 dr.
Lobeliæ Ætherea	Lobelia, spirit of ether	40	Spt. ether	P.	1 in 5	5 to 15 ms.
Myrrhæ	Myrrh	—	90	M.	1 in 5	½ to 1 dr.
Nucis Vomicæ	Liquid extract 5 mils., water 15 mils.	—	90	S.	$\frac{1}{16}$ gr. strychnine in 110 ms.	5 to 15 ms.
Oliveri Cort.	Oliver's bark	40	60	P.	1 in 10	½ to 1 dr.
Opii	Opium 20 gms., water *q.s.* (Standardised)	—	90	M.	1 gr. morphine in 110 ms.	5 to 15 ms. or 20 to 30 ms.
Picrorhizæ	Picrorhiza cut small and bruised	—	45	M.	1 in 4	½ to 1 dr.
Podophylli	Resin	—	90	S.	3·65 p.c.	5 to 15 ms.
Podophylli Indici	Indian podophyllum resin	—	90	S.	3.65 p.c.	5 to 15 ms.
Pyrethri	Roots	40	70	P.	1 in 5	Not taken
Quassiæ	Chips	—	45	M.	1 in 10	½ to 1 dr.
Quillaiæ	Bark	20	60	P.	1 in 20	½ to 1 dr.
Quininæ	Quinine hydrochloride	—	Tr. aurant	S.	2 grs. in 110 ms.	½ to 1 dr.
Scillæ	Squill	—	60	M.	1 in 5	5 to 15 ms.
Senegæ	Root	40	60	P.	1 in 5	½ to 1 dr.
Serpentariæ	Rhizome	40	60	P.	1 in 5	½ to 1 dr.
Stramonii	Leaves	20	45	P.	1 in 5	5 to 15 ms.
Strophanthi	Seeds, ether, *q.s.*	30	70	P.	1 in 10	2 to 5 ms.
Tolutana	Balsam	—	90	S.	1 in 10	½ to 1 dr.
Urgineæ	Urginea, bruised	—	60	M.	1 in 5	5 to 15 ms.
Zingiberis	Rhizome	40	90	P.	1 in 10	½ to 1 dr.

Note. M.=Maceration. P.=Percolation. S.=Solution.

Compound Tinctures

Tinctura	Ingredients	Alcohol p.c. in menstruum	Process	Strength	Dose
Benzoini Co.	Benzoin 100 gms., storax 75 gms. tolu 25 gms., aloes 20 gms.	90	M.	1 in 10	½ to 1 dr. (2 to 4 mils.)
Camphoræ Co.	Tincture of opium 50 mils., benzoic acid 5 gms., camphor 3 gms., oil of anise 3 mils.	60	S.	5 p.c. of laudanum or $\frac{1}{7}\frac{1}{7}$ gr. morphia in 1 dr.	½ to 1 dr. (2 to 4 mils.)
Cardamomi Co.	Cardamom seeds 14 gms., caraway fruit 14 gms., cinnamon bark 28 gms., cochineal 7 gms. glycerin 100 mils.	45	P.	1.4 p.c.	½ to 1 dr. (2 to 4 mils.)
Chloroformi et Morph. Co.	Chloroform 75 mils., morphine hydrochloride 10 gms., diluted hydrocyanic acid 50 mils., tincture of capsicum 25 mils., tincture of Indian hemp 100 mils., oil of peppermint 2 mils., glycerin 250 mils.	90	S.	¾ m. chloroform, ½ m. acid. hydrocyan. dil., $\frac{1}{1}\frac{1}{1}$ gr. morph. hydrochlor. in 10 ms.	5 to 15 m (3 to 10 dls.)
Cinchonæ Co.	Tincture of cinchona 500 mils., bitter orange peel 50 gms., serpentary 25 gms., cochineal 3 gms.	70	M.	½ gr. alkaloids in 110 ms.	½ to 1 dr. (2 to 4 mils.)
Gentianæ Co.	Root 100 gms., bitter orange peel 37½ gms., cardamom seeds 12½ gms.	45	M.	1 in 10	½ to 1 dr. (2 to 4 mils.)
Jalapæ Co.	Jalap 80 gms., scammony resin 15 gms., turpeth 10 gms.	60	P.	1 in 12½	½ to 1 dr. (2 to 4 mils.)

Note. M.=Maceration. P.=Percolation. S.=Solution.

Tinctura	Ingredients	Alcohol p.c. in menstruum	Process	Strength	Dose
Lavandulæ Co.	Oil of lavender 5 mils., oil of rosemary 0.5 mils., cinnamon bark 10 gms., nutmeg 10 gms., red sanders wood 20 gms.	90	M.	1 in 200	½ to 1 dr. (2 to 4 mils.)
Rhei Co.	Rhubarb 100 gms., cardamom, coriander each 12.5 gms., glycerin 100 mils.	45	P.	10 grs. in 110 m.	½ to 1 dr. (2 to 4 mils.) or 2 to 4 drs. (8 to 16 mils.)
Senna Co.	Senna 200 gms., caraway, coriander each 25 gms., glycerin 100 mils.	45	P.	1 in 5	½ to 1 dr. (2 to 4 mils.) or 2 to 4 drs. (8 to 16 mils.)

Complex Tinctures

Tinctura	Ingredients	Alcohol p.c. in menstruum	Process	Strength	Dose
Cantharidini	Cantharidin 0.1 gm., chloroform 10.0 mils.	90	S.	0.01 p.c.	2 to 5 ms. (12 to 30 cls.)
Catechu	Catechu 200 gms., cinnamon bark 50 gms.	45	M.	1 in 5	½ to 1 dr. (2 to 4 mils.)
Ergotæ Ammoniata	Ergot 250 gms., solution of ammonia 100 mils.	60	P.	1 in 4	½ to 1 dr. (2 to 4 mils.)

Note. M.=Maceration. P.=Percolation. S.=Solution.

Tinctura	Ingredients	Alcohol p.c. in menstruum	Process	Strength	Dose
Guaiaci Ammoniata	Resin 200 gms, oil of nutmeg 3 mils., oil of lemon 2 mils., strong solution of ammonia 75 mils.	90	S.	1 in 5	½ to 1 dr. (2 to 4 mils.)
Iodi Fortis	Iodine 100 gms., pot. iodide 60 gms., water 100 mils.	90	S.	$\frac{1}{11}$ gr. in 1 ms.	Used externally
Iodi Mitis	Iodine 25 gms., potassium iodide 25 gms., water 25 mils.	90	S.	1 in 40 or $\frac{1}{44}$ gr., in 1 m.	2 to 5 ms. (12 to 30 cls.)
Kino	Kino 100 gms., glycerin 150 mils., water 250 mils.	90	S.	1 in 10	½ to 1 dr. (2 to 4 mils.)
Opii Ammon.	Tincture of opium 100 mils., benzoic acid 20 gms., oil of anise 5 mils., solution of ammonia 200 mils.	90	S.	$\frac{1}{10}$ gr. of morphine in 110 ms.	½ to 1 dr. (2 to 4 mils.)
Pruni Virg.	Virg. prune bark 200 gms., water 365 mils., glycerin 100 mils.	90	M.	1 in 5	½ to 1 dr. (2 to 4 mils.)
Quininæ Ammoniata.	Quinine sulph. 20 gms., solution of ammonia 100 mils.	60	S.	2 grs. in 110 ms.	½ to 1 dr. (2 to 4 mils.)
Valerianæ Ammoniata.	Rhizome 200 gms., oil of nutmeg 3 mils., oil of lemon 2 mils., ammonia solution 100 mils.	60	M.	1 in 5	½ to 1 dr. (2 to 4 mils.)
Valerianæ Ind. Ammon.	The same as above. Use Indian valerian	60	M.	1 in 5	½ to 1 dr. (2 to 4 mils.)

Note. M.=Maceration. P.=Percolation. S.=Solution.

Trochisci.—Troches or **Lozenges** are flat solid tablets composed of a basis and one or more active drugs uniformly divided, for the purpose of slowly melting in the mouth. They are prepared either with a Fruit basis, Rose basis, Simple basis or Tolu basis. The new B.P. has the following for the preparation of these bases :—

Fruit basis.—Take 500 times the quantity of the drug ordered for one lozenge ; mix with it 6.5 grammes of tragacanth and 26 grammes of refined sugar, both in fine powder. Add sufficient of the black currant paste of commerce to produce 650 grammes, beat into a uniform mass, divide into 500 lozenges and dry in a hot-air chamber at a moderate temperature.

Rose basis.—This is made in the same way as simble basis, previously mixing with the refined sugar 0.025 millilitre of Oil of Rose.

Simple basis.—Mix the drug (500 times) with 496 grammes of refined sugar and 19.5 grammes of gum acacia, both in fine powder. Make into a paste with 35 millilitres of mucilage of gum acacia and a sufficient quantity of distilled water, divide into 500 equal lozenges and dry as above.

Tolu basis.—This is made in the same way as simple basis, except that 10 millimetres of Tr. of Balsam of Tolu are added to the mass instead of rose-water or current paste.

Trochiscus	Ingredients	Basis	Strength in each	Action and use
Acidi Benzoici	Benzoic acid	F.	½ gr.	Antiseptic and expectorant
Acidi Carbolici	Phenol, sugar, gum acacia, tragacanth, and lemon juice	—	¼ gr.	Antiseptic and local stimulant
Acidi Tannici	Tannic acid	T.	½ gr.	A local astringent
Bismuthi Co.	Bismuth oxycarbonate, heavy magnesium carb., precipitated calcium carb.	R.	2½ grs. 2½ grs. 5 grs.	Antacid
Catechu	Catechu	F.	1 gr.	Local astringent
Ferri Redacti	Reduced iron	S.	1 gr.	Hæmatinic tonic
Guaiaci Resinæ	Guaiacum resin	F.	3 grs.	Checks acute tonsillitis
Ipecacuanhæ	Ipecacuanha root	S.	¼ gr.	Expectorant
Kino Eucalypti	Eucalyptus kino	F.	1 gr.	A local astringent
Krameriæ	Extract of karmeria	F.	1 gr.	Astringent
Krameriæ et Cocianæ	Extract krameria, cocaine hydrochloride	F.	1 gr. $\frac{1}{20}$ gr.	Astringent and anæsthetic
Morphinæ	Morphine hydrochloride	T.	$\frac{1}{32}$ gr.	Allays cough

Note. F.=Fruit. R.=Rose. S.=Simple. T.=Tolu.

Trochiscus	Ingredients	Basis	Strength in each	Action and use
Morphinæ et Ipecacuanhæ	Morphine hydrochloride, ipecac. root	T.	$\frac{1}{12}$ gr. $\frac{1}{11}$ gr.	Allays cough
Potassii Chloratis	Potassium chlorate	R.	3 grs.	Alterative in relaxed throat
Santonini	Santonin	S.	1 gr.	A vermicide for round worms
Sulphuris	Precipitated sulphur, cream of tartar, sugar, gum acacia, mucilage and tincture of orange	—	5 grs.	A mild laxative

Unguenta.—Ointments are semisolid or soft preparations for external application containing some active drugs mixed with a fatty, oily or paraffin basis, lard either plain or benzoated, glycerin, oleic acid, spermaceti, almond oil, olive oil, lanoline, prepared suet, bees-wax, etc., either alone or in combination form the basis of all B.P. ointments.

There are forty-three ointments in the B.P. They may be divided into two classes, *viz.*—(1) *General* and (2) *Mercurial.* Thirty-three come under **General,** and ten under **Mercury.**

GENERAL OINTMENT

Unguentum	Composition	Strength	Action and use
Acidi Borici	Boric acid 1, white paraffin ointment 9	1 in 10	Antiseptic
Acidi Carbolici	Phenol, white paraffin ointment	3 p.c.	Antiseptic and deodorant
Acidi Salicylici	Salicylic acid, white paraffin ointment	1 in 50	Antiseptic
Aconitinæ	Aconitine 2 gms., oleic acid 16 gms., lard 82 gms.	2 p.c. aconitine	A powerful local analgesic and sedative
Aquæ Rosæ	Rose-water 20 mils., white beeswax, 18 gms., borax 1 gm., almond oil 61 gms., oil of rose 0.1 mil.	1 in 5	Fragrant, emollient and demulcent
Atropinæ	Atropine 2 gms., oleic acid 8 gms., lard 90 gms.	2 p.c. atropine	A local anodyne

Note. R.=Rose. S.=Simple. T.=Tolu.

Unguentum:	Composition	Strength	Action and use
Belladonnæ	Liquid extract (evaporated) 8 mils., benzoated lard 6 gms., wool fat 2 gms.	0.6 p.c. alkaloid	Anodyne and antiphlogistic
Cantharidini	Cantharidin 0.1 gm., chloroform 10 mils., benzoated lard 290 gms.	0.033 p.c.	Rubefacient
Capsici	Fruit 25 gms., hard paraffin 10 gms., soft paraffin 75 gms., lard 10 gms.	1 in 4½	Rubefacient
Cetacei	Spermaceti 20, white beeswax 8, liquid paraffin 72	1 in 5	Emollient and demulcent
Chaulmoograe	Chaulmoogra oil 10, hard paraffin 40, soft white paraffin 50	1 in 10	In leprosy, lupus, eczema, etc.
Chrysarobini	Chrysarobin, benzoated lard	1 in 25	Antiparastiic and a stimulant application for psoriasis
Cocainæ	Cocaine 4 gms., oleic acid 16 gms., lard 80 gms.	4 p.c. cocaine	A local anæsthetic
Creosoti	Creosote 1, hard paraffin 4, soft paraffin white 5	1 in 10	Antiseptic
Eucalypti	Oil of eucalyptus 1, hard paraffin 4, soft paraffin (white) 5	1 in 10	Antiseptic
Gallæ	Galls, benzoated lard	1 in 5	An astringent application for piles
Gallæ c. Opio	Gall ointment 92.5, powdered opium 7.5	7½ p.c. opium	Anodyne and astringent in inflamed piles
Hamamelidis	Liquid extract hamamelis 1 mil., soft paraffin 3 gms., wool fat 6 gms.	1 in 10	Astringent (for piles)
Iodi	Iodine, potassium iodide each 4 gms., glycerin 12 gms., lard 80 gms.	1 in 25	Irritant, resolvent and alterative
Iodoformi	Iodoform, prepared lard	1 in 10	Antiseptic and antisyphilitic
Lanæ Co.	Lard 4, wool fat 4, paraffin ointment 2	1 in 2½	Emollient and demulcent
Myrobalani	Myrobalans, benzoated lard	1 in 5	Astringent application for piles
Myrobalani cum Opio	Myrobalan ointment and powdered opium	7.5 p.c. (opium)	Anodyne and astringent for piles

Unguentum	Composition	Strength	Action and use
Paraffini	Hard paraffin 27 gms., soft paraffin 70 gms., white beeswax 3 gms.	97 p.c.	A basis for ointment (demulcent)
Picis Liquidæ	Tar 70, yellow beeswax 25, lard 5	70 p.c.	A local stimulant and antiseptic
Plumbi Iodidi	Lead iodide, benzoated lard	1 in 10	Alterative and resolvent
Plumbi Subacetatis	Strong solution of lead subacetate 12.5, wool fat 25, hard paraffin 12.5, soft paraffin 50	1 in 8	A mild astringent and sedative
Potassii Iodidi	Potassium iodide 10, potassium carbonate 0.6, water 9.4, benzoated lard 80	1 in 10	Alterative and resolvent
Resinæ	Resin 26, yellow beeswax 26, olive oil 26, lard 22	26 p.c.	Stimulant to indolent sores
Staphisagriæ	Stavesacre seeds 2, yellow beeswax 1, benzoated lard 8½	1 in 5	Parasiticide. Destroys pediculi
Sulphuris	Sublimed sulphur 1, benzoated lard 9	1 in 10	Antiparasitic. Cures scabies
Zinci	Zinc oxide 3, benzoated lard 17	1 in 20	A mild astringent for eczema
Zinci Oleatis	Zinc sulphate 30 gms., hard soap shavings 90 gms., boiling water and white soft paraffin of each *q.s.*	1 in 2	A mild astringent for eczema

Three ointments contain alkaloids ; *viz.* :—Ung. Aconitinæ, Ung. Atropinæ, and Ung. Cocainæ. They are all prepared with oleic acid and lard.

Mercurial Ointments

Unguentum	Composition	Strength	Action and use
Hydrargyri	Mercury 30, benzoated lard 65, prepared suet 5	30 p.c.	Resolvent, antiparasitic,
Hydrargyri Ammoniati	Ammoniated mercury, benzoated lard	1 in 20	Antiparasitic. Destroys pediculi

Unguentum	Composition	Strength	Action and use
Hydrarg.Comp.	Mercury ointment 40, yellow beeswax, olive oil each 24, camphor 12	12 p.c. of mercury	Absorbent. Useful in glandular enlargement, etc.
Hydrargyri Iodidi Rubri	Red iodide, benzoated lard	1 in 25	A local stimulant and rubefacient. Used in goitre.
Hydrargyri Nitratis	Mercury 1 gm., nitric acid 3 mils., lard 4 gms., olive oil 7 gms.	1 in 15 of mercury	A local alterative, astringent and stimulant
Hydrargyri Nitratis Dil.	Mercuric nitrate ointment and yellow soft paraffin	1 in 5	Same as above. Invaluable in inveterate eczema and tinea tarsi
Hydrargyri Oleati	Mercuric oleate, benzoated lard	1 in 4	Same as Ung. Hydrarg.
Hydrargyri Oxidi Flavi	Yellow mercuric oxide, soft paraffin (yellow)	1 in 50	Alterative, stimulant. In chronic eczema, ringworm, syphilitic eruption. Diluted in conjunctivitis
Hydrargyri Oxidi Rubri	Red mercuric oxide, yellow paraffin ointment	1 in 10	Caustic. Diluted, same as above
Hydrargyri Subchloridi	Mercurous chloride, benzoated lard	1 in 5	Antisyphilitic, alterative and resolvent.

In tropical and subtropical parts of the Empire more or less Benzoated Lard, Benzoated Suet, Prepared Lard, Prepared Suet, Yellow or White Beeswax may be employed in the preparation of the ointments when prevailing high temperatures or otherwise render the basis too soft.

Vina.—Wines are weak tinctures of drugs made with sherry or orange wine instead of alcohol. These are prepared either by solution or maceration like tinctures, but never by percolation. Sherry (16 p.c. alcohol) is the menstruum for all the official medicated Wines, except Vin. Ferri Citratis and Vin. Quininæ which are made with ornage wine (10 p.c. alcohol). The sherry must be good, otherwise the wines will quickly spoil. They are eight in number including **Vinum Aurantii** and **Vinum Xericum.**

Vinum	Composition	Process	Strength	Dose
Anti-moniale	Tartarated antimony 4 gms., boiling water 40 mils., sherry *q.s.* to 1000 mils.	S.	0.4 p.c. or 2 grs. in 1 oz.	10 to 30 ms. (6 to 18 dls.) or 2 to 4 drs. (8 to 16 mils.)
Colchici	Corm 200 gms., sherry 1000 mils.	M.	1 in 5	10 to 30 ms. (6 to 18 dls.)
Ferri	Iron wire 50 gms., sherry 1000 mils.	M.	0.125 to 0.3 p.c.	1 to 4 drs. (4 to 16 mils.)
Ferri Citratis	Iron and ammonium citrate 18 gms., orange wine *q.s.* to 1000 mils.	M.	1 gr. in 1 dr. or 1.8 p.c.	1 to 4 drs. (4 to 16 mils.)
Ipecacu-anhæ	Liquid extract 50 mils., sherry 950 mils.	S.	1 in 20 0.1 p.c. alkaloid	10 to 30 ms. (6 to 18 dls.) or 4 to 6 drs. (16 to 24 mils)
Quininæ	Quinine hydrochloride 2 gms., orange wine 875 mils.	S.	1 gr. to 1 oz.	½ to 1 oz. (16 to 30 mils.)

NON-OFFICIAL OR NON-PHARMACOPŒIAL PREPARATIONS

Few medical practitioners of the present day confine their prescriptions to the range of the official Pharmacopœia. They use a host of other preparations, which are being daily brought to their notice by enterprising manufacturing pharmacists. The list is ever increasing. We therefore limit our descriptions to those which are in ordinary use.

Balnea. Baths.—The immersion of the whole or a part of the body in some liquid or vapour is called a bath. It is said to be **general** when the whole body is brought under its influence, and **local** when a part only.

Properly speaking, only medicated baths come under non-official preparations; but we think this is a fit place for giving a description of the different kinds of medicated and non-medicated baths.

A. Cold Bath.—Temp. 35° to 70° F. Average 50° to 60° F. It has a powerful **tonic** action, increasing digestion, metabolism and body weight; but in order to obtain these effects the bath should not be continued long after the primary reaction has set in. If it is prolonged it may cause secondary depression followed by delayed reaction. In fevers, it **abstracts heat,** and thereby lessens tissue change and prevents complications;

Note. M.=Maceration. S.=Solution.

hence it is very useful in hyperpyrexia of **rheumatism, typhus, typhoid, and remittent fever,** and **pneumonia.** The bath must be repeated if the temperature rises. There are several ways of using a cold bath. The following are a few examples :—

1. **Cold Affusion.**—In which 5 to 6 gallons of cold water are thrown over the body. It is valuable for resuscitating persons from **syncope, narcotic poisoning, convulsions, sunstroke, hysteria,** etc.

2. **River Bath.**—Bathing in the river is more invigorating than a full cold bath either in a tub, reservoir, or tank. It stimulates digestion, gives tone to the system and strengthens muscles, especially if it is accompanied by swimming, or if the current of the water is very strong.

3. **Cold Shower Bath** is an effective **tonic,** being useful in **mania, hysteria, sunstroke,** etc. **Needle Bath** is a shower bath thrown in a fine spray.

4. **Cold Sitz-Bath or Cold Hip-Bath.**—In this a person sits in a tub with the water up to his hips. The vessels of the cooled surface and intestines first contract and then dilate, especially when friction is applied.

5. **Cold Foot-Bath** tones the system and strengthens the feet, but is to be avoided during the menstrual period The Hindu Women of Bengal, who walk bare-footed and wash their feet many times a day, can bathe with impunity at this time.

6. **Cold Wet-Sheet Pack** is done thus —Spread two blankets over the bed taking care to cover the pillow. Thoroughly wet a bed-sheet and spread it over them. Strip the patient naked and make him lie flat on the sheet. Wrap him up tightly in the sheet and blankets, the ends of the sheet being carefully tucked in on each side and the feet covered. Cover him with two or more blankets, the face being left open. After a short feeling of chilliness the patient experiences a delightful glow followed by copious perspiration, thereby reducing the temperature, delirium, and irritability. After ½ to 1 hour the packing is removed and the body well rubbed with dry towels.

Instead of cold, tepid or warm water may be substituted. The above description applies to **general packing,** which is usefully employed in **specific fevers,** such as measles, scarlatina, small-pox, etc., to help the development of the rash, or to bring it out if it has receded. To reduce **delirium, excitement,** and **hyperpyrexia,** and in **mania** and **insomnia,** it is always useful. A **local wet pack** can be used in pneumonia, chronic diarrhœa, etc. A **cold compress** round the throat checks the inflammation of acute tonsillitis, whilst a similar compress on the stomach will often check obstinate vomiting.

7. **Cold Douche.**—In this a single stream of water is forcibly directed against a part of the body. Its effects depend mainly upon the size, height, and temperature of the stream, as well as the extent of the surface affected. The douche can be usefully directed against (*a*) *head,* in alcoholic coma and narcotic poisoning ; (*b*) the *spine,* in spermatorrhœa, melancholia, and general debility ; (*c*) *liver and spleen* for chronic congestion and enlargement ; (*d*) the *joints,* for chronic inflammation and stiffness ; (*e*) the *perinæum,* in which case an **ascending douche** with a rose is used in pruritus ani, hæmorrhoids and spermatorrhœa ; (*g*) the *vargina,* in leucorrhœa ; (*h*) *rectum,* in constipation and hæmorrhage.

8. **Cold Sponging.**—In this the surface of the body is freely sponged over while the patient is sitting or standing on a shallow tub. It has a tonic and bracing effect, serviceable in laryngismus stridulus, chorea, rickets, spermatorrhœa, etc

9. **Ice Bag and Leiter's Coil.**—For local application of cold to the head, chest, or abdomen, an india-rubber bag filled with ice or a closely wound coil of metal tubing through which a continuous stream of water is allowed to flow may be applied.

10. **A Freezing Mixture** consisting of powdered ice 2 parts, common salt 1 part, is very useful in minor operations and in chronic rheumatism. It causes anæsthesia and may vesicate if left too long in contact with the skin.

B. Warm or Hot Bath.—It may be either *medicated* or *non-medicated*, general or local. It (*a*) softens the dermis and liquefies the fatty secretions, and hence acts as a good **detergent** in many scaly and scabby skin diseases; (*b*) stimulates local circulation and lessens that of the internal organs, whereby relieves **pain** of intestinal, biliary, and renal colics; (*c*) relaxes tissues and relieves muscular spasms in urethral stricture, colics, laryngeal spasms, hernia, infantile convulsions, etc.; and (*d*) stimulates the secretion of sudoriferous glands, by which many kidney diseases are benefited and uræmia may be averted.

Great care should be taken during and after a hot bath. The patient must be quickly dried, covered, and put in a warm bed. A cup of hot tea, hot milk, or hot water greatly helps diaphoresis.

1. **Tepid Bath.**—Temp. 85° to 95° F. It has a detergent, sedative, and antipyretic effect. Useful in pyrexia and restlessness.

2. **Warm Bath.**—Temp. 95° to 100° F. Used in fevers, threatening inflammatory affections, etc., as bronchitis, pneumonia.

3. **Hot Bath.**—Temp. 100° to 106° F. Action is the same as above, but more powerful.

4. **Hot Foot-Bath.**—To arrest threatened catarrh, cold in the head, epistaxis, infantile convulsions, and to restore menstrual discharge stopped by cold.

5. **Hot Sitz-Bath.**—Useful in amenorrhœa, dysmenorrhœa, sudden cessation of menstruation from cold, dysuria, cystitis, etc. The addition of a little **mustard** helps to re-establish the menstrual flow more quickly.

6. **Hot-Water Sponging.**—Sponging the head, temples, and neck with hot water relieves the headache in influenza, catarrh, and other diseases.

7. **Hot Douche.**—A very hot uterine douche, temperature between 110° and 115°, is the best method at our disposal for checking post-partum hæmorrhage.

8. **Sir J. Simpson's Poor Man's Bath** is made by filling six to eight bottles with hot water and then wrapping them in stockings wet with hot water These are put by the side of the patient under blankets.

9. **Fomentation** and **Hot Poultices** are local warm baths (which see).

C. Medicated Baths.—In these, medicinal agents are dissolved in cold or warm water. They may be divided into the following :—

1. **Sea Bath.**—On account of the various saline ingredients held in solution, sea-bathing is especially invigorating and stimulating to the skin ; particularly when the water is boisterous. Moreover, the temperature being more or less uniform, sea-bathing is more easily borne by the weak than river-bathing.

2. **Carbonic Acid Bath.**—This is a stimulating saline bath containing sodium chloride 3 p.c., calcium chloride 1 p.c., carbonic acid gas (free) up to 3 grammes to 1 litre. Recommended in heart diseases either functional or organic. The effect of the **Nauheim Bath** is due to its saline and gaseous constituents.

3. **Acid Bath.**—In this a flannel roller 1 foot broad is soaked in a bath containing diluted nitro-hydrochloric acid 8 ozs. in 1 gallon of water at 98° F., and wrapped twice round the hepatic region, after wringing out the superfluous lotion. It is now completely covered by a piece of oiled silk leaving a little margin. The bath should be renewed morning and evening and worn for days. Useful in hepatic disorders.

4. **Alkaline Bath** is made by dissolving crystallised sodium carbonate (1 dr. to 1 gal.) in water, and is useful in removing scabs and scaly incrustations.

5. **Mustard Bath** (½ to 1 dr. in 1 gallon).—A powerful stimulant to the skin, used to quicken the appearance of exanthematous eruptions. The patient should remain in the bath from 5 to 10 minutes.

6. **Bran Bath.**—Bran 4 lbs. are boiled in water 1 gallon and strained. This liquor is added to water sufficient for a bath. It removes irritation of the skin.

7. **Neem Bath.**—It is prepared by adding the decoction of leaves of *melia azadirachta* to the ordinary bath. It may be general or local, and is largely employed in India in various skin diseases.

8. **Mineral Water Bath.**—A course of baths in any of the spas has special advantages. The effects of a bath in simple thermal water are similar to those derived from an ordinary warm bath ; but they differ according to the composition of the mineral waters. Thus, bathing in and drinking sulphur water are very efficacious in chronic rheumatism, gout, hepatic congestion etc.

D. Vapour Bath.—This may be aqueous or medicated. A **Steam Bath** may be made by boiling water over a spirit-lamp under a cane-bottomed chair, on which the patient sits, enveloped completely, except the head, by one or two blankets. Action and uses are the same as those of hot water bath. The **Russian Bath** consists in exposure of the body to moist vapour at different temperatures. It is said to be risky to persons with weak hearts, and there is certainly more danger of heat stroke than in the **Turkish Bath,** in which only dry air is used. Either of these baths is useful in rheumatism, gout, malarious fever, renal and skin diseases.

SCALE OF TEMPERATURES OF BATHS (Startin).

Bath	Water	Vapour	Hot Air
Cold	33° to 65° F.		
Cool	65° to 75° F.		
Temperate ..	75° to 85° F.		
Tepid	85° to 92° F.	90° to 100° F.	96° to 106° F.
Warm	92° to 98° F.	100° to 115° F.	106° to 120° F.
Hot	98° to 112° F.	115° to 140° F.	125° to 170° F.

E. Air Bath.—Hot-air bath may be employed like a steam bath, by simply burning a spirit-lamp under the bed-clothes, which are supported on a framework.

Bolus.—A bolus is a large pill containing over 10 grains of powdered ingredients. In England, when a bolus is ordered, it is dispensed as one large firm pill. Such is also the case in Calcutta. But in Ireland and elsewhere it is sent out as a soft paste or confection wrapped in waxed or oiled paper, folded like a powder with directions to scrape it off with a spoon and to swallow it down like jam. The most convenient plan, when a large dose of nauseous powder is to be administered, is to give it in a cachet or wafer paper.

Buginaria.—Bougies are elongated cylindrical preparations containing active drugs mixed with the suppository basis for introduction into the urethral and the nasal cavities. Bougies are made like suppositories but differ from them in shape. They can be made in a metallic mould, but the basis must first be liquefied and thoroughly mixed with the drugs, otherwise as the bore of the mould is narrow, there is a likelihood of its becoming clogged as the mixture solidifies.

Antrophores are medicated bougies containing a spiral spring wound with fine wire, and coated first with an insoluble layer of white gelatin and then with a diluted mucilage. They may be medicated with cocaine, iodoform, protargol, etc.

Cachets are wafer-paper capsules. They consist of two concave or watch-glass shaped halves or discs of wafer-paper stuck together at the rims by moisture. Any nauseous or bitter drug can be thus enclosed between the two halves and swallowed without being tasted. Cachets should be dipped in water immediately before swallowing.

Capsules.—A capsule is a gelatin sac enveloping a dose of some nauseous or disagreeable drug.

Carbasa Antiseptica.—Antiseptic Gauzes are mulmuls steeped in some antiseptic solution and dried afterwards. The following is the process for an extemporaneous preparation. Take 2 yards of gauze having 30 threads to the linear inch, hang it over a string, and spray over it uniformly the required volume of antiseptic solution on each side, turning once or twice until the whole of it is used. Or the folded gauze may be dipped into the solution in a deep dish, and turned over and over until the whole of it is equally absorbed, and then taken out, unfolded, and dried.

Cataplasmata. Cataplasms.—**Poultices** consist of linseed meal, bread, or starch made into a soft paste with hot or cold water for local application. They may be **hot or cold, medicated or non-medicated.** A hot poultice is the best means of locally applying warmth and moisture as well as medicaments. To prepare a hot linseed poultice, the linseed meal is mixed with boiling water with constant stirring; it should never be made by boiling the meal and water together. It must be of smooth consistency and not lumpy, and it must be nicely moist neither too wet nor too dry. Now spread quickly and evenly over a piece of muslin of the required shape and size, keeping its margins about 2 inches free for turning over the poultice. After application it must be covered with flannel to maintain heat, and kept in place by a bandage. If it is made with powdered cake instead of crushed linseed, some linseed or olive oil is to be added. Bread, flour with milk or water, also make good poultices. Hot bran poultice, though lighter, soon gets cold unless put in a flannel bag.

If the poultice is intended for a sore, boil, or abscess, the poultice material must be in direct contact with the skin.

Ice poultice can be prepared by spreading over a twofold piece of gutta-percha tissue a thin layer of cotton-wool, and over it a layer of powdered ice and a little salt; and then covering the ice with the remaining half of the gutta-percha and sealing the margins with chloroform. The whole thing being placed within a flannel bag. Sometimes a layer of linseed-meal is put on the ice. Useful in pneumonia and pleurisy.

Tokmalanga or *Tokmari* (seeds of *Ocimum basilicum*) make a capital demulcent and emollient cold poultice when soaked in water for a few minutes.

Neem Poultice.—A poultice of the leaves of *Melia azadirachta* is a very valuable soothing application.

Cerata.—**Ceratas** are ointments whose basis contains wax. They are official in the U.S.P. They are harder than ordinary ointments, but softer than plasters.

Chloroform Tinctures.—These are tinctures of drugs made with chloroform instead of alcohol; as Chloroformum Aconiti and Chloroformum Belladonnæ, B.P.C.

Cigarettes are made in the same way as ordinary cigarettes, except that certain drugs are substituted for tobacco; as arsenical and datura cigarettes.

Collunaria are lotions used as nasal douches.

Collutories are throat or mouth paints; as Glycerinum Acidi Borici. Collutoire is a French term.

Collyria are eye-lotions or eye-washes. Sometimes they are called eye-drops.

Cremora.—**Creams** are soft or semi-liquid preparations for external application: having glycerin, vaseline, or some similar substances as a basis, *e.g.* cold cream.

Dentifrices are preparations for cleansing the teeth. They may be a powder, paste, soap, or liquid.

Depilatories are preparations used for the removal of superfluous hair. Their effects depend upon the presence of a sulphide and a caustic alkali. The freshly prepared paste is applied in a thick layer over the affected part and allowed to remain for 5 or 10 minutes. It is then scraped off with a blunt knife and cold cream applied to the inflamed skin. Deep and painful ulcerations may result from incautious application of chemical paste. Those containing orpiment are more dangerous than those having barium sulphide.

Elæosacchara. Aromatic Sugars or Oil Sugars.—These are more common on the Continent than in England, and are made by triturating 9 minims of volatile oils to 1 oz. of sugar. They are used as flavouring agents.

Elixiria. Elixirs.—These are weak tinctures of drugs rendered pleasant and agreeable by the admixture of sugar and aromatics.

Emulsions.—**Emulsions** are mixtures of insoluble drugs minutely divided and suspended in water by mucilage or other substances. An emulsion can be made by (1) *saponification*, by adding an alkali or Tr. Quillaiæ or Tr. Senegæ to a fixed oil ; and by (2) *suspension* of a resinous substance in mucilage or yolks of eggs ; as emulsion of the oil of turpentine.

Enemata. Enemas. Clysters. Lavements. Rectal Injections.—A liquid preparation introduced into or through the rectum by means of a suitable instrument is called an enema.

If the injection is meant to evacuate the bowels, 1 to 2 pints of liquid are injected, the patient lying on his left side ; but when it is intended that it should be retained, a small quantity—2 to 4 ozs.—should be used. If it is considered desirable to introduce 3 to 6 pints, the liquid must be slowly thrown up the bowel while the patient is lying first on his left, then on his right side with his pelvis raised, or, if necessary, on his knees and elbows, pressing the anus with a towel, whenever there are expulsive cramps. This is best done by slowly pouring the fluid into a funnel to which a long gum-elastic tube is attached. It then flows steadily as the result of hydrostatic pressure and is less likely to be ejected. This process is called Enteroclysis. It must be borne in mind that the process of injection should be carried on slowly and with occasional pauses, otherwise the enema will be expelled by premature contraction of the intestine. The temperature of the liquid should be about 98° F. Cold water is soon rejected.

The following are the chief varieties of enemas with their uses :—

1. **Anthelmintic Enemata** are cheifly used to expel thread-worms.

2. **Antispasmodic Enemata.**—For this purpose an injection of Oil of Turpentine, Asafetida, Bromides, Hydrate of Chloral, Ether, etc., is given when the intestine is distended with flatus or getting cramped ; as Enema Terebinthinæ, Enema Asafetidæ, etc.

3. **Astringent Enemata.**—These are used for checking diarrhœa, rectal hæmorrhage, and mucus discharge from the rectum and lower bowels.

4. **Emollient Enemata.**—A decoction of starch, linseed, or barley soothes the irritable mucous membrane of the rectum and colon.

5. **Sedative Enemata.**—These are used in painful affections of the rectum, bladder, and uterus. Opium is used for this purpose.

6. **Purgative Enemata.**—These are often resorted to when the lower bowels are to be evacuated. Ordinarily, for an adult 1 pint, for a child of four years of age 4 to 6 ozs., and for an infant 1 oz., are enough. Soap and warm water, thin gruel, and castor oil or olive oil, etc., are often used for this purpose. Glycerin 1 to 2 drs. injected by means of a suitable syringe or a glycerin suppository introduced into the rectum evacuates the bowels speedily.

7. **Nutrient Enemata.**—In case where food cannot be swallowed by the mouth or retained by the stomach, peptonised milk, beef tea, eggs beaten up either alone or with brandy or milk, etc., may be injected, but not more than 4 ozs. at a time. But excepting glucose hardly anything else is absorbed by the rectum. Before the nutrient enema is given the bowel should be washed out each morning with tepid water.

Fomenta.—**Fomentations** consist of flannels, cloths, or sponges wrung out of hot water to which a drug may or may not have been added, for application to the surface of the body.

The proper way to apply fomentations is to take a twofold piece of flannel large enough to cover the affected part. Immerse this folded flannel in a kettle of boiling water or pour boiling water over it in a basin, and lift it by a pair of tongs or a stick, and put it on a wringer—a stout towel or duster with sticks attached to both ends. The water is then squeezed out as much as possible by the twisting of the sticks in opposite directions and the flannel is immediately applied to the affected part and covered with a large piece of india-rubber sheeting or oiled silk, extending about an inch beyond the flannel. Place over this a thick layer of cotton-wool and bandage. If the full effect of fomentation is desired the flannel should be changed every 20 or 30 minutes. In many cases a sponge or a piece of spongio-piline wrung out of boiling water forms a convenient form of fomentation. In the case of the feet, hands, or forearms, dipping them in hot water may do, but its temperature should be maintained by frequent small additions of boiling water.

If it is desired to produce a gentle counter-irritation, oil of turpentine may be sprinkled over the flannel before application. This forms the **turpentine-stupe.** For an anodyne or sedative action, laudanum may be sprinkled in the same way or a few poppy-heads or a little opium may be put into the water before boiling.

Dry fomentation is made by filling bags with hot bran, salt, sand, or chamomile flowers. Bottles filled with hot water and covered with flannel bags or old stockings may be used for dry fomentation. A piece of flannel roasted over fire and applied also serves the purpose.

Hot antiseptic compresses.—These consist of folds of lint or cloth soaked in hot antiseptic lotions covered with a piece of waterproof or gutta-percha tissue ; as Boric Acid Compress.

Fumigation is a local or general bath of volatilised drugs. Sulphur and mercury are chiefly used for this purpose. Mercurial fumigation, either *general* or *local*, has long been used in the treatment of secondary syphilis.

General mercurial fumigation is carried out in the following way :— The best apparatus for a mercurial vapour bath is that of Henry Lee. It consists of a spirit lamp enclosed in a case of wire gauze, on the top of which is a small plate surrounded by a procelain trough. About an ounce of water is poured into the trough and the lamp is lighted. When the water begins to boil, 20 to 30 grains of resublimed calomel are sprinkled on the plate, and the apparatus is placed under a chair, on which the patient sits undressed, but surrounded by a moleskin or india-rubber cloak tied round his neck, though kept away from his body by a cane hoop. If necessary, the slit of the cloak can be opened from time to time, to allow the vapour to be inhaled. The patient should be in the bath for about ½ hour and then removed to bed with his cloak on. The patient must not be left alone during the bath, lest he should faint.

Local mercurial fumigation is serviceable in obstinate syphilitic affections of the skin and mucous membranes.

Sulphur fumigation cures scabies.

Gargarismata.—Gargles.—A gargle is a liquid preparation used for topical action on the mouth, throat, and pharynx. A gargle may be any of the following kinds :—

1. **Stimulant Gargle,** that stimulates the mucous membrane and glands : as Capsicum (Tr. Capsicum 2 drs. to water 8 ozs.), Myrrh, Pyrethrum, Eucalyptus Gum (2 drs. to 8 ozs.), etc. These gargles often relieve deafness due to obstruction of the eustachian tube by increased pharyngeal secretion.

2. **Astringent Gargle,** that checks excessive secretion ; as iron salts zinc salts, alum, tannic acid (½ dr. to 8 ozs.), astringent infusions, etc.

3. **Antiseptic Gargle,** that removes foul secretions and odours ; as carbolic acid ½ dr., to rose-water 6 ozs. (Brunton), boric acid, potassium permanganate, etc.

4. **Demulcent Gargle,** that removes burning and irritation ; as barley water, linseed tea, ispaghul seed tea, milk, olive oil, etc.

Gossipia Antiseptica.—Antiseptic Cottons are made by charging absorbent cotton-wool with various antiseptic drugs. This is done by soaking cotton in some saturated antiseptic fluid and afterwards drying it ; as Gossip. Acid. Borici, Gossip. Acid. Salicylici etc.

Granules are minute pills. Granular preparations are very popular The B.P. effervescing preparations are granular.

Guttæ.—Drops are liquid preparations used as drops ; as eye-drops, drops for the ear, etc.

Haustus. Draught.—A liquid preparation or mixture when taken in a single dose is called a draught ; as caster oil draught, hydrate of chloral draught, etc.

Injectiones. Injections.—A liquid introduced into the body by means of a suitable instrument is called an **Injection.** The Injections can be introduced into the

(1) *Natural canals* or *open cavities* of the body ; as external ear eustachian tube, nose, nasal duct, stomach, rectum (*see* enema), urethra, bladder, vagina, and uterus.

(2) *Closed sacs*; as tunica vaginalis, serous cavities, synovial cavities, sheaths of tendons, cysts.

(3) *Veins*; as transfusion of blood and saline solutions.

(4) *Subcutaneous tissues and muscles*; as hypodermic injections.

Insufflations are powders blown into the throat, nostrils, or larynx. Laryngeal insufflation can be managed thus:—A vulcanite tube curved at a suitable angle, having an aperture covered by a slide, through which the medicinal powder is introduced, is carried over the tongue to the laryngeal orifice, and the powder is either blown in by the mouth or by an elastic bulb attached to the end of the tube. This instrument is called the "Pulverflator." A quill or a tube half filled with powder and blown by the mouth may do for nostrils and throat.

Jujubes are lozenges made of gum arabic and sugar. They are prepared by boiling to a suitable consistence, gum arabic 16 lbs., sugar 7 lbs. and water ½ gal. They are sometimes covered with a coating of crystallised sugar.

Lanolinum is an ointment or cream having hydrous wool fat as its basis; as Lanolinum Hydrargyri.

Linctus.—Lincture or **Loch** is a thin confection to be slowly swallowed in small doses, so as to act on the throat. The basis of linctus is either treacle, syrup, honey, or any other sweet substance. When powders are the active ingredients they should be made very fine, before admixture with the basis.

Linteum.—Lint is lint impregnated with medicinal agents; as Linteum Acidi Borici, Linteum Iodoformi. These are prepared in the same way as antiseptic cottons.

Massæ.—Masses consist of ingredients mixed together to the consistence of a pill. They are official in the U.S.P.

Masticatories are solid pieces of drugs used for chewing; as Pellitory Root.

Mollinum is an ointment prepared with mollin or superfatted soap. It is easily washed off with water forming a lather and leaves the skin fresh and supple. As Mollinum Hydrargyri. Mollin contains 17 p.c. of uncombined fat and 30 p.c. of glycerin.

Nebulæ are solutions of drugs sprayed into the throat by the help of a spray-producer; as Nebula Acidi Lactici, Parolcine.

Opodeldocs or **Saponimenta** are preparations having as their basis soap liniment. Medicated opodeldocs are official in Continental Pharmacopœias.

Pasta.—Paste is prepared like ointment, but generally without any fatty basis; as Pasta Arsenicalis. It is better to confine the term *Pasta* to preparations for external application, and *Massa* to those for internal use; as Massa Copaibæ U.S.P.

Pastillus or **Pastil** is a soft jujube variously medicated having glycogelatin as its basis instead of gum arabic and sugar. These are used like lozenges. As Pastillus Acidi Borici, T. H.

Perles are minute pills.

Pessi.—Pessaries resemble suppositories, but are intended for introduction into the vagina. The active drugs are mixed either with cacao-butter or with gelatin mass. These may be *sedative*, *astringent* or *antiseptic*.

Pigmenta.—Paints are liquid preparations used for application to the throat, skin or other parts. A pigment differs from a collutoire in that the former is used as a paint for any part of the body, whereas the latter is for brushing the throat or mouth only. As Pigmentum Acidi Borici, Pigmentum Acidi Tannici, Pigmentum Argenti Nitratis Ethereum, etc.

Pomades are greasy preparations resembling ointments, but used as dressings for the hair.

Sprays are liquid preparations intended for application to the upper air passages through an atomizer.

Steatina.—Steatins. Ung. Extensa or **Salve Mulls** are ointments of a hard consistence spread on muslin, and capable of being folded and cut at pleasure. Mutton or beef suet form their principal basis.

Sticks or **Pencils** are solid cylindrical rods prepared by fusing drugs and pouring the melted mass into suitable moulds; as Toughened and Mitigated Caustics. When the melted mass is poured into a conical mould it is called a cone; as Menthol Cone.

Styles are thin bougies about 2 inches long for introduction into the lachrymal sac and nasal duct.

Tabellæ Hypodermica.—Hypodermic tablets are made with granular sodium sulphate or sugar of milk. They contain a definite quantity of the active ingredient and are easily soluble in water, so that they are very convenient for making hypodermic injections.

Triturationes.—Triturations are solid dilutions. These are intimate mixture of substances with sugar of milk. They are official in the U.S.P.

Vapores. Vapours. Inhalations.—These are drugs in a gaseous or atomised form brought in contact with the mucous membrane of the respiratory tract. The methods of inhalation vary with temperatures at which drugs volatilise. Chloroform, Ether, Bichloride of Methylene, Nitrite of Amyl vaporise at ordinary temperatures; but to volatilise Sublimed Sulphur and Calomel, high temperatures are necessary. The majority of drugs are vaporised through the medium of hot water or steam. Inhalation of vapours is best carried on from an inhaler.

Varnishes are preparations which, when applied to the skin, evaporate and leave a coating. Varnishes are often medicated.

Vaselinum.—Like Lanolinum, it is a term applied to an ointment having vaseline as its basis.

Wafer papers are used to wrap round nauseous or bitter powders to disguise their taste. They are made of flour and water, and become limp when moist. Cachets consist of the same material.

PART II

PHARMACY AND DISPENSING

HINTS FOR PRACTICAL PHARMACY AND DISPENSING

THE extemporaneous formulæ or prescriptions given by a physician are called *Magistral*, because they are ordered by a *Magister*, *i.e.* master of his profession. The compounding and dispensing of these prescriptions are the ostensible duties of a dispenser. For the satisfactory discharge of these duties certain combinations of qualities are requisite in the individual undertaking them. "With some degree of physical strength and agility, he should combine a quick perception, sound judgment and firmness of resolution. He should maintain a constant and lively attention to every operation, however trifling, with which he may be occupied, and evince both by night and by day a readiness to fulfil his duty in serving others, even at the sacrifice of his own convenience and pleasure."

The following hints, especially prepared, are likely to prove useful both to the dispenser and practitioner.

GENERAL DIRECTIONS

1. **The dispensing room** must be well *lighted* and well *equipped* with every necessary article, furniture and apparatus for compounding and dispensing purposes.

2. **Pure drugs of the best quality** are to be used, and preparations are to be made in strict accordance with the *official* and other *recognised methods*.

3. **Bottles are to be duly labelled.**—Those containing corrosive fluids must have *enamelled inscription* or names engraved on glass. Bottles containing **poisonous** substances must bear an extra label—"**Poison**"—at their shoulders. It is a good plan to have also the *doses* printed on the labels.

4. **Poisonous drugs** must be kept within a separate glass case under lock and key.

5. **The counter and the apparatus** for compounding and dispensing must be kept scrupulously clean, in good order,

and ready for immediate use. Always clean and put away every article in its proper place after use.

6. **Testing of drugs** must be done occasionally so as to ensure their purity and strength. Substances like vegetable extracts, spirit of nitrous ether, hydrocyanic acid dilute, etc., require occasional looking after.

7. **Corks of good quality** should be used. Cracked, old, rotten and soiled corks should be rejected. The practice of pressing corks between the teeth should never be indulged in. Fit a cork before pouring the medicine into the bottle.

8. **Evidence of slovenliness** as regards externals does not encourage faith as to the care with which the contents have been dispensed.

9. **Prescription reading.**—Read through a prescription calmly and rapidly, without creating any suspicion in the mind of the presenter, but noting at the same time any inconsistency either in dosage or in combination.

10. **Consultation with the prescriber** must be arranged without delay wherever possible, if there is any **poisonous** or **unusually large dose,** or a grave **incompatibility** in a prescription. The dispenser should on no account alter a physician's prescription without his sanction.

11. **The directions** on the label should be written first of all before the medicine is dispensed. At the same time the prescription should be copied in the copy-book, noting afterwards any peculiarity of compounding or dispensing. If the directions are in Latin, the dispenser should give their English translation. In India, the directions should be written in the familiar language of the place, when the medicines dispensed are meant for those who cannot read English.

12. **Labels** should be neatly and distinctly printed without much flourish, and their margins carefully trimmed. **"Poison," "Shake the bottle," "Not to be taken"** and other accessory labels are best placed on the **shoulder** of a bottle. If affixed at the foot, the fingers holding the bottle may cover them, or a hurried patient may overlook them. The colour of labels for liniment and lotion ought to be different from that of mixture and powder. Orange-red and dark-yellow for the former and white for the latter may be used. Sometimes the labels for liniment and lotion are printed with red on white paper.

13. **Bottles for dispensing** mixtures should be of a different colour from those used for liniments and lotions. Amber-coloured or uranium bottles are best suited for silver nitrate lotions, and blue bottles for liniments. Bottles covered with blue paper can be used for silver lotions, when uranium or amber-coloured bottles are not available.

14. **The dispensing of two prescriptions simultaneously** should never be attempted. But if an infusion is to be made the dispenser may set it on, noting on a bit of paper the time and the substance, and placing it between the cover and the pot.

15. **The position of a prescription during dispensing** must be such that the dispenser can read it while dispensing. This can be best accomplished either by fixing it to a hook on a counter-shelf, or by holding it between the index and the middle fingers of the left hand.

16. **Manipulation.**—Be expeditious in manipulation. Finish tying, sealing, labelling and wrapping as quickly as possible. The holding of powder envelopes between the lips, the handling of drugs, the stirring of mixtures with the fingers is to be avoided.

17. **The final reading of a prescription** is essential before the medicine leaves the hands of a dispenser, so as to make a revision of his work. If there is any doubt, always begin where there is none.

18. **Wrong delivery.**—Be careful not to deliver a wrong medicine to the presenter of a prescription. A serial number entered upon both the original prescription, the copy in the dispenser's book and the label applied to the medicine, ought to prevent the occurrence of mistakes.

19. **Graduations of bottles** must be accurate. Want of symmetry of the bore makes a great deal of difference. Blown lines of graduation are generally wrong. Paper graduation is the best, but it must be done by hand in each case. Mark-papers should either be notched or lined equidistantly, but in either case the number of doses should be put down in figures on the label.

20. **Repetition of prescriptions.**—If a prescription contains such drugs as are likely to produce a cumulative effect, as strychnine, arsenic, lead, digitalis, etc., the dispenser should warn the patient against repeating it for a lengthened period, without the knowledge and sanction of the prescriber. To prevent indiscriminate renewals of medicines containing poisonous ingredients, the physician should write "*non-repetatur*" or some similar direction on his prescriptions.

WEIGHING AND MEASURING

1. **Scale.**—An upright fixed beam and scale with a movable glass pan should be used. If a hand scale is used, hold it firmly by the left hand, never lift it too high above the counter, and judge of the weight as much by the indicator as by the position of the scale. A delicate scale should be used for weighing minute quantities of powerful drugs; such as strychnine, hyoscine, arsenic, etc.

2. **Corroding substances.**—Substances which corrode or act on the brass should be weighed upon glass pans. Crystallised acids, iodine, carbonate of ammonia and similar salts should never be weighed on brass pans.

3. **Soft or sticky substances,** such as soft extracts, confections, ointments, etc., should be weighed on a piece of paper spread over the right pan, after placing a corresponding piece of equal weight on the left along with the weights. Scrape the medicine by a spatula from the paper after weighing.

4. **No guesswork** in weighing or measuring is allowed. Every drug must be either weighed or measured as the case may demand.

5. **Label upwards.**—In pouring out liquids, always keep the label of the bottle upwards in order that it may not be spoiled by the trickling down of the drops of liquid left on the lip of the bottle.

6. **Minim measure.**—From a few drops to a drachm, the liquid should be measured in a minim glass. The true level of the surface of the liquid in a minim glass is the midway between the highest point close to the glass and the lowest at the centre.

7. **Castor Oil, Copaiba, Glycerin,** etc., should be weighed instead of measured if not otherwise directed.

8. **Lip drops.**—The drops that hang from the lip of a bottle out of which a liquid has been poured, should be caught upon the bottom of the stopper, before putting it back into the mouth.

9. **How to drop.**—Before permitting drops to fall into any mixture, the dispenser must allow a few drops to fall on the floor, till he is confident that he has a perfect control over dropping. If he is not sufficiently skilful, let him measure the drops into an empty glass until he is satisfied that he has obtained the correct number.

10. **Volatile liquids,** such as, ether, chloroform, nitrite of amyl, diluted hydrocyanic acid, etc., should always be measured instead of dropped. A solution of 10 or 20 per cent. may always be kept in stock for measuring out small quantities when ordered.

11. **The size of drops** varies considerably, and therefore it is safe to give *minims* where *guttæ* are ordered. Thus, chloroform dropped from an ordinary phial will require 150 to 300 drops to one fluid drachm.

12. **Division of a grain or a minim** is best accomplished by triturating or mixing the weighted or measured quantity with sugar of milk or any liquid excipient, and dividing the mixture as ordered. For instance, suppose that 24 pills are ordered, each containing $\frac{1}{30}$ grain of strychnine hydrochloride.

The total amount in the 24 pills will be $\frac{24}{10} = 1\frac{2}{5}$ grain, therefore weigh out 1 grain of the salt and triturate it with 14 grains of milk sugar, making 15 grains in all. Then 12 grains of this mixture will contain $1\frac{2}{5}$ grain of strychnine hydrochloride. Take this amount and destroy the remainder.

13. **A liquid drug is always weighed** and never measured on the Continent.

WATERS

1. **Camphor water.**—2 ozs. of water dissolve only $\frac{1}{2}$ gr. of camphor. The easiest way of making a good camphor water, is to mix flowers of camphor with coarsely powdered glass, enclose and tie the mixture in a muslin bag and suspend it by a thread into the water from the cork. A good solution is obtained sooner by moving the bag up and down two or three times a day.

By dissolving $2\frac{1}{2}$ drs. of spirit of camphor in 40 ozs. of water, camphor water may be quickly obtained.

2. **Chloroform water** is made by the simple shaking of chloroform in water.

3. **Mint waters** are best prepared by agitating oils in hot water, before pouring into the still, and immediately commencing distillation.

4. The following **alternative method** of preparations is sanctioned by the B.P. for use in India and the Colonies :—

"Aquæ Olei Anethi, Anisi, Carui, Cinnamomi, Fœniculi, Menthæ Piperitæ, Menthæ Viridis. Each of these waters may be prepared by triturating the corresponding oil with twice its weight of Calcium Phosphate and five hundred times its volume of Distilled Water and filtering the mixture. In India and other tropical countries these waters may be used in place of the corresponding *Aquæ* of the text of the Pharmacopœia."

DECOCTIONS

1. **Drugs** should be coarsely powdered or sliced before they are boiled in water for 5 minutes or longer. If the comminution is too fine some sediment deposits. The drugs should always be put in cold water before boiling.

2. **Decoction pots** should be enamelled or tinned and covered. A false bottom made of tinned or silver gilded copper wire half an inch or more above the bottom should be used to prevent imparting a fusty odour to the decoction from the particles of the drug adhering to the bottom of the vessel during boiling.

INFUSIONS

1. **Drugs for infusion** should not be too finely comminuted.

2. **No other water than distilled water** boiling or cold is to be used.

3. **Suspension of drugs** is essential. A muslin bag containing the drugs can be suspended by a thread from the lid of a covered pot, or a Squire's or Maw's infusion pot may be used.

4. **Uniform temperature,** as far as possible, should be maintained.

5. **Hard spring water** does not give a good colour, as the extractive matters are not well dissolved by it.

6. **Whenever wanted** the infusion should be made fresh. If business is very brisk, the infusion can be made and preserved for two or three weeks, by bottling hot infusions in 6 or 8 oz. bottles up to the brim, and then by covering their mouths and necks with bladder or by well-fitted stoppers, so as not to allow any air to get in.

7. **Concentrated infusions** can never supply the place of fresh ones. They are, however, useful for field hospitals. The concentrated infusion of digitalis is inactive.

EMULSIONS AND MIXTURES

Emulsion, as its name implies, is a liquid externally resembling milk. The milkiness is due to the suspension of resinous or oily bodies in water, by means of an adhesive substance known as the *emulsifier.*

Fixed oils and **viscid substances** are best emulsified in a mortar, and volatile oils, alkaline emulsions and less viscid substances in bottles.

1. **The first fundamental rule** *in the compounding of a mixture is to avoid chemical decomposition taking place among its ingredients, unless such is the implied intention or the express order of the prescriber.*

2. **Distilled water** is the official water to be used in compounding. Tap or other waters produce a considerable change in mixtures. For example, Tinct. Card. Co. produces a brilliant crimson colour with tap, and a reddish-brown with distilled, water. Tinct. Lavand. Co. gives a bright mixture with distilled, and a muddy one with tap. Liquor arsenicalis precipitates calcium carbonate with tap water, hydrargyri perchloridum produces an insoluble mercuric salt when dissolved in tap water. Tap water gives a muddy colour to a mixture containing ferrum tartaratum, and distilled water makes a clear solution.

3. **Order of mixing.**—It is not the spirit of practical pharmacy to mix the ingredients in the order in which they are arranged in a prescription. The dispenser should exercise his own judgment in determining the best method of effecting a combination.

It is a good plan first to pour in the tinctures and spirituous fluids as they are measured, next add syrups and essences, and lastly fill up the bottle with the vehicle.

4. **Poisonous drugs** such as arsenic, strychnine, perchloride of mercury, aconite, hydrocyanic acid dilute, etc., should be separately dissolved and then added to the mixture last of all, immediately before corking the bottle. In this way you avoid the possibility of putting them in twice over.

5. **Mortar and pestle** should never be used if the ingredients are easily soluble. Dispense syrups and fluid preparations in such an order that the vehicle will finally rinse out the measure glass.

6. **Shaking.**—All mixtures should be briskly shaken before labelling, to ensure a thorough incorporation of the ingredients.

7. **Heat** should not be used to help the solution of salts when they will not entirely dissolve in cold water, for they are sure to crystallise on cooling. Suspension is the best method under such circumstances.

8. **Wholly or partially soluble vegetable drugs,** especially which contain tannin, should be *mixed with earthy and metallic salts in largely diluted solutions.*

9. **Gelatinous mixtures,**—Some mixtures become *gelatinous* on keeping, due to the growth of an organism called *viscous ferment.* An addition of 20 per cent, of alcohol to the mixture prevents this.

10. **Chemical reaction.**—If there is a chance of a chemical reaction taking place, the ingredients which are likely to act with one another, should be freely and separately diluted or suspended, before mixing. The mucilage of acacia always suspends the precipitate uniformly, and to some extent retards or modifies the chemical decomposition.

11. **Froth.**—Sometimes a lot of froth rises as the result of shaking, especially if the mixture contains vegetable solutions, thus preventing the bottle from being filled or corked. A few drops of alcohol remove this.

12. **Insoluble powders,** such as rhubarb, chalk, etc., should be triturated with a small quantity of water in a mortar to produce a thin paste, before mixing with the vehicle.

13. **Medicinal filtrates** produced in a mixture should not be filtered, but suspended. But if any foreign particles float on a clear solution, they should be removed either by straining or by filtration through wetted cotton or tow plunged lightly

into the neck of a funnel. All mixtures depositing a sediment should bear the label "*shake the bottle.*"

14. **Mucilage** should be recently prepared, but it can be kept ready made for some time provided that the bottle containing it is full up to the neck and properly sealed.

15. **Oils** are best emulsified either by rubbing them up with gum or by mixing them with an alkali, or with both. Copaiba is well emulsified with gum and alkali. Essential oils require to be mixed either with some fixed oils before emulsification or with the yolks of eggs.

16. **Scale preparations** in a mixture are either to be dissolved in a mortar with warm water or poured into the bottle with the vehicle, and shaken briskly. If poured in a dry condition into the bottle, and the water or vehicle added afterwards, a sticky mass cakes at the bottom.

17. **Volatile ingredients in a mixture.**—Volatile drugs such as ammonia, ether, chloroform, hydrocyanic acid, sulphurous acid, etc., should never be mixed with hot fluids, and should always be added last of all, after the vehicle has been poured into the bottle. Care should be taken that sufficient space is left for the requisite quantity of the soluble ingredient. As soon as this has been added, the bottle must be tightly corked and well shaken.

MIXTURES AND EMULSIONS OF SPECIAL DRUGS

1. **Acacia** in a mixture is best added in the form of mucilage, which should be freshly made.

2. **Almonds oil** does not emulsify well with mucilage or powdered gum, but a small quantity of liquor potassæ or carbonate of potassium without mucilage answers well.

3. **Ammoniacum, Almond and Guaiacum** should be triturated first with a little water or some similar vehicle so as to form a thin paste, and then gradually mixed with the emulsifier.

4. **Ammonium Carbonate** should be dissolved in a cold vehicle, only translucent pieces being used. Those portions which have effervesced are wanting in strength.

5. **Benzoic acid** should be powdered before mixing. If there is a tincture in the formula it should be dissolved in it, and water added gradually with shaking.

6. **Bismuth Oxynitrate** is chemically incompatible with potassium bicarbonate or sodium bicarbonate, producing a large quantity of carbonic acid gas when mixed in a mixture. $2BiONO_3 + 2NaHCO_3 = Bi_2O_2CO_3 + 2NaNO_3 + H_2O + CO_2$. The gas must be allowed to escape by gentle heat before bottling. Otherwise the bottle may subsequently burst or the cork be

suddenly blown out. An equivalent quantity of bismuth carbonate may be substituted as the finished mixture contains the same. Bismuth salts and iodides produce bismuth oxyiodide which gives a brownish-red colour to the mixture though therapeutically it is harmless.

7. **Borax** powdered and rubbed up with mucilage makes a soft, jelly-like mass. But a limpid mixture may be obtained by mixing freely diluted mucilage with a solution of borax in warm water.

8. **Butyl-Chloral Hydrate** forms oily compounds with alcohol, insoluble in water. Dissolve in glycerin and warm water. **Chloral hydrate** behaves in the same way, and is decomposed by alkalies, liberating chloroform.

9. **Caffeine Citrate** forms a syrupy liquid when mixed with three times its weight of water; on addition of more water, caffeine hydrate is precipitated. This is again redissolved on further dilution.

10. **Chlorate of Potassium and Hydrochloric Acid.**—Sometimes a formula composed of Pot. Chloras, Acid. Hydrochloric and water comes to the dispenser for dispensing. Here, the object is to make a solution of chlorine, and is best fulfilled by adding the acid directly to the salt, corking the bottle for a while before adding water, so as to make a solution of chlorine in water.

Chlorate of potassium with syrup of iodide of iron liberates *free iodine* which has proved fatal.

11. **Cocaine** in solution requires the addition of a little salicylic acid to prevent fungus growth.

12. **Cod-liver Oil** is well emulsified by the following method: Place powdered tragacanth in a dry mortar and triturate a little of the oil, then add the yolk of an egg and the oil and stir briskly, adding water as the mixture thickens, and lastly mix flavouring oils and water alternately, with constant stirring, avoiding frothing. The mixing of limewater 1 to 5 with cod-liver oil greatly facilitates its emulsification, and reduces its tendency to cause eructations. Limewater and acacia gum emulsify cod-liver oil just as well as the yolk of egg.

13. **Copaiba Balsam** can be well emulsified by rubbing it with one-third its weight of milk sugar, and about its own weight of powdered gum acacia, adding water gradually. Liqr. potassæ also emulsifies it well.

14. **Ethers** should never be mixed with hot liquids, and must be added last to a mixture.

15. **Ferri Sulph.** soon gives a rusty colour to a solution from the production of ferric hydroxide, which is retarded by adding an acid.

16. **Glycerin** is used as a sweetening agent for mixtures, especially those that contain perchloride of iron. It is also used as an appropriate solvent for, and a preservative of, the pancreatic and peptic ferments. It prevents gelatinisation of kino in tr. kino, and also to a certain extent prevents and retards chemical changes and precipitation in a mixture.

17. **Iodine** is very sparingly soluble in water, but iodide of potassium helps solution to the extent of three-quarters of its own weight. Salts of ammonia also increase its solubility by the formation of a soluble salt ammonium iodide. Some essential oils, such as oils of peppermint and fennel, chemically combine with iodine. Strong solution of iodine with solution of ammonia, or with ammoniated camphor liniment, precipitates iodide of nitrogen, which is a most dangerous explosive. (*See* Explosive Combinations.)

18. **Morphine Salts** should not be dissolved by heat, for at a temperature above 104° F. their solutions turn yellow or brown.

19. **Phenazone** is sometimes a troublesome drug to deal with in a mixture. It is rather a free base, and gives precipitates with tannin, alkaloids and many other substances. Thus, with alkaline salicylates, it forms *salipyrin* (insoluble); with ferric chloride *ferripyrin* (orange-red); with free iodine *iodopyrin* (insoluble); with chloral hydrate *hypnal* (insoluble), etc.

20. **Potassium Iodide** is decomposed by acids, liberating *free iodine*, which may produce fatal results. This also happens when potassium iodide is mixed with tincture of perchloride of iron.

21. **Quinine Salts.**—The following points in respect of the mixing of a quinine salt should be noted :—

(*a*) It produces an *insoluble salt* when added to a strong mineral acid; the acid should be freely diluted with the vehicle before the alkaloidal salt is mixed.

(*b*) When it is prescribed with spirit of nitrous ether, tinctures, ether, or any spirituous liquids along with glycerin or syrup and water, the quinine is to be first dissolved in the undiluted spirituous mixture and then glycerin or syrup added, and lastly the vehicle is gradually mixed, If no mucilage is ordered it may be added, to prevent quinine from adhering to the sides of the bottle.

(*c*) The sulphate should not be dissolved in diluted hydrochloric or nitro-hydrochloric acids unless so ordered.

(*d*) When ordered with bark or any other substances containing tannic acid, it deposits a precipitate of tannate of quinine which should not be filtered.

(*e*) No acid should be added by the dispenser to make a solution if it is not prescribed. The quinine is then to be rubbed up in a mortar with a little mucilage and diffused in

water, or added to the vehicle in its crystalline state, with "shake the bottle" as a direction. The former is the better method.

(*f*) Quinine salts are *incompatible with alkalies*, such as bicarbonates, carbonates, hydrates, spirit. ammon. aromat. etc. They should be suspended and diluted *separately* before mixing; a small quantity of mucilage will make a better mixture.

(*g*) Ammoniated tincture of quinine gives a precipitate when diluted with water, but the addition of a little mucilage (½ dr. to 1 oz. of mixture) suspends it.

(*h*) With liberated chloride, quinine salts yield a yellow solution, *i.e.* when added to the chlorine mixture mentioned in para. 10, page 81.

(*i*) Mercuric chloride throws down a poisonous precipitate, which can be dissolved by diluted hydrochloric acid. Glycerin and gum also retard to some extent chemical reaction.

(*j*) Donovan's solution, too, behaves in the same way, but an admixture of glycerin and mucilage prevents to some extent chemical changes.

(*k*) When it is ordered with salicylates in a mixture, an ugly-looking mass, salicylate of quinine, forms inside the bottle and refuses to flow out. The mixture may be improved by rubbing with quinine and gradually mixing the salicylate dissolved in a large quantity of water, and agitating very briskly.

(*l*) Neutral solution of quinine and iodide of potassium do not react chemically, unless there is an acid present, free or liberated, in which case iodine is set free.

(*m*) The growth of fungus in a solution of quinine is prevented by the addition of a 5 per cent. solution of alcohol or a trace of chloroform.

22. **Spirit of Nitrous Ether** soon turns *acid* from decomposition, and should therefore be made *alkaline* before being mixed with iodides or bromides, otherwise free iodine or bromine will be liberated and will darken the mixture. It can be kept permanently alkaline or neutral by dropping a few crystals of potassium bicarbonate in it.

It should be kept in an amber-coloured bottle (blue or green is useless) in the dark, for daylight decomposes it.

23. **Salol** when combined with other salts in a mixture falls to the bottom in a somewhat granular form; this is prevented by adding mucilage in the proportion of 13 to 1.

24. **Strychnine** in a mixture containing alkalies is precipitated to the bottom of the bottle, and fatal results may follow the swallowing of an overdose. Bromide and iodide of potassium,

Liq. Hydrargyri Perchloridi and Liq. Sodii Arsenatis all throw down insoluble precipitates of strychnine compounds.

25. **Tannic acid** should be dissolved in pure distilled water, as tap water makes the solution opalescent. It precipitates alkaloids in solution and gives with iron an inky colour. Alkalies give precipitates, and turn the mixture brown to black. Mucilage makes it flaky.

26. **Terebene and Turpentine** are best emulsified with the yolk of egg. At least one egg is required for each ounce of oil of turpentine. Thick mucilage and Tr. Quillaiæ answer fairly well, but are not so good as the yolk of egg.

27. **Vegetable extracts** should be carefully *rubbed* in a warm mortar with a little water till a soft paste is obtained, with which the vehicle is to be gradually mixed. If they are resinous rub them with two or three times their weight of powdered acacia in warm water, and then gradually mix with the vehicle when cold. *Ext. Filicis Liquid.* may be triturated with powdered acacia, soap or milk.

PILLS

1. **In making a pill-mass,** the following points should be observed :—

(*a*) Put the substance (powder) prescribed in smallest quantity into the mortar first, and triturate it with the next smallest (if it is powder), add the next, again triturate, and so on.

(*b*) Toxic substances (*e.g.* alkaloids and arsenic) should always be triturated well with double their weight of a hard powder (*e.g.* sacch. lactis), if there is none in the pill constituents, before adding the other ingredients gradually.

(*c*) Potent extracts which are prescribed in the pill should not be treated as excipients, *e.g.* Extr. Nucis Vom. gr. ½ with Pulv. Aloes gr. ii and Pulv. Ipecac. gr. ss. Here rub the extract with the ipecacuanha, add a little of the aloes, again triturate, and continue thus until the extract is equally divided throughout the whole.

(*d*) Essential oils should be treated like No. (*c*). Thus in the case of Pil. Aloes, the oil of caraway should be triturated lightly with the powdered soap (the oil being added gradually), then aloes, trituration, aloes, trituration, etc.*

2. **The official pill-masses** :—The following can be conveniently and usefully kept in powder, *viz.* :—Pil. Aloes et Ferri, Pil. Aloes et Myrrh., Pil. Aloes et Asafetida, Pil. Colocynth. Co., Pil. Hydrarg. Subchloridi Co., etc., noting on the label of each the quantity of the powder that is equivalent to the pill-mass. Thus, Pulv. pro-Aloes et Asafetida gr. iv = 5 grs. Pil. Aloes et Asafetida.

* Chemists' and Druggists' Diary, 1898.

3. **Pills under one grain** should be made up to 1 grain by the addition of liquorice powder or sugar of milk. Fractions of a grain of such **powerful drugs** as strychnine, perchloride of mercury, sulphide of calcium, arsenic, etc., should be intimately triturated with sugar of milk, and then made into a pill-mass with soft manna, or other suitable excipients. For calculation of fractional weights, *see* p. 76.

4. **Pills liable to crumble** will keep their shape for a reasonable time if some fibrous materials, such as liquorice powder, paper pulp or lycopodium are added to the mass. If the pill-mass is too soft, it should be hardened on a hot plate, but if the ingredients are hard and brittle, such as pitch, chian turpentine, etc., they should be massed in a warm mortar. When the pill-mass contains dry vegetable powders, some minutes must be allowed for the absorption of moisture before rolling.

5. **The same spatula** should never be dipped into the extract pot after it has been used to scrape the pill-mass from the tile, pestle and mortar.

6. **To prevent sticking together,** cinnamon or liquorice powder, mixture of starches, powdered French chalk are used. Pills containing hygroscopic and volatile ingredients should be varnished or coated and then dispensed in a well stoppered or corked bottle. Pills for silvering should never contain glycerin.

7. **Substances that are decomposed by iron,** such as silver nitrate, copper, and bismuth salts, corrosive sublimate, and calomel, ought not to be mixed in an iron mortar, or scraped by an iron spatula.

8. **Crystalline salts** soluble in water should be very finely powdered, and massed with theriacanth and some inert powder. Before silvering, they must be varnished with tolu and dried. Glycerin of tragacanth is the best excipient for insoluble salts.

9. **Essential oils.**—Soap or sometimes soap and powdered liquorice root make a good excipient. Wax is to be avoided. When there is much essential oil, the addition of liquor potassæ helps greatly.

10. **Potent Drugs.**—*To diffuse* potent drugs as aconitine, atropine or strychnine, add a minute quantity of glycerin before massing.

11. **Scale preparations** should be finely powdered with a palette-knife instead of triturating in a mortar before massing. Manna is a good excipient for such substances.

EXCIPIENTS

An excipient is a substance either solid or liquid added to bind the ingredients of a pill-mass into a plastic and adhesive mass.

1. **Acacia** in powder is not a good excipient, though frequently used. It makes the pills too hard. With calomel it forms a regular cement.

2. **Bread crumb** has fallen into disfavour.

3. **Calcium phosphate** in minute quantities gives a pilular consistence to greasy substances and essential oils. It is a good desiccant.

4. **Castor oil** with or without soap is a good excipient for making camphor pills.

5. **Confection of roses** is best for potent drugs like strychnine.

6. **Compound decoction of aloes** in minute quantities is a good excipient for pills containing aloes and gum resins. It should not be used where there is an incompatibility with carbonate of potassium.

7. **Glycerin** keeps pills soft, but it is very hygroscopic. The addition of one-third of its weight of water overcomes its hygroscopic property.

8. **Glycerin, mucilage of acacia, water, and alcohol** in equal parts make a good general excipient.

9. **Glucanth,** as prepared by Lucas, consists of powdered tragacanth 1 oz., glycerin 1½ oz., water ½ oz., syrup of glucose 3½ ozs. It is useful where glycerin of tragacanth is unsuitable on account of the large quantity of glycerin.

10. **Glucose syrup,** or glucose 12, glycerin 4, water 1, by weight, is a serviceable excipient.

11. **Honey and treacle** do not make the pills hard, and are at times used in preference to mucilage, etc.

12. **Kaolin** is useful for massing oxidisable and reducible ingredients ; as potassium permanganate.

13. **Kieselguhr** (fossil earth) absorbs liquids (1 gr. = 1 m.). The mixture can be massed by glucanth.

14. **Lanoline** may be used in massing certain scale preparations. Being non-oxidisable it may be used to mass Pot. Permanganas or Argenti Nitras with prepared kaolin.

15. **Liquorice and marshmallow** in powder are absorbent and give elasticity to the soft mass.

16. **Manna** can be used for massing calomel, quinine, and bismuth salts.

17. **Proctor's paste** consists of pulv. tragacanth. 1 dr., glycerin 3 drs., and water 1½ dr. The paste improves by keeping. The B.P. glycerinum tragacanthæ may be used as a substitute. It is an all-round good excipient.

18. **Resin ointment** is used for scale preparations.

19. **Soap powder** is the best excipient for vegetable powders, extracts and gum resins. It neither hardens nor crumbles. It should not be used for masses containing acids, acid salts, metallic salts, and substances containing tannin.

20. **Syrup** alone is rarely used, but makes a useful excipient with powdered althea.

21. **Spirit** softens resinous substances, but the mass should be quickly rolled, otherwise it will crumble.

22. **Theriacanth** is an admirable excipient for intractable drugs, as reduced iron, phosphate of iron. It is made by rubbing pulv. tragacanth. 1 dr. with rectified spirit 2 drs. and mixing quickly with warm treacle 2 ozs.

23. **Tincture of gentian and treacle** in equal parts make a good excipient, giving firmness, toughness, and solubility.

24. **Tragacanth** powder gives in small quantities solidity and elasticity to a soft mass ; more so when the compound powder is used.

25. **Water** should be used with caution. It is a good excipient for masses containing gum or soap and makes a good pill with powdered opium.

26. **Wax** is not much used now, for it makes pills indigestible, though it makes a beautiful pill-mass with camphor, creosote, carbolic acid, and most of the essential oils. Cacao butter makes a good mass with silver oxide.

Ince's Precautions.—The excipients to be avoided are :—

(*a*) Those incompatible with any of the ingredients of the pill-mass. Thus, confection of roses must not be used to make up iron compounds ; acetic extract of colchicum must not be stiffened with magnesia.

(*b*) Those which make the pill either too hard or too soft.

(*c*) Those which unduly increase size.

PILLS OF SPECIAL DRUGS

1. **Acids.**—Mineral acids are rarely used in pills, but the addition of powdered marshmallow and glycerinated water makes a good pill-mass.

2. **Aloes** is best made into pills, with a minute quantity of compound decoction of aloes, which has a great solvent power, or with proof spirit. **Aloin** is massed with glycerin of tragacanth.

3. **Antipyrin** makes a good pill with tragacanth or glucanth.

4. **Argenti Nitras** and **Argenti Oxidum.**—The former is triturated with kaolin and massed with paraffin ointment, the latter with kaolin ointment.

5. **Bismuth Salts** are best made into pills with Proctor's paste or manna.

6. **Butyl-Chloral Hydrate** makes a good pill-mass with equal parts powdered acacia, tragacanth and syrup.

7. **Calcium Sulphide** should be triturated with ½ gr. of sugar of milk for each pill, and massed with powdered tragacanth and glycerin. Each pill should be of 1 gr. gross weight.

8. **Calomel** with manna makes a good pill.

9. **Camphor** should be powdered first with a few drops of alcohol, and after the evaporation of the spirit, Proctor's paste is to be added. Some like soap and fixed oil.

10. **Camphor Monobromata** should be triturated with Pulv. Tragacanth. Co. and massed with Proctor's paste.

11. **Carbolic Acid** (crystallised) is massed with wheaten flour, powdered soap and liquorice, or powdered marshmallow with a minute quantity of Proctor's paste.

12. **Citrate of Iron and Quinine** can be made into a pill by the addition of proof and rectified spirit and rolling the mass quickly. Canada balsam is best.

13. **Codeine** can be massed with half its weight of powdered liquorice and glycerin of tragacanth.

14. **Copaiba** when massed with carbonate of magnesia, make a very hard pill which is insoluble in the intestinal secretions. If it be made into an emulsion with gum, and be set aside for twelve hours, after adding 1 part of magnesia levis to every 10 parts of the balsam, it may be converted into a good pill-mass by the addition of a minute quantity of borax, and such a pill is soluble. Phosphate of calcium also makes a good pill.

15. **Creosote** with powdered curd soap B.P. and powdered liquorice makes a good mass. The following method is recommended by Martindale :—"Put the creosote in a wide-mouthed stoppered bottle, add the soap, and mix well. Then digest in a water-bath till they combine." **Guaiacol** should be treafed like creosote.

16. **Croton oil** forms a good pill-mass with wheaten flour, mucilage and liquorice powder, or powdered curd soap with a little glycerin of tragacanth.

17. **Ergotin** makes a good pill with powdered althea or any inert vegetable powder, and sometimes with a minute quantity of tragacanth. It must be hardened by evaporation if too soft.

18. **Ferri Sulphas.**—The granular sulphate forms a good pill with glycerin of tragacanth and a little powdered sugar of milk. **Ferri sulph. exsiccat.** does not make a good pill. It cracks after a while. However, the following method may be tried :—The iron salt is to be triturated with equal parts

of powdered acacia and tragacanth and massed with a mixture of glycerin 1 and water 2.

19. **Ferrum Redactum** makes a good pill, when rubbed down to a fine powder, powdered liquorice added, and massed with liquid glucose or glycerin of tragacanth. Theriacanth makes an excellent excipient. Extracts may swell the pills from the production of hydrogen, if they turn acid.

20. **Gallic acid and tannic acid** make a good pill-mass with glycerin (4 gr. with ½ m.).

21. **Hydrargyrum c. Creta** can be massed with glycerin of tragacanth. It should never be vigorously triturated in a mortar, as the mercury may separate.

22. **Hydrargyri Perchloridum** should be finely triturated with sugar of milk and made into a pill with glycerin of tragacanth.

23. **Hydrargyri Subchloridum** makes a good pill with manna.

24. **Menthol** should be worked like carbolic acid. If it liquefies during manipulation, add kieselguhr.

25. **Pepsin** can be massed with a mixture of equal part of glycerin, syrup and water by quick rolling. 1 m. of diluted hydrochloric acid and 5 grs. of pepsin can be rolled into a pill.

26. **Phosphorus** can be made into pills by three methods :—

(*a*) *Solution by Carbon Disulphide.*—Phosphorus is first dissolved in disulphide of carbon, and while the solution is going on pour in two or three drops of chloroform, which gives rise to a thick vapour around the solution, and thus prevents ignition. A little powdered liquorice is now added and a workable mass is made by the addition of a little of Proctor's paste. (*b*) *Solution by Oil.*—Phosphorus is melted in hot mutton suet or oil of theobroma, in a wide-mouthed bottle with an india-rubber cork, and well shaken till the fat solidifies. Then add liquorice powder and make a plastic mass. (*c*) *Combined method* or the *B.P. Process.*—In this, phosphorus is dissolved in carbon disulphide and the solution is carefully mixed with oil of theobroma and beeswax, and made into a pill-mass with the addition of a little kaolin. The last method is better suited for India. The mass must be kept immersed in cold water in a blue bottle away from light. 3 grs. of the mass and 1 gr. of acacia powder can be rolled into a pill for dispensing.

Pills containing phosphorus require varnishing or a pearl coating.

27. **Potassium Acetate** is rarely used as a pill. Canada balsam makes a fair mass, but boro-tartrate of potash, a scale compound, makes a better one.

28. **Potassium Iodide** must first be rubbed up with a little water, so as to make a thick paste, before liquorice powder is added.

29. **Potassium Permanganate** requires careful treatment, for it soon oxidises when brought in contact with organic matter, such as sugar, syrup, vegetable extracts, etc. It can be made into a good pill-mass by mixing it with kaolin and a little water, or with Martindale's *kaolin ointment* which consists of equal parts of vaseline, paraffin and kaolin.

30. **Quinine Sulphate** with tartaric or citric acid makes an excellent mass. Sometimes a drop or two of glycerin or water may be necessary in dry weather. The pills must be varnished or capsuled, otherwise, they will become soft and sticky by damp. Glycerin of tragacanth, manna and strong sulphuric acid (1 drop to 4 grs.) are also good excipients. White excipients should be used for white drugs.

31. **Rhubarb powder** is a troublesome substance for pill-making. Proof spirit or tincture of rhubarb (1 m. to 3 grs.) makes a soft mass which should be rolled quickly. Simple syrup, treacle and equal parts of glycerin and rectified spirit may also be used.

32. **Salol** can be made into a pill with glucanth.

33. **Taraxacum extract** causes fermentation and thereby swelling of pills. It should be mixed with powdered tragacanth after evaporation. Pills should stand for half an hour before silvering.

34. **Zinc Valerianate** makes a good mass with a little powdered acacia and spirit. Glycerin of tragacanth and liquorice powder may answer well.

PILL-COATING

1. **The general rule** in the coating of pills is that *all pills requiring a coating should be perfectly made, of a firm consistence, and free from contamination and powder.*

2. **Silvering** is done in a covered earthenware pot or a boxwood pill-silverer. The pills being damped with thin mucilage are dropped on to a silver leaf put within the silverer. The cover is then put on and the silverer is shaken for about a minute. After the superfluous fragments of silver-leaf have been blown off, the pills are exposed to air for a few minutes to dry. One silver leaf covers six 5-gr. pills, and two drops of mucilage are enough to damp a dozen of such pills. When the pills are too damp, more leaf is required for silvering, moreover the finish is not so elegant. A better and finer silvering can be obtained by putting the pills and leaf in a covered porcelain pot or a metallic silverer, heating the pot or silverer over a spirit lamp and rotating it as before.

Pills containing asafetida and sulphides should not be silvered unless they are very *stiff* and *varnished*, otherwise the silvering will soon get blackened. Pills containing mercury produce an unsightly amalgam.

3. **Gelatin-Coating.**—A coating solution is made by dissolving 1 of gelatin in 4 of water on a water-bath, straining while hot, and cooling it afterwards. If there are air bubbles, the solution should be repeated. The pills are now stuck on the points of pins or needles and dipped into the warm solution. The needles are taken out slowly and rotated for a few seconds and then stuck into a sheet of cork or pincushion by their opposite ends. As soon as the outside coating dries, the needles are withdrawn, and the holes close of themselves.

4. **Sugar-Coating** is rather a complicated process. Dr. Symes recommends the following as the most practical method :—" Pills well dried on the surface are placed in a tinned copper bowl with a flat bottom, or an enamelled iron dish, the surface of which has been moistened with syrup, or syrup and gum. They are then rotated and gently heated, very finely powdered sugar being dusted on, and the motion kept up till a perfectly dry, hard, and whitish coating is obtained, the operation being repeated if necessary."

5. **Keratin-Coating.**—Keratin solution is made by first removing from horn shavings all that is soluble in pepsin and diluted hydrochloric acid, dissolving the residue in alcoholic solution of ammonia or acetic acid, and then evaporating the solution to the consistence of a liquid gum. The pills are simply rotated with this solution in a pot and dried on a slab. The coating often gets sticky. Pepsinised keratin can be bought and dissolved in any of the above solvents. Drugs intended to pass undissolved through the stomach are coated with keratin or salol ; as carbolic acid.

6. **Salol-Vernishing.**—The varnish contains salol 2, shellac 3, absolute alcohol and ether of each 3, and should be applied several times till a thick coating is obtained. Or salol can be melted by heat in a copper bowl and the pills rotated as in sugar-coating.

POWDERS

1. **Compound Powders.**—The B.P. gives no directions as to the manner of mixing compound powders, consequently the dispenser is left to his own experience and resources in compounding them. The following hints, however, will greatly help him.

(*a*) **Powders must be thoroughly mixed** in a mortar or on paper. Powders mixed by a spatula on paper and sifted are more diffusible in water than those rubbed up in a mortar ; but there are exceptions to this rule. Take for example the following prescription :—R Sulph. Precipit. gr. xx, Guaiaci Resin gr. x, Magnesia gr. xx. Here the most miscible powder is obtained by triturating guaiacum and magnesia together in a mortar, before adding sulphur, whereas if mixed on paper,

it would not diffuse in water. Powders for insufflation should never be triturated in a mortar, but only loosely mixed on paper.

(*b*) They should be **passed and repassed through a fine hair sieve** as often as possible. By repeated sifting and shaking in a bottle, the ingredients are thoroughly incorporated and a uniformity of colour is obtained.

(*c*) They should be **very lightly rubbed** in a mortar if this process is at all adopted, otherwise they would cake.

(*d*) **Ingredients in smaller quantities** should first be thoroughly mixed together, and afterwards larger quantities be gradually incorporated.

2. **Folding Paper and Boxes.**—Powders should be folded in ordinary writing paper, or better if possible, in demy glazed powder-paper made for the purpose. Waxed or paraffined paper is to be used for hygroscopic drugs. Coloured paper is used for powders for lotions. Folded powders should be of the same breadth and length, better done on a powder-folder. Powders under six are generally dispensed in a neat small oblong envelope on which "The Powder" is printed; but those over six in a cardboard box or bottle with a label gummed outside.

3. **Waxed Paper and Tinfoil.**—Drugs that are **perishable,** as ergot; that are **volatile,** as camphor, essential oils; that are **hygroscopic,** as potassium acetate, carbonate and citrate, and sodium iodide, etc.; that are liable to **decomposition,** as calcium sulphide, valerianates, should be folded first in waxed paper, and then each covered with tinfoil and dispensed in a bottle.

4. **Powders in Quantity.**—When a powder is ordered to be given in spoonfuls, it should be dispensed in a well-corked or stoppered, wide-mouthed bottle.

5. **Salts** which mutually decompose each other must be mixed and stirred lightly together in a dry condition; as sodium sulphate with potassium tartrate, potassium nitrate with sodium salicylate, etc.

6. **Oxidising Substances** should be each separately rubbed to powder, and then lightly blended on paper with safe ingredients by a bone spatula.

7. **Hygroscopic Powdered Drugs** should never be kept in paper packets. They should be dried and preserved in wide-mouthed bottles or stone jars with accurately fitted stoppers or corks. Suspending a bag of dry quicklime from the cork helps also to keep powders dry. Powdered squill and ammoniacum can be kept dry in this way.

8. **Removal of Identity.**—Crystalline salts, as potassium bromide; roots, as ipecacuanha; leaves, as digitalis; barks, as cinchona, etc., should be finely pulverised before admixture.

9. **Division of Powders.**—There should be no guesswork in division. **Each one must be weighed.**

10. **Liquids** are rarely prescribed in powders ; if so, white kieselguhr may be used to absorb them (1 gr. to 1 m.).

BLISTERS

1. **Blister Spreading.**—A blister is best spread over an adhesive plaster, which has been previously spread upon glazed thin calico. First of all the dispenser should cut a " shape "—an exact size and form of the blister ordered—out of a square piece of writing or packing paper, leaving all round a margin 1 inch wide. This is best done by folding the square piece, twice upon itself, and cutting by a pair of scissors the shape of the blister out of the middle, rejecting the cut out central piece. This *empty space is the shape of the blister.* The dispenser now cuts a piece of spread adhesive plaster or adhesive plaster mull one inch bigger than the size ordered, and gently warms it to make it slightly sticky, and quickly lays the " shape " upon its sticky surface, and evenly presses it down. (In India the warming of the adhesive plaster is not often necessary during hot months). He then takes a quantity of the B.P. cantharidin plaster sufficient for the size and softens it well between his thumb and fingers. Taking a small pellet, he spreads over the adhesive surface, with the side and front of his right thumb, while the fingers of his left hand keep the plaster *in situ.* He goes on making a series of rainbow-like strokes from left to right till the whole of the surface within the shape is covered. A long spatula not unlike a large dinner knife is gently warmed, and firmly passed over the spread cantharidin, removing any superfluous plaster and making its surface smooth. The paper shape is now removed, and the edges are neatly trimmed, keeping a margin of the plaster three-eighths of an inch wide. A piece of oiled or waxed paper is now loosely laid over the blister and the whole put within a paper box.

2. **Powdered Cantharides, Blistering Liquid** or **Olive Oil** should not be sprinkled or applied to increase the action, or improve the appearance, of the blister.

3. **Paper-Covering** should be removed before use, otherwise the blister will not stick. Both the dispenser and prescriber should give directions to this effect. A better plan is to pin the margins to a piece of paper which is then stuck to the bottom of the box.

PLASTERS

Most of the plaster-mulls of the market are made by machinery. Dispensing of such a spread plaster means the cutting

of a piece ordered. It is only when a special plaster is ordered that the dispenser is required to make one on the counter. The spreading of a plaster requires great skill and dexterity.

1. **Plaster Spreading.**—A plaster is made in the same manner as a blister, except that the method of spreading is different. Sheepskin, stiff chamois, dimity, moleskin or sometimes adhesive plaster-mull is used, but the white sheepskin is generally preferred when not otherwise ordered by the prescriber. The "shape" is cut in the same way as for a blister. A piece of leather larger than the size of the plaster ordered, is cut off, and stretched out in all directions by pulling. The leather is now placed with its rough surface upwards on a thick pad of paper, and the gently warmed plaster iron is passed over it, to remove any wrinkles or inequalities. The paper shape merely dipped in water is evenly pressed against this rough surface, and all the necessary appliances being in readiness the process of spreading is begun, in one or other of the following ways :—

(*a*) The plaster is cut into thin slices, put in a small enamelled pan with a lip and handle, and warmed over a gas flame or fire, stirring it constantly and not allowing it to boil. In the meantime, the leather, the shape, and the plaster iron or spatula are kept ready as already described. As soon as the plaster becomes creamy, it is poured over the leather within the shape at the left end, then with a long spatula or plaster iron it is spread rapidly over the surface any superfluous plaster being removed and returned to the pot.

(*b*) The easiest and most convenient method of spreading is to cut a piece of plaster from the stick, allowing 15 grs. for each square inch of plaster required, and to put it on a sheet of strong, smooth, brown paper. Having prepared the shape and the leather, melt the cut-off piece to a creamy consistence by gently rubbing a hot plaster iron over it, and scrape the mass to the edge of the paper. The leather with the shape, having been brought alongside, with one or two sweeps the dispenser covers the whole surface, removing any superfluous plaster with a spatula. A second hot iron may be required at this stage.

A mixture of plaster can be made by a similar process.

2. **Plaster with an Adhesive Margin** is made in the following manner :—The shape is cut as before, and the central piece instead of being thrown away, is damped and stuck to the middle of the leather. The shape is again folded up, and a piece of the width of the intended adhesive margin is cut off ; and the shape is pressed against the leather, thus leaving a free space between the centre-piece and the shape ; which space is now covered over with the adhesive plaster. When cold remove both the papers, and apply a second shape cut to the

proper size, having previously coated it lightly with soft soap to prevent it from sticking to the adhesive margin. The plaster is now spread in the ordinary way, the shape removed, and any soap that may have adhered to the margin is wiped away with a wet cloth or sponge.

The Writer's Method.—The plaster is spread as usual and the shape is pulled off, and the margin of the leather is trimmed, leaving exactly the width to be covered over with the adhesive plaster. The dispenser now melts a small piece of adhesive plaster in a gallipot, and with a spatula spreads it over the margin and finally smooths it by passing a hot spatula over.

3. **Plaster for bed-sores** are spread on chamois leather without margins.

4. **Mammary plasters** must be circular in shape, 7 in. in diameter, with an opening 4 in. in diameter in the centre. The margin is to be notched to fit these plasters to the curved surface of the breasts.

SUPPOSITORIES, PESSARIES AND BOUGIES

1. **Basis.**—Oil of theobroma is the *official basis*. It should be liquefied on a water-bath in a casserole or a porcelain evaporating dish. In India and the Colonies, where the prevailing temperatures are higher than in England, a sufficiency of white beeswax may be added to raise the melting-point to the necessary degree. *Gelatin basis* (Squire's) is made by soaking gelatin 1 oz. in water 1 oz. until absorbed, and then dissolving in glycerin 3½ ozs. on a water-bath. This can be kept ready made, covered by a layer of alcohol, in a wide-mouthed bottle. The relative proportions can be altered as required. Gelatin basis is used for making nasal bougies, uterine pessaries and suppositories.

2. **Ingredients** should be treated like those for ointments. Any powder or crystalline substance must be rubbed very fine with a little cacao butter, before mixing with the melted oil of theobroma.

3. **Moulds** must be perfectly clean and cooled with ice or cold water, and the inside surface wiped with a bit of a rag or lint soaked with soap liniment. Wiping with almond oil is necessary for gelatin suppositories.

4. **Operations.**—Triturate as in para. 2, and mix with the melted oil of theobroma with constant stirring, until a creamy mass without lumps is obtained, and then pour it into the moulds, or divide into equal parts when hard, and mould them with the fingers into the shapes of suppositories, pessaries and bougies. Finely powdered starch prevents them from sticking during manipulation.

SUPPOSITORIES AND BOUGIES OF SPECIAL DRUGS

1. **Alkaloids.**—Alkaloidal salts are generally better absorbed than pure alkaloids, and therefore the salts instead of the alkaloids should be used dissolved in oleic acid.

2. **Aristol** makes very good bougies with cacao butter by the cold process.

3. **Boric Acid** makes a good mass, if Glycer. Acid. Boric.. B.P. and gelatin basis are mixed together.

4. **Chloral Hydrate** should not be mixed with heated cacao butter, but rubbed up with cold cacao butter and a little wax, if necessary, and pressed into the mould.

5. **Extracts** must be made into a smooth paste with water or proof spirit, and gradually mixed with the melted basis. **Ergotin** must be treated similarly.

6. **Hamamelis** suppositories are made of liquid extract of hamamelis evaporated to one-half (5 ms. for each). Hamamelin or hamamelidin too (1 to 3 grs.) with cacao butter makes a good suppository.

7. **Ichthyol** should not be worked up with gelatin basis which makes it insoluble. Use cacao butter and add 1 gr. of bees-wax to give it firmness.

8. **Iodoform** makes good bougies and suppositories with cacao butter by the cold process.

9. **Despatching.**—These preparations should be sent out wrapped in absorbent cotton-wool. In hot weather, they may be dispensed in a wide mouth stoppered bottle containing iced water. If they contain volatile ingredients, each of them should be covered with waxed paper or tinfoil.

SYRUPS

1. **Ingredients.**—Refined or unfaced cane sugar and distilled water should only be used in the preparation of syrups. If any scum rises during boiling, it should be skimmed off. The quantities must be exact, otherwise either crystallisation or fermentation may occur.

2. **Straining.**—Syrups are to be strained through a felt bag, and carefully stored away in well-stoppered or corked bottles in the dark.

3. **Fermentation.**—Care should be taken that no admixture of water or other fluids occurs, otherwise they will ferment and decompose.

4. **Syrups containing organic fluids,** like the majority of the B.P. ones, keep better and longer if they are despumated.

5. **Syrupus Ferri Iodidi** requires boiling, so as to convert a portion of the sugar into glucose, with a view to preserve

ferrous iodide in its pristine condition; but pharmacists generally fail to do so. It is now, therefore, largely prepared from the **liquor,** which keeps bright and without oxidation indefinitely by the addition of a trace of hypophosphorous acid.

6. **Syrupus Ferri Phosphatis** darkens by keeping, but can be extemporaneously prepared from a concentrated solution of iron in phosphoric acid, by the addition of simple syrup.

7. **Easton's Syrup** darkens also by keeping, but a clear syrup may be made at any time by mixing 1 part of liquor ferri phosph. with 7 of a syrup containing the other ingredients.

TINCTURES

In the preparation of tinctures three things are essential, *viz.*—(1) the **Solvent,** (2) the **Process,** and (3) the **Ingredient.**

1. **Solvent.**—Alcohols of various strengths, making absolute alcohol the standard unit, are used in the preparation of most of the tinctures.

(*a*) *Alcohols of higher strengths* are used (1) for the *abstraction of alkaloidal principles,* as of aconite, strophanthus, etc.; (2) for the *solution of resinous substances,* as asafetida, benzoin, myrrh, Indian hemp, etc.; (3) for the *solution of volatile oils,* as cubebs, lavender, orange peel, etc.; and (4) for the *solution of inorganic substances,* as iodine, ferric chloride.

(*b*) *Ammonia along with alcohol* is used in the preparation of ammoniated tinctures of ergot, guaiacum, opium, quinine, and valerian.

(*c*) *Spiritus Ætheris* is the menstruum for Tr. Lobeliæ Ætherea.

(*d*) *Tr. Aurantii* is for Tr. Quininæ.

(*e*) *Glycerin, Chloroform, and Distilled Water* are used for dissolving gummy, juicy, resinous, extractive, saline, metallic, non-metallic and alkaloidal drugs.

2. **Process.**—Any of the following processes is used for making tinctures.

(*a*) *Solution.*—Alcohol is the principal solvent. Next to it is water. The necessary conditions for promoting a perfect solution are:—

(1) The solute should, if possible, be comminuted to allow a large area for action by the solvent.

(2) Agitation must be continued or the solvent passed and repassed through the solute, or the solute suspended in the solvent.

(3) Heat should, if necessary, be applied to expedite the solution.

(4) Stirring is necessary for dissolving a solid. Glass mortars should not be used if not annealed, as they may crack, from increase and decrease of temperature.

(*b*) *Maceration* is not considered as suitable or economical as percolation, because it requires seven day's operation. But, if the ingredients are uniformly comminuted and soaked in the menstruum with frequent shaking, an efficient tincture can be obtained after five days. The B.P.

process is to strain the tincture, press the marc, mix the strained and expressed fluids, filter, and add more menstruum to bring up the tincture to the prescribed volume.

(*c*) *Percolation.*—Moisten the ingredients with the prescribed amount of the menstruum and set aside for 24 hours. Pack the mixture in a percolator and gradually pour the menstruum over the mixture, maintaining a layer of liquid on the top, until three-fourths of the volume are used or the exhaustion of materials is effected. Press the marc, filter the expressed liquid, and mix with the percolate. Enough menstruum is then added to make up the prescribed volume.

A good percolation depends upon thorough soaking, depth and uniformity of packing, and slow passage of the liquid.

3. **Ingredients.**—These require to be carefully selected. Most of them are to be *powdered* according to the degree of comminution as prescribed by the B.P. Some are to be *cut small*, some to be *bruised*, and some are used in their natural state.

LOZENGES

1. **The B.P. lozenges** are made like a pill-mass. Confectioners rarely use powdered gum acacia, though the B.P. directs the use of both the powder and mucilage.

2. **Ingredients.**—The essential ingredients for making lozenges are, finely powdered or icing sugar, mucilage of picked gum arabic and medicinal and flavouring agents.

3. **Operation.**—The ingredients having been thoroughly mixed and kneaded, the resulting paste is placed on a slab with adjustable edges and rolled out to the desired thickness. The lozenges are then cut out with a punch and exposed to the air for 12 or 24 hours, after which they are removed to a drying chamber.

4. **Stamping.**—While the lozenges are still soft, they are stamped with letters indicative of their composition.

5. **Packing.**—Lozenges should be kept in dry, well-fitted stoppered bottles in a dry place. Dampness makes them sticky. They are to be dispensed in wide-mouthed stoppered bottles.

OINTMENTS

1. **The preparation of Ointments** is not always easy. Special tact and care can alone turn out a good product. The following general hints are worth remembering :—

(*a*) If the active drug is a *solid* or a *powder*, as galls, mercuric iodide, sulphur, etc., it should be reduced to a state of fine powder before admixture with the basis ; so that the ointment may be free from grittiness.

(*b*) If it is a *soluble* or *deliquescent salt*, as potassium carbonate or iodide, it should be first made into a thin paste with water, before mixing with the basis.

(*c*) If it is a *hard extract*, a *balsam* or a *resin*, a preliminary treatment is necessary with such substances as water, oil, glycerin, or rectified spirit, as the case may be.

(*d*) If it is a *liquid extract*, as in the case of belladonna ointment, it must be evaporated to the required consistence.

(*e*) If it is an *alkaloid*, as aconitine, atropine or cocaine, it should be dissolved in oleic acid by trituration and gentle heat.

(*f*) If it is a *crystallised drug*, as boric acid, salicylic acid, iodoform, tannic acid, etc., it should be reduced to a fine powder, and triturated with its own weight of the basis for a while before adding the rest.

(*g*) If it is a *volatile substance*, such as menthol, chloral hydrate, hydrocyanic acid dilute, chloroform, it should be mixed after all the ingredients have been incorporated so as to reduce its evaporation to a minimum.

2. **Basis.**—Whatever basis is selected it should not be a chemical incompatible, nor should it in any way affect the action of the ointment. Rancid lard or ointment should never be used. If the basis becomes too soft on account of the prevailing high temperatures, as in India and the Colonies, indurated lard, prepared suet, or beeswax may be added as required.

3. **Incorporation of a liquid** with a fatty or oily basis is best effected by slowly adding the liquid drop by drop, and keeping up a steady rotatory motion. The mortar must be warmed beforehand.

4. **Spatulas.**—A bone or boxwood spatula is the best for scraping, stirring or mixing ointments.

5. **Two ointments,** or an ointment and a liquid or oily substance, are best mixed on a porcelain slab.

6. **Oleates** should not be melted in a metallic cup, but in a procelain casserole.

7. **Tinctures and spirituous substances** are best incorporated with the fatty medium by spreading the latter evenly on the bottom and side of a mortar and mixing the tinctures gradually.

OINTMENTS OF SPECIAL DRUGS

1. **Acid Carbolic Ointment B.P.** is best prepared by using liquefied carbolic acid and a cold basis. As previously prepared part of the phenol crystallised on keeping. This is now obviated by dissolving the phenol in glycerin.

2. **Chrysarobinum B.P.** when dissolved by heat partly recrystallises on cooling, as happens in the B.P. ointment. It being more soluble in castor oil than lard, a mixture of the two gives satisfactory results.

3. **Glycerin** can be well incorporated with extracts by first rubbing the extracts with a little hot water in a warm mortar and adding glycerin gradually.

4. **Hydrargyri Perchloridum** is sometimes prescribed in the shape of ointment. It must be triturated well with glycerin (2 ms. to 1 gr.) before mixing with the basis, otherwise minute particles may violently irritate the skin. When ordered with potassium iodide, both of them should be triturated first before admixture.

5. **Iodine.**—First triturate, then add a few drops of rectified spirit and rub with its own weight of fatty basis, and lastly mix with the remaining basis.

6. **Iodoform ointment B.P.** should be made by the cold process. When exposed to sunlight it changes colour from liberation of iodine, and will then stain lint black.

7. **Paraffin Ointment B.P.**—Unless the melted paraffins are stirred well, the ointment is sure to be lumpy. White soft paraffin should be used for colourless ointments.

8. **Resorcin** readily absorbs oxygen and becomes discoloured.

9. **Thymol crystals** are very irritating to the skin. With camphor (1 to 1), thymol forms a liquid which can be worked up into an ointment.

10. **Despatching.**—Where expense is no object, ointments should be sent out in covered pots, a piece of waxed paper intervening between the cover and the ointment. When open pots are used, tinfoil should be applied over the waxed paper.

NON-OFFICIAL OINTMENT BASES

1. **Gelatums or gelatin-pastes** were first brought to the notice of the profession by Unna. They are mixtures of gelatin, glycerin, and water in varying proportions, and are non-irritating protectives to the skin. They require to be melted before use, and are then applied with a brush. The best known of them is gelatum zincum, but ichthyol, resorcin, and many other drugs may be usefully combined with the gelatin basis in fashionable dermatological practice.

2. **Gelanthum** is Unna's latest jelly basis. Soak tragacanth 2½ drs. and gelatin 2 drs. in water 10 ozs. for 24 hours in a steam-bath, press through muslin, and add glycerin 5 drs. Heat the whole on a water-bath for 1 hour, and add water in which ¼ gr. of thymol is dissolved, to make up the product to 12 ozs. by weight.

3. **Mollins** (*see* p. 71) are prepared with superfatted soap.

PART III

ADMINISTRATION OF DRUGS

CHANNELS FOR ADMINISTRATION OF DRUGS

HAVING gained a sufficient knowledge of the preparation of various official and non-official drugs, the student must direct his attention to the various routes or channels through which drugs enter the circulating fluid, and exert their influence on the whole or on a particular part of the body. The activity of a drug varies greatly with the form and the mode of administration. Thus, if it is a pill, it takes a longer time to act than if it is in solution. Again, a remedy subcutaneously injected produces its effects sooner than when administered by the mouth or rectum, or used as an inunction.

The following are the various channels through which drugs enter the system :

1. **The Digestive Tract** is the most important and the ordinarily selected route.

(*a*) *The Mouth.*—We administer drugs by the mouth for absorption by the gastric tract. For topical action, we use gargles, collutories, pigments, pastils, lozenges, jujubes, dentifrices, etc.

(*b*) *The Pharynx* is reached by pigments, pastils, collutories, sprays, insufflations, lozenges and jujubes.

(*c*) *The Stomach and Intestine.*—The stomach is the chief organ of absorption, and after this the intestines. The absorption of a drug is influenced by (i) its *solubility*, and (ii) the *conditions under which it is administered.* Thus, a pill takes a longer time to absorb than a mixture. Again, salines are more rapidly absorbed than metallic salts or alkaloids. A drug acts more rapidly on an empty stomach than a full one. Mixtures, draughts, pills, powders, boluses, emulsions and confections are administered by this route.

(*d*) *The Rectum.*—When medication by the stomach is impossible, we take advantage of this route by means of enemas and suppositories.

2. **The Respiratory Tract** is the next most important route.

(*a*) *The Nose.*—What the mouth is to the stomach, the nose is to the lungs. Inhalation is carried on by the nose and mouth. Collunaria, snuffs, bougies, pigments, insufflations are used here.

(*b*) *The Larynx* is reached by inhalations, insufflations and pigments.

(*c*) *The Lungs.*—Through this channel vapours or atomised drugs rapidly enter the system. The rapidity of absorption can be gauged from the production of chloroform anæsthesia.

3. **The Skin.**—By the following methods, we can introduce medicaments into the body through the cutaneous surface :—

(*a*) *Enepidermic.*—In this method, drugs are simply kept in contact with the unbroken skin without friction or rubbing. Pastes, plasters, poultices, fomentations, pigments, cerates, creams, ointments, etc., are thus applied.

(*b*) *Epidermic or Iatroleptic.*—In this method, drugs are rubbed into the unbroken skin. As liniments, cod-liver oil inunction in scrofula.

(*c*) *Cataphoresis* or *Ionic Medication.*—Drugs when in solution split up into their component molecules or ions. When a constant electric current is passed through them, the metallic ions and basic radicles are driven away from the positive pole, the acid radicles are driven away from the negative pole. This is utilised in medicine by soaking a thick pad in the solution of the drug to be used, attaching the negative pole of the pad when one desires to drive acid radicles to the tissues, the positive pole being on a neutral part. The exact opposite holds good when basic radicles have to be driven into the tissues.

(*d*) *Endermic.*—In this, the cuticle is first denuded to promote rapid absorption of drugs. This can be rapidly done by soaking a piece of blotting-paper or some porous tissue with strong solution of ammonia, and applying it to the skin and immediately covering it with a watch-glass or a piece of oiled silk. After a few minutes, a blister rises and the cuticle is removed, and the finely-powdered drug is sprinkled over the raw surface. Morphine can be thus dusted over in ovaritis, sciatica, etc.

(*e*) *Inoculation.*—In this, the epidermis is punctured or scarified for introduction of medicaments ; as vaccination.

4. **The Subcutaneous Tissues.**—These are reached by hypodermic injection, which is effected by a small syringe to which is attached a hollow needle.

5. **The Deep Tissues.**—By the same instrument we can administer drugs to deeper structures, such as the muscles and nerves. When the injection is given within the substance of a muscle, it is called *intramuscular injection.* A familiar example is the intramuscular injection of calomel cream in the treatment of syphilis.

6. **The Blood-vessels.**—Through these channels, blood and saline fluids are *transfused* and drugs are administered *intravenously.*

Intravenous injection is the most certain and rapid way of bringing drugs into the circulation and tissues. It is generally used when a definite concentration of a drug is required in the blood rapidly. For instance, in the treatment of kala-azar and syphilis. The drugs used by this route must be in complete solution and must not react with the proteins of the blood.

7. **The Serous Cavities.**—These are only useful when the local action of the drug is required.

(*a*) *The Pleura.*—In empyema, we can wash out the pleural cavity by antiseptic lotions.

(*b*) *The Peritoneum.*—An injection of saline solution has been advocated in conditions of collapse. The peritoneum may be washed out by antiseptic fluids in some varieties of peritonitis.

(*c*) *The Tunica Vaginalis.*—Tincture or strong solution of iodine, or liquefied carbolic acid is sometimes injected to produce an adhesive inflammation in hydrocele.

8. **The Conjunctivæ and Lachrymal Ducts.**—Mydriatics, myotics, and drugs for local action on the conjunctivæ and lachrymal ducts are applied either as collyria, ointments, or powders.

9. **The Ear** is reached by injections, drops, insufflations, etc.

10. **The Bladder and Urethra** by injections and bougies.

11. **The Vagina and Uterus** by douches, injections, pigments, pessaries, medicated cottons, etc.

12. **Intra-cerebral or Subdural** injections in the treatment of cerebro-spinal meningitis, tetanus and cerebro-spinal syphilis, &c.

DOSAGE OR POSOLOGY

Having selected a drug and the route through which it is intended to be administered, the student must determine its dose. The word " dose," as ordinarily understood, means the quantity of a drug which is necessary to produce a certain pharmacological action either at once or after repetitions. The study of these doses is called **posology.** By a **maximum dose** we mean the largest quantity which may be given to an adult without producing evil effects, and by a **minimum dose** the lowest quantity which is necessary to obtain a physiological action. The B.P. doses represent only average ordinary doses for an adult. The student must bear in mind that the action of a drug varies with different doses. Thus, antimonium tart, is a diaphoretic in $\frac{1}{12}$ to $\frac{1}{4}$ gr. and an emetic in 1 to 2 grs. ; ipecacuanha radix is an expectorant in $\frac{1}{4}$ to 2 grs. and an emetic in 15 to 30 grs. Though the B.P. posology

is meant as a general guide, yet the practitioner can reduce the minimum and exceed the maximum limits of the pharmacopœial doses. For instance, the B.P. dose of Tr. Digitalis is 5 to 15 ms., we often give it in larger doses. Again we daily exceed the official maximum doses of quinine salts, potassium iodide, bismuth salts, male fern, opium, etc.

In determining doses, the following circumstances should be taken into consideration :—

1. **Age.**—The dosage varies considerably with the age. By **adult dose** we mean the dose for a person between 20 and 60 years of age. Children should get a fractional part of the adult dose. A practical method of calculating the children's doses under 12 years is given by Young. *The rule is to divide the age in years by the age in years plus* 12 ; *the resulting quotient is the proper fraction of an adult dose.* Thus the dose

for a child of 1 year, will be $\frac{1}{1+12} = \frac{1}{13}$ of an adult dose

,, 4 years ,, $\frac{4}{4+12} = \frac{1}{4}$,,

Cowling's Rule :—Adult dose $\times \frac{\text{age next birth day}}{24}$

The dose for a child of three years old will be $\frac{4}{24}$ or $\frac{1}{6}$ of adult dose.

From 12 to 16 years $\frac{1}{2}$ to $\frac{2}{3}$, and from 17 to 20 $\frac{2}{3}$ to $\frac{4}{5}$, are the proportions. Over 60 years, the dosage should again be diminished slightly. For hypodermic medication, the dose is one-half of what is given by the mouth, and for rectal medication, it is the normal dose plus one-fourth, except in the case of strychnine, which should be exhibited in smaller quantities than when given by the mouth.

2. **Sex.**—Women, as a rule being more delicate than men, cannot bear full adult doses. The menstrual period should also be taken into consideration. For instance quinine, if given during the period, may cause alarming hæmorrhage.

3. **Size and Body Weight.**—The quantity which is required to produce a certain physiological effect in a strong, healthy, and stout person of more than average size and weight, is certainly not necessary to produce the same action on a thin and weak individual.

4. **Temperament** has some influence on doses. A person with a sanguine or nervous temperament requires smaller doses than one with a lymphatic one.

5. **Idiosyncrasy.**—Individual susceptibility to the action of a particular drug or drugs has long been recognised. We often come across patients who cannot take a grain of potassium iodide without coryza, though ordinarily many can take it in 5 gr. doses without inconvenience. Quinine sulphate does not agree with many. Others again are readily salivated by quite small doses of mercury.

6. **Tole-ation and Habit.**—Certain drugs, for some reason or other which we cannot explain, fail to produce the same effects with the same dose, when continued for a lengthened period. This is what specially happens with opium. Its dose must be increased after a while, in order to get the full or the original effects of the drug. This gradual loss of activity is due to **toleration by custom.** Sometimes the person taking it becomes so addicted to its use that he actually craves for and indulges in it, to the detriment of his health. This craving for a particular drug is called a **habit.** Like opium-habit, persons may contract alcohol-habit and cocaine-habit. Tolerance is also established in the case of arsenic, as the arsenic-eaters of Styria.

7. **Rate of Absorption and Excretion.**—The quicker the absorption, or the slower the excretion, the greater is the effect produced by a drug. Thus morphine, subcutaneously injected, requires a smaller dose to produce a definite action, within a definite period, than what is necessary if administered by the mouth or rectum.

8. **Mental Condition.**—A morbid inclination of the mind towards the action of a particular drug increases the action of the same. Thus, if a patient can be convinced that he will sleep by a certain draught a small dose of a hypnotic may induce sleep.

9. **Fasting.**—A drug acts more powerfully on an empty stomach than on a full one. Thus the same quantity of alcohol which would intoxicate a person if taken on an empty stomach, can be ingested with impunity if taken during or after meals.

10. **Disease.**—Many diseases considerably modify the dosage of medicines. Thus, opium is borne in surprisingly large doses in biliary and renal colic. Large doses of mercury are tolerated in syphilis, but in Bright's disease both opium and mercury are ill-borne.

11. **Climate.**—It is a well-known fact that alcohol can be consumed in large quantities in cold countries than in hot climates.

12. **Time of Administration.**—Vital force is lowest at the early hours of the morning. Consequently, in debilitating diseases, stimulants are more necessary at this time than later on in the day. It is useless to administer even a very large dose of chloral hydrate when the person is in active labour, it should be given at bedtime. Cod-liver oil should always be given after food ; given at any other time it may derange digestion. Iron and arsenic, too, should always be given on a full stomach.

13. **Preparations of a Drug.**—Alkaloids, glucosides, neutral principles, extracts, etc., are all prescribed in smaller doses than the crude drugs from which they are prepared. Thus,

for 5 grs. of quinine sulphate, we should have to prescribe about 200 grs. of cinchona bark, had we no such preparation as quinine.

14. **Accumulation.**—Ordinarily a drug after introduction into the body is either slowly or rapidly excreted. But if we continue to administer it very frequently for a sufficient length of time, *i.e.* so quickly that it cannot be fully eliminated, a time may come when it will accumulate to such an extent as to produce suddenly toxic symptoms. This is called the *cumulative action* of a drug. It may be caused by the following circumstances :—

(*a*) *Rapid absorption and slow elimination of a drug.*—This occurs in the case of lead and mercury, both of which are eliminated slowly and with difficulty by the kidneys.

(*b*) *Sudden arrest of the excretion of a drug.*—Digitalis and strychnine are cited as examples of this class. During a course of digitalis treatment, if no precaution is taken, symptoms of poisoning may suddenly develop, without any increase of the dose. These toxic symptoms are said to be due to the powerful contraction of the renal vessels, which suddenly retards the elimination of the drug.

(*c*) *Sudden solution and absorption of a sparingly soluble drug owing to some changes in the contents of the intestine.*

GROUPING OF DOSES

The following grouping of doses will be a useful adjunct to the study of posology :—

Group	*Doses*
Acids, diluted, all (except hydrobrom., 15 to 60 ms.; **hydriodic 5 to 10 ms.**; acetic ½ to 1 dr.; hydrocyanic 2 to 5 ms.)	5 to 20 ms.
,, vegetable crystallised (except tannic 5 to 10 grs.)	5 to 15 or 20 grs
Aquæ, all (except laurocerasi **½ to 2 drs.**)	1 to 2 ozs.
Confections, all	60 to 120 grs.
Decoctions, all	½ to 2 ozs.
Effervescent powders, all	60 to 120 grs.
Extracts, dry, non-poisonous (except aloes 1 to 4 grs.; krameriæ 5 to 15 grs.; and euonymin 1 to 2 grs.)	2 to 8 grs.
,, ,, poisonous	½ to 1 gr.
,, **soft** (except taraxacum 5 to 15 grs.) ..	2 to 8 gr. or ½ to 1 gr.
Infusions, all (except digitalis **2 to 4 drs.**)	½ to 1 or 2 ozs.
Injections, Hypodermic, all	5 to 10 ms.
Liquors, containing arsenic and strychnine, excepting Donovan's solution (5 to 20 ms.) ..	2 to 8 ms.
,, containing morphine salts	10 to 60 ms.
,, containing iron	5 to 15 ms.
Mixtures, all	½ to 1 or 2 ozs.

Oils, Volatile, all (except copaibæ, cubebæ, 5 to 20 ms.; gaultheriæ, 5 to 15 ms.; santali, 5 to 30 ms.; terebinth. 2 to 10 ms. or 3 to 4 drs.)	½ to 3 ms.
Pills, all (except ferri 5 to 15 grs.; phosphori 1 to 4 grs.; plumbi c. opio 2 to 4 grs.; saponis co. 2 to 4 grs.) ..	4 to 8 grs.
Powders, all (except antimonialis 3 to 6 grs.; butea seminum 10 to 20 grs.; glycyrrhizæ 60 to 120 grs.; ipecac. co. and opii co. 5 to 15 grs.; and kino co. 5 to 20 grs.)	10 to 60 grs.
Spirits, simple, all (except æther. 20 to 40 or 60 to 90 ms.; juniper 20 to 60 ms.)	5 to 20 ms.
Spirits compound, all (except armoraciæ 1 to 2 drs.; ætheris nitrosi 15 to 60 ms.)	20 to 40 ms. or 60 to 90 ms.
Succi, all	1 to 2 drs.
Syrups, all (except cascar, arom., chloral, codeinæ phosphatis, rhei, sennæ ½ to 2 drs.)	½ to 1 dr.
Tinctures, all (except Tr. iodi mitis, Tr. Aconiti, Tr. Cantharidini and Tr. strophanthi 2 to 5 ms.) ..	30 to 60 ms. or 5 to 15 ms.

ANTAGONISM AND SYNERGISM

By antagonism is meant the weakening or prevention of the action of a drug by that of another. An antagonist may be a drug, or a substance formed in the body. They may act by (1) **Distoxication,** *i.e.*, by chemical combination with one another, *e.g.*, free acids and alkaline carbonates, oxalates and lime salts; (2) **True antagonism.** Here the drugs have no chemical affinities for, nor do they react with, each other, but produce opposite effects by acting either on (*a*) *the same structures*, as bromides and strychnine on the spinal cord; or (*b*) *on the different structures*, *e.g.*, adrenalin and amyl nitrite, the former constricts the vessels by stimulating the nerve-endings, while amyl nitrite dilates the vessels by direct action on the muscles.

Just as the weakening or prevention of the action of one drug by that of another is known as antagonism, the one sided or reciprocal augmentation of such action is known as *synergism*. For example magnesium sulphate and sulphuric acid make a stronger purgative than magnesium sulphate given alone. It has been found that doses of cocaine which by themselves produce no appreciable effects, very markedly increase the effects of adrenalin on the vessels, the dilator of the iris, etc. Bromide and chloral hydrate make a better hypnotic than either used alone.

INCOMPATIBILITY

A Prescription should not contain any ingredients which can counteract one another either physically, or physiologically, when mixed together. If they do so, they are known as **Incompatibles.**

Incompatibility, therefore, may be of the following kinds :—

I. **Physical.**—This is also known as *pharmaceutical*, and occurs when the ingredients are not soluble in water, so as to produce a clear solution. As oils, insoluble powders, some spirits, resinous tinctures, some extracts, etc., when ordered in a mixture.

II. **Chemical.**—Such drugs should not be prescribed as would chemically react on one another, unless such a reaction is desired. Chemical incompatibility can be classified under two heads :—

A. *Homogeneous.*—In this *no visible change of form*, such as the liberation of a gas or formation of a precipitate occurs, though colour may be changed. Thus, acids and bases are chemically and physiologically incompatible with each other; *e.g.* lactic acid with lime water, diluted hydrochloric acid with aromatic spirit of ammonia. Again, if the resulting salt is soluble and poisonous, the chemical neutralisation cannot resist the toxic action, as hydrocyanic acid and alkalies, for KCN is as poisonous as HCN, although the alkaline carbonates are not incompatible with HCN.

B. *Heterogeneous.*—In this there is *a visible change of form*, *i.e.*, the production of a gas or a precipitate. CO_2 is the chief gas liberated in such a decomposition, sometimes H_2S. The precipitates or the insoluble compounds form the largest chemical incompatibles. This class can again be subdivided into :—

1. *Intentional.*—Seidlitz powder, black wash, yellow wash, sodii citro-tart. efferv., all effervescing mixtures, etc., are examples of this variety. Vegetable astringents with chalybeates, and lead salts with sloutions of opium also come under this category.

2. *Avoidable.*—This form of chemical incompatibility is very difficult to master. A complete knowledge of chemistry and solubility of drugs can alone help the student out of this difficulty. The following rule would greatly minimise his errors :—"*A drug should never be ordered in combination with any of its tests or antidotes.*" Thus, carbonates should not be given with free acids (except HCN and H_2S) ; acid salts basic salts, double citrates, *e.g.*, scale preparations of iron, halogens with solution of ammonia, etc.

Alkaloidal salts should not be prescribed with alkaline carbonates or hydroxides, *e.g.*, liqr. strychnine with spt. ammon. aromat. or morphine acetate with sodium or potassium bicarbonates, etc. Pot. iodide and tannic acid also throw down alkaloidal precipitates, especially if the solution is concentrated. Many fatal accidents have taken place from swallowing the last dose of a mixture containing a poisonous alkaloidal precipitate. Although, to some extent, the alkaloidal incompatibility can be avoided by the addition of HCl

and alcohol, yet it is a safer plan to follow the practical rule of Dr. W. G. Smith :—"*All poisonous alkaloids as far as possible be prescribed in simple solution, and not in too concentrated a state.*"

Sometimes explosive combinations result from inattention to grave incompatibility (*see* below).

III. **Physiological.**—When the pharmacological action of a drug is antagonised by that of another, both drugs are *physiological incompatibles* or *antagonists.* It is presumed that this antagonism takes place either in the blood or in the tissues. We do not know any drug which can fully and completely counteract the action of another on all points, though instances are common where *partial antagonism* takes place. Thus, opium contracts the pupils and depresses the respiratory centre, belladonna dilates the pupils and stimulates the respiratory centre (*see* Opium and Belladonna) ; hence both of them are partially physiological incompatibles to each other. Digitalis counteracts the action of aconitine on the heart ; and strychnine and brucine that of physostigmine, bromides and chloral hydrate on the cord. The depressant action of aconitine on the heart is also neutralised by the stimulant action of atropine, daturine and hyoscyamine on the same organ. Pilocarpine increases, while atropine decreases, both salivation and perspiration. (*see* Antagonism page 107).

EXPLOSIVE COMBINATIONS

Certain drugs, such as chlorates, bichromates, iodates, nitrates, picrates, permanganates, oxide of silver, etc., are **rich in oxygen** or part with it very easily : while others, such as sulphur, sulphides, iodine, reduced iron, hypophosphites, organic powders, charcoal, camphor, iodide of iron, ammonia salts, essential oils, etc., are **easily oxidisable.** An admixture between any two of these classes is sure to result in an explosive combination. The following are a few typical examples :—

1. A few tablets of potassium chlorate kept in a pocket with a box of safety matches cause explosion.

2. Potassium chlorate with tannic acid, catechu, morphine hydrochloride, or gallic acid mixed as a dry powder has been known to explode.

3. Mixture of Tr. Ferri Perchlorid., glycerin, and potassium chlorate explodes when warm.

4. Calcium hypophosphite alone, when triturated hard, sometimes causes explosion. Never heat it with glycerin.

5. Potassium permanganate should not be made into a pill with vegetable extracts or combined with glycerin (*see* p. 90).

6. Oil of turpentine and sulphuric acid, and amber oil and nitric acid are sure to explode violently.

7. Oxide or nitrate of silver with creosote forms a compound which may take fire if it becomes warm.

8. Chromic acid with glycerin, ether, strong alcohol, or organic substances causes an explosive combination.

9. Chloral hydrate and spt. ammon. aromat, in a mixture liberate so much chloroform as to explode.

10. Bismuth subnitrate and sodium bicarbonate given in a mixture, liberate CO_2 to cause an explosion.

11. Tr. iodine and solution of ammonia should not be prescribed together as iodide of nitrogen is formed, which causes explosion.

12. Erythrol tetranitrate is very sensitive to percussion. A young chemist lost his life from explosion due to the rubbing of the tetranitrate with milk-sugar in a mortar.

13. Nitric acid should not be mixed with glycerin.

14. Chloride of lime triturated with sulphur causes explosion.

POISONOUS COMBINATIONS

1. Potassium chlorate and potassium iodide in solution do not react in ordinary temperatures but in the body produce a poisonous product, probably iodate of potassium.

2. Potassium chlorate given with syrup ferri iodide liberates free iodine in the stomach and causes severe gastric irritation.

3. Hydrocyanic acid dilute with metallic hydrates, carbonates, subnitrates, or subchlorides forms cyanides of metals which are more poisonous than the acid.

COMBINATION OF DRUGS

One or two words with reference to the combinations of drugs will be of use to a prescriber, whose first aim ought to be to present his patient with an effective and rational prescription free from incompatibles. An admixture of 12 or 15 ill-understood and ill-chosen drugs, in the hope that either one or other of them may hit the right nail on the head, can no longer be tolerated in these days of rational therapeutics. The student is therefore strongly advised never to prescribe unless he is quite sure of the pharmacology of the drugs he is using. Simplicity in combination should be the rule, but it does not follow that one drug only at a time is to be prescribed at a time. An effective combination of judiciously selected drugs is of the utmost value in the treatment of diseases. The following are the advantages for a good combination :—

1. *The efficacy of a drug can be greatly increased by combining it with different preparations of the same.*—Thus, if we desire

to obtain the full effects of cinchona, we can get them best by combining its extract, tincture, and infusion in one prescription. So also the full effects of calumba by prescribing tincture and infusion at the same time.

2. *By a combination of various drugs, whose actions bear resemblance with one another, we can augment or intensify certain properties of a drug.*—Thus, a mixture of salts of potassium, sodium, and lithium will produce more diuresis, or increase the alkalinity of urine more rapidly than when given separately. (*see* Synergism, page 107).

3. *By a careful admixture of corrigens, we can correct unpleasant and undesirable properties of a drug.*—Thus, ginger is added to Pulv. Rhei Co., Pulv. Jalap. Co., and Pulv. Scammonii Co. to remove the griping properties of the potent drugs. Hyoscyamus and belladonna correct the griping caused by colocynth. Hydrobromic acid lessens the cinchonism of quinine, and sal volatile the iodism of iodides. Arsenic prevents bromide rash, and atropine the unpleasant symptoms caused by the injection of morphine.

4. *By a combination of two or more drugs individually producing entirely different physiological effects, we can sometimes increase the potency of a remedy in a particular direction.*—Thus, by combining mercury and iodide of potassium with digitalis and squill, we can increase the diuretic properties of the latter drugs. Iron and digitalis in combination are more powerful cardiac tonics than when they are given uncombined.

5. *By mixing such drugs as chemically decompose each other we at times get better results from the resulting products.*—Thus, by giving potassium or sodium carbonate with citric acid, we derive the benefit of carbonic acid gas and potassium or sodium citrate. When mercuric chloride and potassium iodide are combined in a mixture, iodide of mercury is formed, which is much stronger and more efficacious than the salt prepared by an elaborate process.

6. *By a combination of such substances as would assist the solubility or absorption of a drug, a more effective remedy can be obtained.*—Thus, salicylic acid is almost insoluble in water, but it is rendered entirely soluble by the addition of borax, alkaline carbonates, hydroxides, etc. The absorption by the skin of the alkaloids of belladonna is greatly facilitated if belladonna is combined with fat, glycerin, oil or chloroform. Oleic acid is combined with alkaloidal salts in ointments, because it is a solvent for the same.

ART OF PRESCRIBING

WEIGHTS AND MEASURES IN A PRESCRIPTION

The weights and measures of capacity and length to be used in a prescription are those of the Metric System (*see* p.13),

though the scruple and the drachm are still permitted to exist under protest. Besides, certain signs indicating weights and measures of capacity are also common, which have not been officially recognised. They are :—

G. = Granum, 1 grain = $\frac{1}{480}$ of a Troy ounce or $\frac{1}{437}$ of an Avoirdupois ounce.
℈ = Scrupulum, 1 scruple = 20 grains.
ʒ = Drachma, 1 drachm = 3 scruples or 60 grains ; or $\frac{1}{8}$ of a *fluid* ounce, or 60 minims.
℥ = Uncia, 1 ounce = 1 Troy ounce (480 grs.) or 1 fl oz. (480 minims) or 437.5 grains or water.
M. = Minimum, 1 minim = $\frac{1}{480}$ part of a drachm or the volume of 0.91145 grain of water.
Gtt. = Gutta, 1 drop, supposed erroneously to represent 1 minim. (It varies so much in size that it should neither be used in dispensing nor as a measure for powerful drugs (*see* p. 76).
O. = Octarius, 1 pint = 20 fluid ounces, or 1¼ lbs. of water.
C. = Congius, 1 gallon = 8 pints or 10 lbs. of water.

ENGLISH DOMESTIC MEASURES

A tea-spoonful = 1 fluid drachm, ʒi or a little more.
A dessert-spoonful = 2 fluid drachms, ʒii (about).
A table-spoonful = 4 fluid drachms or ½ ounce, ʒiv or ℥ss. (about).
A wine-glassful = 2 fluid ounces, ℥ii or more.
A gill = 4 fluid ounces, ℥iv or more.
A tea-cupful = 7 fluid ounces or more.
A breakfast-cupful = 8 fluid ounces or more.
A glassful = 12 fluid ounces or more.
A tumblerful = 15 to 20 fluid ounces.

These are only average measurements, for no cups or spoons are of the same size.

INDIAN DOMESTIC MEASURES

Measures of Capacity current in the Bengal Presidency

A Half-kancha = ½ chattack or $1\frac{1}{2}$ seer = 2 fl. drachms (about).
A Kancha = ¼ ch. or $\frac{1}{64}$ seer = 4 fl. drachms, or 218.75 grs. of dist. water.
A Half-chattack = ½ poa or $\frac{1}{32}$ seer = 1 fl. ounce (about).
A Chattack = ¼ poa or $\frac{1}{16}$ seer = 2 fl. ounces (about).
A Poa = ¼ seer = 8 fl. ounces (about).
A Half-seer = ½ seer = 16 fl. ounces (about).
A Seer or 64 kancha or 16 chattacks = 32 fl. ounces (about).

Measures of Capacity current in the Bombay Presidency

A Sundia-palliful	=	1 drm.
A Curd-palliful	=	5 tollas or 2 ounces.
A Swayapak-palliful	=	10 tollas or 4 ounces.
A Panchpatriful	=	8 or 12 ounces.
A lota or tambiaful	=	3 or 4 lbs.

The following contractions of words are ordinarily seen in prescriptions :—

Contr.	*Name*	*Meaning*
aa.	Ana	Of each.
Ad.	Adde	Add.
Aq.	Aqua	Water.
Aut	..	Or.
C.	Cum	With.
Cap., Cpt.	Capiat	Let the patient take.
Cibus		Food.
Colo	..	To strain.
Co. or Comp.	Compositus	Compound.
Cras	..	To-morrow.
Div.	Divide	Divide.
Et.	..	And.
F.	Fac	Make.
Ft.	Fiat	Let it be made.
Gr.	Granum	A grain.
Gtt.	Gutta	A drop.
Haust.	Haustus	A draught.
H.	Hora	An hour.
In.	..	In or into.
Ind.	Indie	Daily.
Levis	..	Light.
M.	Massa	A mass.
M.	Mice	Mix.
M. or Min.	Minimum	A Minim.
Mist.	Mistura	A Mixture.
Mitte	..	Send.
Nox	..	Night.
Om.	Omnis	All, every.
Post	..	After.
R.	Recipe	Take.
Rept.	Repetatur	Let it be repeated.
Sine	..	Without.
Sig.	Signa	Mark.
Ss.	Semmis	Half.
Stat.	Statim	Immediate.
Talis	..	Such.
Vel	..	Or.
Ver.	Verus	Genuine.
Vesp.	Vesper	The evening.
Vetus	.	Old.
Vitellus	..	The yolk of an egg.

The following contractions of phrases are often used in prescriptions :—

Contraction	*Phrase*	*Meaning*
Ad lib. ..	.. Ad libitum ..	.. At pleasure.
A. H. ..	.. Alternis Horis ..	.. Every other hour.
Aq. Bull.	.. Aqua Bulliens ..	.. Boiling water.
,, Dest. ..	.. ,, Destillata	.. Distilled water.
,, Ferv. ..	.. ,, Fervens. ..	.. Hot water.
,, Font. ..	.. ,, Fontalis.	.. Spring water.
,, Pluv. ..	.. ,, Pluvialis	.. Rain water.
Bis ind. ..	.. Bis indies ..	.. Twice daily.
B.P. or Ph. B.	.. Pharmacopœia Britannica	British Pharmacopœia.
C.M. ..	.. Cras mane ..	.. To-morrow morning.
C.N. ..	.. Cras nocte ..	.. To-morrow night.
Coch. amp.	.. Cochleare amplum	.. A table-spoonful.
,, mag.	.. ,, magnum	.. Do.
,, med.	.. ,, medium	.. A dessert-spoonful
,, min.	.. ,, minimum	.. A small spoonful or a tea-spoonful.
,, parv.	.. ,, parvum	.. A tea-spoonful.
C. Vinar.	.. Cyathus Vinarius	.. A wine-glass.
Dieb. alt.	.. Diebus alternis ..	.. On alternate days.
D. in p. æ or Div. in p. æq.	.. Dividatur in partes æquales	Let it be divided into equal parts.
F. A. O. ..	.. Folio Argenti Obruantur ..	Let it be rolled in silver leaf.

Contraction	*Phrase*	*Meaning*
Ft. Haust.	Fiat Haustus ..	.. Let a draught be made.
F. M. or Ft. Mist.	.. Fiat Mistura ..	.. Let a mixture be made.
Ft. Mas. in pil. xii div.	.. Fiat Mass in pilulæ xii divide	Let a pill mass be made and divide into 12 pills.
H. D. ..	.. Hora decubitus ..	.. At bedtime
H. S. or H. S. S.	.. Hora Somni Sumendum	.. To be taken at bed time.
M. B. ..	.. Misce Bene ..	.. Mix well.
M. D. U.	.. More dicto utendum.	.. To be used as directed.
M.P. ..	.. Massa Pilularis ..	.. A pill mass.
Mic. pan.	.. Mica panis ..	.. Crumb of bread.
O. M. ..	.. Omni mane ..	.. Every morning.
Omn. bih.	.. Omni bihoria ..	.. Every two hours.
O. N. ..	.. Omni nocte ..	.. Every night.
P. R. N. ..	.. Pro re nata ..	.. When required, occasionally.
Q. S. ..	.. Quantum sufficit	.. Sufficient quantity.
Q.h., O. h.	.. Quaque hora or Omni hora	Each or every hour.
S. S. ..	.. Statim sumendum.	.. Immediately to be taken.
T. d. ..	.. Ter in die ..	.. Thrice daily.

PRESCRIPTION WRITING

A prescription is **simple,** when it contains a basis and a vehicle or excipient with or without a corrective ; and **complex,** when it contains several adjuvants and corrigents besides the basis. The construction of a model prescription must be in the following order :—

1. The **Superscription,** which consists of the symbol Re, which originally symbolised the planet Jupiter, but is now an abbreviation of *recipe*— " Take Thou."

2. The **Inscription** or the body of a prescription, containing the *basis,* the *adjuvant,* the *corrigent,* and the *vehicle* or *excipient.*

3. The **Subscription** or the directions to the dispenser, such as *misce, fiat, mist., pilula,* etc.

4. The **Signature** (from L. *Signetur*—let it be labelled) or the directions to the patient. This is written either in English or in vernacular.

5. The **Prescriber's name or initial** and the **date.** These are put at the bottom. The patient's name should invariably be written at the top of the *recipe.*

The following is an example of a model prescription :—

Patient's name.—W. Thomas, Esqr.

Superscription.—℞

Inscription.	Liqr. Ammon. Acetat.	.. ℥ii (*Basis*)
	Pot. Acetas ..	.. gr. x (*Adjuvant*)
	Spt. Æther. Nit. ..	.. m. xx (*Adjuvant*)
	Syr. Aromat. ..	.. ℥i (*Corrigent*)
	Aq. Destill. ..	ad. ℥i (*Vehicle*)

Subscription. { M., ft. mist. Mitte talis vi. div. in p. æ.

Signature.—*Sig.* ½ part every 3 hours during fever.

Date, 20-1-01. *Prescribers' name,* R. Ghosh.

• It is customary to write prescriptions in Latin. But directions should, as a rule, be given in the language of the country. They should be legibly written and ambiguous nomenclature avoided. In case the B. P. limits of doses are exceeded, the doses should be initialed. They must be revised and, if possible, copies kept before they are handed over.

ELEGANT PRESCRIPTIONS

Elegance in a prescription should always be aimed at, but it does not follow that the student should prescribe only fancy pills, capsules, tablets and cachets. These are good and useful, but they cannot supply the place of a mixture. The importance of giving a mixture in an inviting and palatable form cannot be over-estimated. We have various flavouring agents. Aromatic syrup, syrups of orange, orange-flower, glucose, hemidesmus, lemon, Virginian prune, tolu and ginger are the popular ones. During the hot months, mixtures containing syrups soon decompose, but glycerin and flavouring waters may be substituted for them. Spirit of chloroform, chloroform water and liquid extract of liquorice cover the taste of many bitter and saline mixtures. Syrup of yerba santa disguises fairly well the taste of quinine salts. Rose water, orange-flower water, cinnamon water and anise water are good flavouring vehicles either for mixtures or for lotions. Cinnamon water disguises the odour of castor oil. Syrup of roses and red poppy are only used as colouring agents. Compound tinctures of lavender and cardamoms are used both for flavouring and for colouring purposes. Liniments or ointments can be perfumed by otto of roses, oil of neroli and lavender. Nauseous and bitter powders can be given in cachets, or pills which can be coated or gilded.

DIRECTIONS TO THE PATIENT

Make it a point to give directions in a definite manner. They should be short, simple and to the point. It is very important to mention the hour of the day when medicines are to be administered. To the student this may appear confusing in the beginning, but the following hints will aid him in this direction :—

1. Mineral acids, as a rule, are given after meals.

2. When we want to neutralise the acid secretion, we give alkalies, such as sodium bicarbonate, etc., after food.

3. Gastric sedatives, such as acid hydrocyanic dilute, bismuth salts, are best given on empty stomach, as we want their local action.

4. Pepsin, papain, taka-diastase, should be given immediately after or along with the meals.

5. Pancreatin or other pancreatic ferments should be given two hours after food, along with sodium bicarbonate, as they aid duodenal digestion.

6. Cod-liver oil and its preparations should be administered after, and not before food. If given before they spoil the appetite.

7. All preparations of iron, specially the astringent varieties, are to be administered after meals.

8. All stomachics and bitter tonics, such as calumba, chiretta, quassia, are given ½ to ¾ hour before food.

9. Arsenic is always given after meals, except in a few rare cases, where its local action on the stomach is desired.

10. Potassium permanganate is always given after food.

11. Castor oil should be given on an empty stomach in the early morning.

12. Cathartic pills containing aloes should be given after dinner, as they take about 12 hours to act.

13. Emmenagogues should be taken at least one week before menstruation.

14. All diaphoretics act well when the patient is kept warm, and diuretics when cool.

15. Hypnotics, as a rule, should be taken at least half an hour before going to bed; but sulphonal two or three hours before, as it dissolves slowly.

16. Morphine should be administered subcutaneously when the patient is in bed.

17. Bromides, when given as a sedative, are to be administered after meals or at bedtime.

PRESCRIPTIONS FOR CHILDREN

Great tact and caution are required in prescribing for children. The hints given below will greatly help the student in this direction :—

1. The dosage must be in proportion to the age.

2. The bulk of a mixture must be small, not exceeding one or at the most two tea-spoonfuls.

3. Medicines must be made as palatable as possible. Children like either sweet or tasteless medicines. They refuse bitters. Euquinine may be used as a tasteless substitute for quinine salts. Quinine should not be dissolved in mineral acids, as its bitterness is intensified.

4. Infants do not refuse either castor oil or cod-liver oil, but older children often reject the former. Cod-liver oil with extract of malt is never refused.

5. Never order pills for children, give dry drugs in the form of powders mixed with honey, syrup, milk, sweetened water, malt extract, or jam.

6. Suckling babes are best treated by giving medicaments to their mothers; but some drugs, such as copaiba, oil of turpentine, asafetida, make the milk so nasty that they refuse to draw it.

7. They can bear belladonna and hyoscyamus in fairly large doses.

8. Arsenic, too, is well borne, some choreic children can take very large doses without harm.

9. A teaspoonful of castor oil to a newly-born babe is not a big dose.

10. Goodeve's Red Mixture is a very useful carminative aperient.

11. Children are **very susceptible to opium.*** Opium and its perparations should therefore be used with caution in children's practice.

12. Plain dill or anise waters make good all-round general vehicles for children's mixtures.

13. For round worm, santonin must be given on an emtpy stomach at night and then followed by a dose of castor oil next morning. It is best given with calomel and sugar followed by oil.

14. Children tolerate calomel better than adults and are rarely salivated.

15. Expectorants are best given in the form of syrups or mixed with a syrup.

* In some parts of India infants are habituated to the use of opium. It is given with a view to keep them quiet while their mothers are at work. Many wet-nurses secretly administer this drug to their wards. The writer has seen an infant only 14 months old taking daily one grain of opium without any other evil effects than constipation.

PART IV

PHARMACOLOGY

GENERAL PHARMACOLOGY OF DRUGS

By the action of a drug on the human organism is understood the interaction between a drug and the blood and the tissues, whereby either the existing functions are altered, or certain functions are brought more into prominence which were latent before. Thus, the functions may be increased or diminished, and the drug is then said to *stimulate* or *depress* as the case may be. Sometimes this stimulation has an injurious effect on the tissues and it is then known as *irritation*. A moderate degree of stimulation continued for a long time leads to fatigue or exhaustion of the organs concerned.

Some drugs act more powerfully on certain organs and tissues than others, and this preferential effect is known as the *selective action of the drug*. This fact has been taken advantage of in the modern treatment of parasitic diseases and forms the basis of chemotherapy. Substances have been discovered which are supposed to be harmful to the infecting parasites, *i.e., parasitotropic*, and at the same time harmless to the host, *i.e., not organotropic*. The conception of chemotherapy is, however at its best, a speculation, and that most of the parasitotropic agents act not so much by their selective affinity on the parasite but by definite pharmacological action on the cells of the body of the host.

It is not always very easy to explain exactly how the different drugs produce their pharmacological effects on the system. Since the processes of life are governed by the chemical and physical changes in the constituents of the cells, it is possible that the different drugs act by altering or modifying these chemical and physical factors in the cells and produce corresponding changes in their functions.

Many attempts have been made to explain the action of drugs, but still we are far from any satisfactory solution as to the real nature of the action of most of them. Although the effect produced by certain drugs are certainly due to chemical changes, yet the actions of many are produced differently and cannot be explained by the chemical theory alone. Some drugs act in a purely mechanical way, while

a few others depend for their action on osmosis, *e.g.*, the saline purgatives. Mayer and Overton explain the action of another group of drugs, *viz.*, the narcotics, as being due to their solubility in fats and lipoids. Even this theory does not explain the action of all narcotics, and it will be seen while discussing narcotics, that other views are also held.

Another group of drugs alter the bodily functions indirectly by destroying certain agents which are the causes of the disease, *e.g.*, anthelmintics.

Be that as it may the following will help the student in forming some idea of the different ways the drugs act.

1. **An intimate relation exists between the chemical composition and constitution, and the physiological action of a drug,** as will be evident from the following :—

(*a*) *The intensity of action of a drug increases in proportion to the atomic weight,* but this is only possible in those compounds which are isomorphous, *i.e.* which crystallise in the same form. Thus, magnesia, ferrous salts, manganous salts, nickel, cobalt, copper, zinc and cadmium agree in action, but differ in degree. The toxicity of cadmium is the greatest and that of magnesia the least.

(*b*) *The molecular arrangement in a compound sometimes determines the action of a drug, without reference to its molecular weight.* Thus isomerides have the same chemical composition and the same percentage of weight, but differ in properties, on account of their different molecular arrangements. Resorcin and pyrocatechin are isomers $C_6H_4(OH)_2$. The former is sweet, the latter is bitter.

(*c*) *It is possible to modify the physiological action of a drug by artificially modifying its chemical constitution.* Fraser, Crum Brown and others have shown that by introducing *a methyl radical* into the molecules of strychnine, brucine and thebaine, new compounds are formed, which instead of acting as convulsants, are paralysers of the peripheral terminations of the motor nerves.

Similarly benzol, C_6H_6, the mother substance of the coal-tar series, has a low toxicity, because it cannot react with protoplasm. It becomes toxic by replacing part of the H atoms by other groups, especially by OH (forming phenols) or by CO_2H, or by both. The OH radicle is the most active, the antiseptic and toxic actions increasing with the number of OH groups. Thus : benzol $= C_6H_6$; phenol $= C_6H_5OH$: resorcin $= C_6H_4(OH)_2$. The introduction of CO_2H group alone (*i.e.* benzoic acid $C_6H_5\ CO_2H$) does not render the substance more active. But both OH and CO_2H, *i.e.* salicylic acid ($C_6H_4 \begin{matrix} OH \\ CO_2H \end{matrix}$) results in a compound which is less toxic and less antiseptic than phenol, but has a peculiar anti-

rheumatic properties. The substitution of an H of the C_6H_5 in phenols by *alkyls* = Cresol, $C_6H_4 \begin{matrix} OH \\ CH_3 \end{matrix}$ leads to an increase of the antiseptic power, and diminishes at the same time the toxicity to tissues.

2. **The action of a drug is determined to a great extent by its affinity for certain class of tissues, or by its power of acting on certain organs and tissues.**—This selective action is observed in the pharmacology of almost every drug. Thus, amyl nitrite and nitroglycerin dilate the blood-vessels, ergot contracts them; atropine, hyoscyamine, and cocaine dilate the pupils; physostigmine, pilocarpine and morphine contract them.

The variation of action may be caused by many other influences besides the selective affinity; such as the varying rate of solubility, rate of osmosis, rate of absorption, rate of excretion, and the interaction of various functions.

3. **The action of a drug also depends to a great extent on its power of dissociation into ions.**—When we consider the action of a powerful drug like strychnine we find that its various salts produce the same effect which the acid radicle (sulphate, nitrate, etc.) does not modify. This is not however the case with less powerful bodies, *e.g.*, sodium; here the acid radicle with which it is combined greatly modifies its action, as is observed in the different effects resulting from the administration of NaCl and Na_2SO_4. To appreciate these differences of action it is essential to understand the ionic theory. All substances are divided into two groups, *electrolytes* and *non-electrolytes*. An electrolyte is a substance which is capable of being decomposed by the electric current, as sodium chloride, potassium bromide, etc. The theory assumes that certain substances such as inorganic acids, salts and bases in solutions undergo partial decomposition into their constituent elements or radicles called *ions*. These ions carry definite charges of electricity. Thus, sodium chloride, if dissolved in water, exists in part commingled, but not chemically bound sodium kations and chlorine anions

NaCl	=	Na	+	Cl
(Electrolyte)		+ion or kation		−ion or anion

The effect of an electric current on the solution of an electrolyte is to drive in from the positive pole the anions of all metals and basic radicles and drive in from the negative pole all acid radicles. Elements in the molecular and ionic conditions are therefore different things.

A non-electrolyte is a substance which cannot be further decomposed without losing its chemical identity. In ionic dissociation when the solvent is evaporated the salt is obtained in the same state as before solution, in chemical decomposi-

tion however the evaporation of the solvent will not re-unite the separate ingredients.

The great value of this theory to pharmacology is that it is the ions of the salts and not the whole molecule which gives rise to pharmacological action. For instance, when an ionizable substance is introduced into the blood it has a threefold effect on the functions of the body, *viz.*—

(*a*) That due to the influence of its kation,
(*b*) that due to the influence of its anion, and
(*c*) pure salt action.

Sometimes the basic and sometimes the acid ion exercises the predominent power, and when neither ions are potent we get the typical salt action. When the two ions are of approximately the same toxicity we have the same effects of both ions. The following examples will serve to illustrate :—

$NaCl$ = typical salt action.

Na_2SO_4 = action of acid ion predominating, and acts as a purgative.

$FeSO_4$ = astringent and hæmatinic, action of basic ion predominating.

Similarly in the case of potassium cyanide, the cyanide ion is so poisonous that the action of K is negligible, and it is not possible to introduce enough of the salt in the body to exercise the salt action.

4. **The action of a drug is sometimes determined by the reaction of the body tissues and body fluids.**—The acidity and alkalinity of tissues depend upon the dissociation of H and OH ions. These two ions part readily with their electric charges and produce marked alterations in the functions of cells. Even chemically pure water contains H and OH ions in a state of dissociation. At 21°C. pure water contains 1.0×10^7 of a gramme of free hydrogen-ion per litre. This is represented as "CH" (Hydrogen-ion-concentration) $= 1.0 \times 10^7$. Such negative figures are difficult to deal with in practice, and therefore the potential of H-ion concentration is taken as the standard, rather than the actual H-ion concentration itself. The hydrogen-ion-concentration-potential or *p*H is the decimal logarthim of the reciprocal of CH, and in the case of water *p*H = 7.0, and a standard of *p*H = 7 may be taken as neutral.

The tissues and fluids of the body are normally neutral, inclining a trifle towards alkalinity, *i.e.*, *p*H = about 7.1 to 7.8. The *p*H of gastric juice is 0.9 to 1.6 : urine 6.0 ; cow's milk 6.7 ; human milk 7.1 ; saliva 6.9 ; pancreatic juice 8.3 etc. Living cells are dependent upon the maintenance of a strictly limited H-ion concentration in their environment for the normal performance of their functions.

The normal blood has a *p*H range of from 7.3 to 7.5, and life is incompatible when the *p*H of blood is below 7.0 or above 7.8. While the *p*H of different excretions varies between

wide limits, the maintenance of the *p*H at its normal level in the blood and tissues is very important. This is regulated by a fine adjustment of different mechanisms. The carbonates and the alkaline phosphates of the blood and tissues form the alkaline reserve, while the carbonic acid and phosphates the acid reserve. These act as " buffers " and tend to neutralise any attempt to change the actual reaction.

The importance of the knowledge of *p*H of the different tissues of the body to the pharmacologist is great. Action of drugs which are supposed to have a selective affinity for certain organs or tissues often depends upon their *p*H reaction. Thus Acton has shown that at *p*H of 8 quinine kills paramœcium at a dilution of 1 in 10,000 ; while a concentration of 1 in 100,000 is necessary at *p*H of 7. Dale has shown that emetine in large doses failed to cure dysentery in kittens, produced by strains from man, while these men were cured by a course of emetine. It is possible that the *p*H of human gut is responsible for the effect of emetine. In fact emetine acts ten times more powerfully, if the acidity of the gut, which has a *p*H of about 6.2 in amœbic dysentery be reduced or rendered alkaline to a *p*H of 8 ; when cure is taking place and the stools are returning to normal. It is clear therefore that the action of drugs in certain instances is modified or intensified by the *p*H reaction of the particular organ over which it has the main effect.

The action of a drug may be either *direct* or *local*, or *indirect* or *remote*. It may also be either *primary* or *secondary*.

The direct or local action of a drug is what it exerts on a part or organ with which it comes directly in contact. Thus, caustic potash causes irritation and sloughing when applied to the skin, hence its *immediate local* action is irritant and caustic. Copaiba during elimination stimulates urinary cells and bronchial glands, hence its *remote local* action is diuretic and expectorant.

The indirect or remote action of a drug is what it exhibits after absorption, on different, parts of the body through the nervous system. For example, apomorphine hypodermically injected causes vomiting by exciting the vomiting centre, and not by exciting the gastric nerves. This action is spoken of as the systemic effect of the drug. The immediate local action of aconite on the tongue is tingling and numbness, and its indirect or remote action on the heart is the slowing of its force and tension, due to the stimulation of the vagal roots.

The primary action of a drug is what is produced by it in its unaltered state ; *e.g.*, the emetic action of tartar emetic.

The secondary action is that caused by compounds formed in the body from the decomposition of a drug ; *e.g.* the conversion of rhubarb into chrysophanic acid in the body and consequent cure of psoriasis during a course of rhubarb treatment.

CLASSIFICATION OF DRUGS ACCORDING TO THEIR PHARMACOLOGICAL ACTIONS AND THERAPEUTIC USES

CLASS I.—DRUGS THAT ACT ON THE DIGESTIVE ORGANS

A. Drugs that act on the tongue

1. **Drugs that influence the sensory apparatus of the tongue.**—Drugs that act on the sensory branches of the glossopharyngeal, lingual and chorda tympani, can be divided into the following groups :—

(*a*) *Acids* ; as vegetable and mineral acids, lemon, tamarind, vinegar, oxymel, etc.

(*b*) *Aromatics* ; as dill, anise, fennel, cardamoms, coriander, nutmeg, cinnamon, ginger, cloves, peppermint, etc.

(*c*) *Aromatic bitters* ; as chamomile flowers, cascarilla, orange peel, cusparia, and serpentary.

(*d*) *Bitters* ; as aloes, calumba, cinchona, and its alkaloids, nux vomica, strychnine, quassia, salicin, neem-bark, etc.

(*e*) *Demulcents* : as acacia, linseed, almonds, starch, honey, olive and almond oils, syrup, ice, ispaghul, etc.

(*f*) *Nauseants* ; as asafetida and valerian.

(*g*) *Pungents or acrids* ; as capsicum, cubebs, mustard, black pepper, horseradish, etc.

(*h*) *Spirituous substances* ; as alcohol in every form, chloroform, and ether.

(*i*) *Sweets* ; as sugar, glycerin, honey, liquorice, manna, etc.

B. Drugs that act on the teeth and gums

1. **Dentifrices.**—These are preparations used for cleansing the teeth. Chalk is an excellent basis for a toothpowder. Charcoal scratches the enamel. Dentifrices may be grouped under he following heads :—

(*a*) *Antiseptic* ; which may contain quinine, carbolic acid, borax, or thymol. They prevent decomposition of food lodged either between the teeth or within a cavity.

(*b*) *Astringent* ; which may contain myrrh, rhatany, catechu, betel-nut, kino, or alum. Alum injures the teeth when continued for any length of time. These check bleeding and harden spongy gums.

(*c*) *Alkaline* ; which may contain chalk, soda, or magnesia. They act by neutralising acidity.

2. **Local anodynes** are used to relieve toothache, which is generally caused by exposure of the tooth-pulp from destruction of the dentine. Opium, cocaine, strong carbolic acid, arsenious acid, creosote, menthol, chloral c. camphor, etc., are introduced into the cavity of the tooth by means of a pledget of cotton-wool, after the cavity has been cleaned. In the case of irritants and caustics, a second pledget should be introduced either alone or better soaked in a solution of gum mastiche in chloroform.

C. Drugs that influence the secretion of the salivary glands.—Drugs that increase the flow of saliva are called **sialagogues.** Their action is dependent upon (1) the activity of the secreting cells, and (2) the rapidity of the flow of blood, so as to maintain a supply of material for secretion.

1. **Drugs which increase the salivary secretion reflexly by exciting the periphery of afferent nerves.**—These are sometimes called **reflex sialagogues,** and may again be subdivided into :—

(*a*) *Those which act by stimulating the gustatory and the glosso-pharyngeal nerves of the mouth* :—

All vegetable and mineral acids | Æther Chloroform | Alcohol Acid salts | Pungents

(*b*) *Those that act by stimulating afferent filaments of the vagus in the stomach* ; as nauseants and emetics, *e.g.* ipecacuanha and antimony.

Besides the remedial agents, mental emotion, sight, smell, etc., may reflexly stimulate the secretion of saliva.

2. **Drugs which increase the salivary secretion by stimulating the secreting nerves.**—These are sometimes called **specific sialagogues** :—

Pilocarpine Physostigmine

Many drugs, such as mercury, potassium iodide, are excreted with the saliva and increase its secretion. This effect is counteracted by atropine.

3. **Drugs which increase salivary secretion by acting on the ganglionic cells.**—Nicotine, etc., first excite, later inhibit salivary secretion.

4. **Antisialagogues or Antisialics** are drugs which lessen the secretion of saliva. They may do this in the following ways :—

(*a*) *By allaying irritation of the mouth and thereby depressing the irritated terminal ends of the afferent nerves.* As potassium chlorate, borax, astringent gargles, etc., which, by curing stomatitis check excessive flow of saliva.

(*b*) *By reducing the excitability of the reflex centres or efferent nerves.* As opium and morphine.

(*c*) *By reducing the vascularity of the glands.* As physostigmine in large doses.

(*d*) *By paralysing the periphery of the secreting nerves* (parasympathetic system). The action of atropine is most marked in this respect.

Therapeutics.—The secretion of saliva is considerably lessened in fevers, Bright's disease, diabetes, belladonna and stramonium poisoning, etc., consequently dryness of the mouth and thirst are urgent symptoms. To relieve thirst, we use *refrigerant* drinks. By **refrigerants** we mean substances that are used to allay thirst and produce a feeling of coolness ; as acidulated and effervescing drinks, juices of fruits, sherbets, acid salts, acetates and tartrates.

When the mucous membrane of the mouth is irritated and inflamed, as in irritant poisoning, we use *demulcents* or substances which soothe and protect the mucous surface.

D. Drugs which act on the stomach.—For thorough digestion the following factors are essential, *viz.*—(1) complete mastication and insalivation of the food, (2) proper secretion of the gastric juice both in quantity and quality, (3) proper churning movements of the stomach. The pyloric end of the stomach protects the small intestine by preventing the passage of unassimilable material. This orifice is under the control of the reflex action, and opens only when the food material has reached a certain stage of digestion. It also prevents concentrated solutions from entering the small intestines without being suitably diluted.

1. Drugs which influence the gastric secretion

(*a*) *Drugs which increase the secretion of the gastric juice* are called *stomachics*. They do so (1) reflexly by stimulating the nerves of the mouth; and (2) by stimulating the nerve-filaments and dilating the blood-vessels of the stomach: as all aromatic, bitter, pungent and spirituous substances. Substances which increase the sensation of appetite also increase the psychic secretion of the gastric juice. Condiments and bitters increase the secretion of the stomach reflexly through the mouth.

Therapeutics.—Stomachics are used in dyspepsia and in the convalescent stage of many acute diseases. They act by improving the appetite and then increasing the flow of gastric juice.

(*b*) *Drugs which decrease the secretion of gastric juice.*—Alkalies, fats and spirituous stomachics (if in large doses). Alkalies are largely employed before meals in certain forms of dyspepsia; when so administered they act by checking the flow of the gastric juice, give the gland cells time to rest and after recuperation enable them to pour out normal juice. They are also used after meals, to relieve the acidity due to the presence of lactic and fatty acids. Lead, silver, zinc salts in small doses, opium, tannic acid and vegetable astringents as kino, catechu, etc., reduce vascularity and act as *gastric astringents* and indirectly as *gastric sedatives*.

(*c*) *Drugs that modify the composition of the gastric juice and the contents of the stomach.*

We have considerable control over the composition of the gastric juice, and the gastric contents as shown below:—

(1) *Drugs that increase the acidity of the gastric contents.*—As hydrochloric acid dilute after food.

(2) *Drugs that neutralise the acidity.*—These are the *direct antacids*, as alkalies.

(3) *Drugs that supply the deficiency of gastric ferments.*—As pepsin and papain, alone or in combination with dilute hydrochloric acid.

(1) *Drugs that prevent fermentation and decomposition of the gastric contents.*—For this purpose, we use **antiseptics,** though with temporary benefit. Large doses are injurious. They are :—

Boric acid	Creosote	Iodoform	Sulphurous anhydride
Carbolic acid	Eucalyptus	Naphthol	Sodium hyposulphite
Bismuth salicylate	Charcoal	Salol	Sodium sulphocarbo-
Salicylic acid	Cyllin	Thymol	late

2. **Drugs that dilate the gastric vessels.**—The vascularity of the stomach increases on the least irritation, especially in the presence of food. All stomachics except alkalies, and diluted mineral acids dilate the blood-vessels to a small degree, but there are other drugs which powerfully irritate the mucous membrane, and are therefore called *gastric irritants*, as arsenic, iron, mercury, senega, squill, colchicum, copaiba, guaiacum, etc.

3. **Drugs that contract the gastric vessels.**—Gastric astringents do this, but their use is more confined to the intestine than to the stomach.

4. **Drugs that influence the gastric nerves and muscles**

(*a*) *Drugs which increase the flow of the gastric juice as well as the churning movements of the stomach*, without producing those peculiar movements which cause emesis, are called *gastric stimulants*, or *gastric* or *stomachic tonics*. As mineral acids, bitters, strychnine, ether, volatile oils, etc.

(*b*) *Drugs which depress the gastric nerves and muscles.*—They may be either *direct* or *local* and *indirect* or *remote* :—

(1) *Direct or local Gastric Sedatives.*—These directly soothe the irritable gastric nerve-filaments by their local action. They are :—

Ice	Carbonic acid	Belladonna
Bismuth salts	Hot water	Hyoscyamus
Hydrocyanic acid dilute	Opium	Stramonium

(2) *Indirect or remote Gastric Sedatives.*—These remedies soothe gastric irritation by reflexly depressing the afferent nerves through the nerve-centres. They are :—

Blisters	Morphine	Hydrocyanic
Fomentations	Chloroform	acid dilute
Poultices	Opium	

There are a few gastric sedatives whose action is not yet known, such as cerium oxalate, ipecacuanha wine and tincture of iodine in drop doses.

(*c*) *Drugs that help the expulsion of gas from the stomach and bowels.*—These are called **carminatives.** They appear to act (1) by exciting healthy and regular peristaltic movements of these organs, (2) by dilating either the cardiac or sometimes the pyloric sphincters, and (3) by stimulating the gastro-

intestinal nerves and muscles. As a result of these actions, there is either *eructation* or a discharge of flatus by the anal aperture. They are :—

Aromatics	Asafœtida	Valerian
Aromatic bitters	Camphor	Spirits
Ammoniacum	Pungents	Volatile oils

Of these, aromatics and spirituous substances are the most effective.

(*d*) *Emetics.*—Vomiting is a complex physiological phenomenon to produce which several parts are brought into play. The chief of them is the vomiting centre in the medulla and the afferent stimuli brought from various sources. During the act of vomiting the cardiac sphincter opens, and the pyloric portion of the stomach tightly contracts and the contents of the stomach are expelled by a simultaneous contraction of the abdominal muscles and the diaphragm. *Emetics* are drugs which produce vomiting. They are generally divided into *local or gastric*, and *remote or central.*

(1) *Local or Gastric Emetics.*—These cause vomiting by stimulating the sensory endings of the vagus in the stomach. They act only when they reach the pyloric end of the stomach, and therefore they act better when used with large bulk of water for rapid action, as then it will reach the pyloric end rapidly. They are often used in poisoning, but being irritants they have an injurious effect if emesis does not occur. They are :—

Zinc sulphate	Ammon. carbonate	Mustard	Warm water
Alum	Copper sulphate	Common salt	(in large
Ipecacuanha	Tartar emetic		draughts)

(2) *Remote or Central Emetics.*—These act by stimulating the vomiting centre, through the circulation after absorption. They are accompanied by nausea, salivation, sweat, secretion of mucus from the air-passages and œsophagus, quick pulse and irregular respiration. For instance apomorphine.

Therapeutics.—Emetics are indicated :—

(i) To remove foreign bodies impacted in the throat and œsophagus.

(ii) To expel undigested substances and poisons.

(iii) To remove false membranes, or excessive bronchial secretion.

(iv) To aid the action of antiperiodics.

(v) In small doses to increase secretion of bronchial glands.

They are contra-indicated in hernia, aneurism, prolapse of the rectum and uterus, peritoneal and intestinal inflammation, and in cases where there is a tendency to hæmorrhage, atheroma of blood-vessels or abortion.

(*e*) *Antiemetics* are drugs which stop vomiting either by acting locally on the stomach, or centrally on the vomiting

centre. Vomiting may be due either to direct stimulation of the centre or presence of irritating substances in the stomach. They may be divided into :—

(1) *Direct or Gastric Antiemetics.*—These stop vomiting by their direct sedative action on the gastric nerves. They are :—

Alcohol (in small doses)	Carbolic acid	Hot water
	Carbonic acid	Hydrocyanic acid
Arsenious acid (in small doses)	Chloroform	Ipecacuanha wine (in 1 m. doses)
	Cerium oxalate	
Bismuth salts	Cocaine	Ice
Calomel (in small doses)	Creosote	Iodine (Tr. in 1 m. doses)
	Ether	

(2) *Remote or Central Antiemetics.*—These act by removing the irritation of other structures or organs, besides that of the stomach and the nerve centres. Examples of vomiting due to central origin are sea-sickness, vomiting of pregnancy, cyclic vomiting and vomiting due to passage of a calculus through the ureter or bile-duct. Morphine frequently produces vomiting by stimulating the centre, which is stopped by the administration of atropine. Prevention of central vomiting is rather difficult. The centre may be depressed by general depressants, of which bromides in large doses are effective. Atropine by paralysing the vagus, the motor nerve of the pylorus, prevents spasm of the pylorus and may prevent vomiting. The common antiemetics are :—

Opium	Chloral hydrate	Nitroglycerin
Morphine	Hydrocyanic acid dilute	Amyl nitrite
Bromide salts	Alcohol (in small doses)	Atropine

E. Drugs that act on the duodenum.—We have not so much control over this part of the digestive tract as we have over the stomach. The normal chyme slightly acid in reaction is passed into the duodenum in driblets, and the acid which it contains helps the production of secretin, which is taken by the blood stream to the pancreas, whose secretion it stimulates. The presence of the food material in the duodenum excites the contraction of the gall-bladder, so that the chyme is subjected here to a further digestive process by the alkaline secretions from the liver, the pancreas, and the intestinal glands. Drugs which aid duodenal digestion can be divided into the following two groups :—

1. *Direct duodenal stimulants.*—By increasing the acidity of the chyme towards the end of the gastric digestion, by diluted hydrochloric, nitric, nitro-hydrochloric or phosphoric acids, we can aid or stimulate the alkaline secretion in the duodenum.

2. *Remote duodenal stimulants.*—Sialagogues, stomachics and purgatives, indirectly stimulate the duodenal digestion, by transmitting into the duodenum chyme having a greater acidity.

F. Drugs that act on the intestine.—The chyme after transmission into the small intestine is further subjected to the digestive processes, and the chyle and other soluble constituents are absorbed by the lacteals and portal veins as the chyme is propelled downwards by the intestinal movements, known as *peristalsis*. These peristaltic waves pass rapidly along the whole length of the intestine down to the ileo-cæcal valve. These waves occur every three or four minutes, and with each wave the contents are pushed down a few inches. Absorption is carried on by *osmosis* or diffusion, and excretion partly by osmosis and partly by the glands, which furnish the *succus entericus*. The excretion particularly of the watery portion is so profuse, that the effect of absorption is neutralised, and the contents of the small intestine and the duodenum remain liquid. In addition to this certain benign micro-organisms, whose normal habitat is the intestinal tract, play an important part in intestinal digestion. They may occasionally give rise to toxins and so produce symptoms of considerable gravity. The absorption from the gut varies. Substances not soluble in water and lipoids are not absorbed at all, while the soluble ones are usually absorbed. (Absorption takes place from the small intestine, and the rate of absorption of water-soluble substances depends upon the rate of diffusion, which in its turn depends on the size of their molecules.) True colloids like proteins and starches, are not absorbed, but soaps and alkaloids which are semi-colloids are rapidly absorbed.

The colon has a lower absorptive power than the small intestine. Sugar and salts are absorbed from the colon. Many drugs are absorbed when given per rectum. But substances which depend for their absorption upon the changes produced by the digestive juices are not absorbed when given per rectum. Many drugs act quickly and are strongly absorbed when administered per rectum.

The muscular coat is supplied by the sympathetic system: through the splanchnic nerves, the stimulation of which causes inhibition, and therefore arrest of movement. The parasympathetic system supplies the motor or augmentor nerves, the stimulation of which causes increased peristalsis. The vagus supplies the motor nerve to the whole of the intestine and also part of the colon.

Four classes of remedies are known to affect the intestinal functions, *viz.*—(1) purgatives, (2) intestinal astringents, (3) gastro-intestinal irritants, and (4) intestinal antiseptics.

1. **Drugs that increase the secretion and peristaltic movements.**—These cause evacuation from the intestine, and are known as **purgatives, aperients** or **evacuants** (*see* **purgatives Part V**).

2. **Drugs that decrease the secretion and peristaltic movements of the intestine.**—These are called **intestinal astrin-**

gents, and may be subdivided according to their mode of actions under the following heads :—

(*a*) *Intestinal astringents that act by contracting the vessels.*—They are alum and lead salts, silver salts (in dilute solutions) and sulphuric acid dilute.

(*b*) *Intestinal astringents that act by coagulating albuminous fluids and thereby cause constriction of the vessels.*—These are also called *intestinal constringents.* They are :—

Ferric salts	Bismuth salts	Catechu	Krameria
Copper ,,	Tannic acid	Cinnamon	Eucalyptus gum
Zinc ,,	and substances	Kino	Hæmatoxylum
Lead ,,	containing it, as	Acacia bark	Myrobalans

(*c*) *Intestinal astringents that act by reducing the glandular secretion.*—They are lead, calcium salts and opium.

(*d*) *Intestinal astringents that act by diminishing the peristalsis.*—They are opium, stramonium, lead salts, belladonna, hyoscyamus, lime and bismuth salts.

Therapeutics.—Intestinal astringents are employed to check diarrhœa. If it is due to offending matters or impacted fæces, a laxative or a simple purgative, such as castor oil or Gregory's powder, should be given.

3. **Drugs that produce gastro-intestinal irritation.**—These are known as **gastro-intestinal irritants.** Many irritant poisons are given in minute doses therapeutically, but if they are swallowed in large doses a train of symptoms is produced which are known as toxic actions. Thus, if the irritant is caustic or corrosive, it causes burning and pain in the lips, mouth, pharynx and œsophagus. These parts soon inflame and become red and swollen. On reaching the stomach, it sets up intense irritation, causing severe vomiting and retching, accompanied by severe abdominal pain and tenderness. As it is transmitted into the intestine, it causes the same irritation as in the stomach, accompanied by diarrhœa. The vomiting and purging may commence so suddenly that the symptoms may be mistaken for those of cholera. The vomit and stools often contain blood. General prostration, vascular depression and collapse are the chief general symptoms. If the patient survives for a few days, peritonitis, gastric or intestinal ulcers, or stricture of the œsophagus may follow ; but if the patient dies soon after swallowing the poison, at the autopsy the mucous membrane of the stomach and intestines is found red, ecchymosed and swollen.

Certain irritant poisons, such as phosphorus, give rise to secondary toxic symptoms some time after the cessation of the primary ones.

4. **Intestinal antiseptics.**—These are occasionally used to prevent fermentation of the intestinal contents, or absorption of septic matters. Their action is doubtful. Gastric antiseptics are generally used. (*See* p. 126).

G. Drugs that act on the entozoa infesting the human alimentary canal, *see* **Anthelmintics Part V**

H. Drugs that act on the liver.—The functions of the liver are but imperfectly understood. In short, it is a doorkeeper to the circulation. It is known to perform the following specific actions, *viz.*—(1) the formation and secretion of bile ; (2) the excretion of bile ; (3) the conversion of carbohydrates and some portion of proteins into glycogen ; (4) the storing of glycogen and its reconversion into sugar ; (5) the destruction or storing up and the excretion of organic poisons formed in or introduced from without into and absorbed by the intestine, and (6) the production of urea and uric acid. In the present state of our knowledge we cannot influence all the above functions. Those that we can, are given below :—

1. **Drugs that influence the secretion of bile.**—Drugs which increase the flow of bile are called **cholagogues.** They are either *direct* or *indirect. Hepatic stimulants*, properly speaking, are drugs which increase the functional activity of the liver, which includes, no doubt, the increased amount of bile formed and secreted. It does not follow that simply because more bile appears in the stool there is an increased secretion of bile. It is possible that the gall bladder and the ducts have emptied more thoroughly, or that the bile poured into the duodenum has been swept down without giving time for reabsorption.

(*a*) *Drugs which are supposed to increase the secretion of bile* are called *direct cholagogues.* Sometimes they are erroneously called hepatic stimulants. By far the best cholagogue is bile and bile salts, and next to these are salicylates and aspirin. A number of other substances have a mild cholagogue effect. They are :—

Podophyllum	Nitric Acid dil.	Colocynth
Euonymus	Sodium benzoate	Rhubarb
Iridin	,, phosphate	Antim. sulphurat.
Ipecacuanha	,, sulphate	Potass. sulphate
Aloes	Mercuric chloride	Ammon. chloride
Acid. nit-hydrochlor. dil.	Colchicum	Arsenious acid

Of these, sodium salicylate and aspirin make the bile watery. Podophyllum and iridin increase the solid ingredients of the bile.

(*b*) *Drugs that only increase the excretion of the already formed bile, by the increased peristaltic action of the lower part of the duodenum and the upper part of the jejunum.*—These cause the bile to be rapidly swept along the intestine without allowing time for its re-absorption. These drugs are called *indirect cholagogues.* As mercurials and many cathartics.

Therapeutics.—Since bile stimulates the peristaltic action of the bowels most cholagogues act as purgatives. In hepatic disorders, such as biliousness, jaundice, hepatic dyspepsia,

cholagogues are very useful, especially if the direct and indirect ones are combined together.

(*c*) *Drugs which lessen the quantity of the bile secreted* are called *anticholagogues or hepatic depressants.* As opium, morphine, codeine, lead acetate, magnesium sulphate, castor oil, etc. Therapeutically they are never used.

(*d*) *Drugs that are used to dissolve gall-stones* are called *biliary lithontriptics.*—Our knowledge of this class of drugs is very slight. Sodium salicylate and aspirin increase the fluidity of bile. Durande's remedy (ether 3, oil of turpentine 2), olive oil, glycerin, soap, Carlsbad mineral water are said to dissolve, expel or reduce the size of the stone.

2. **Drugs that influence the glycogenic function of the liver.** They are :—

(*a*) *Glycogenic stimulants.*—As adrenalin.

(*b*) *Glycogenic depressants.*—As antimony, arsenic, phosphorus, opium, morphine and codeine.

3. **Drugs that influence the formation of urea in the liver.**—It is believed that ammonia salts and amido-acids, *e.g.* leucin, a nitrogenous derivative, are converted into urea in the liver. It is also believed that phosphorus, arsenic, antimony, ammonium chloride and iron *increase* the quantity of urea excreted in the urine ; but they are never used therapeutically for this purpose. On the other hand, opium, morphine, colchicum, alcohol and quinine are believed to *decrease* the quantity of urea excreted in the urine.

I. Drugs acting on the Pancreas.—The pancreatic secretion depends upon the formation of secretin, and administration of acids by increasing the acidity of the food as it passes into the duodenum may promote the formation of secretin and consequently the secretion of pancreas.

Class II.—Drugs that act on the Respiratory System

There is an intimate relation between the respiratory organs and the external air, the blood, the circulation, the nervous system and the respiratory centre. A disturbance in any of them at once reflects upon the respiratory mechanism. The chief functions of respiration are to supply oxygen to the body and to excrete CO_2. Any failure of respiration is therefore accompanied by deprivation of oxygen and accumulation of CO_2, both of which give rise to symptoms of asphyxia. Thus, if the air inhaled is of abnormal pressure and temperature, or is deficient in quality or quantity, the respiratory functions are interfered with. If the condition of the red blood-corpuscles which are the oxygenating elements of the body is altered, the respiratory activity is at once affected. This is also the case if the circulation and the functions of the afferent nerves of the respiratory and other organs are modified. The object, therefore, is to remove the cause of the respiratory difficulty, either by

influencing the external air, by stimulating the respiratory centre, or by depressing the centre against afferent impressions. Hence, drugs, acting on the respiratory apparatus may be arranged under the following heads :—

A. Drugs that are inhaled with the air.—Chloroform and ether are inhaled diluted with air to produce general anæsthesia, but there are other groups of drugs which can be inhaled in the same manner to produce definite actions as given below :—

1. *Stimulant Inhalations.*—These increase the vascularity, muscular activity and secretion from the bronchial tubes. They are carbolic acid 20 grs., cajuput oil 20 ms., fir-wool oil 5 ms., creosote 30 ms., cubebs ½ oz. and Tr. benzoin. co. ½ oz. The doses indicate the quantities to be added to a pint of water at temperature 140° F.

2. *Irritant Inhalations.*—These cause irritation of the bronchial mucous membrane ; as chlorine, bromine, iodine, tobacco, etc. They are never used therapeutically.

3. *Antispasmodic Inhalations.*—These relieve bronchial spasm ; as chloroform, ether, amyl nitrite, smoke of stramonium. nitre-paper, a mixture of nitre and chlorate of potash, lobelia, belladonna, etc.

4. *Antiseptic Inhalations.*—These disinfect and deodorise foul, bronchial secretions ; as eucalyptus oil, terebene, creosote, carbolic acid, iodoform, sulphurous anhydride, juniper oil, cubebs oil, pumiline and solution of benzoin.

B. Drugs that act on the nose

1. *Sternutatories* or *Errhines* are drugs which cause sneezing and increase the secretion of the nasal mucous membrane, when locally applied. They are, tobacco (snuff), capsicum, ginger, black pepper, etc. ; ipecacuanha, quillaia, senega, in powder.

Therapeutics.—These are sometimes used (*a*) to expel foreign bodies from the air-passages, (*b*) to remove headache, (*c*) to check hiccough. They are contra-indicated in cases where there is a tendency to pulmonary or cerebral hæmorrhage, hernia, prolapse of the uterus and rectum, and in atheroma of the blood-vessels.

2. *Nasal sedatives* are drugs which remove irritation of the nasal mucous membrane. They may be either *local*, as bismuth salts alone, or with morphine, cocaine, etc., or *general*, as pulv. ipecac. co., etc.

Therapeutics.—Ordinary nasal catarrh often yields to nasal sedatives, but infectious coryza due to hay fever or influenza, may require an antiseptic nasal douche, spray, insufflation or gargle.

3. *Nasal astringents* are drugs which check epistaxis and excessive secretion of mucus from the nasal mucous membrane, when locally applied. They are alum, tannic acid, hamamelis, ferri perchlorid., ice, etc.

4. *Drugs that act on the olfactory apparatus* :—

(*a*) *Drugs that stimulate the olfactory nerves.*—The pungent vapours of certain drugs, such as ammonia and acetic acid, stimulate the terminal ends of the olfactory nerve and reflexly stimulate the vaso-motor and cardiac centre.

(*b*) *Drugs that depress the terminal ends of the olfactory nerves.*—Drugs which possess very powerful odours, such as musk, asafetida and ethereal oils, first stimulate the olfactory terminations, and then after a while depress them, so that the smells cannot be perceived with the same degree of intensity. Anosmia can also be induced by such substances as cause acute and chronic alterations in the nasal mucous membrane, *e.g.* potassium iodide, snuff (tobacco), and irritant inhalations (*see* above).

C. Drugs that influence the respiratory centre.—The chief respiratory centre is situated at the tip of the calamus scriptorius in the medulla, at a point called *nœud vital* by Flourens, the destruction of which stops breathing and causes death. The vagal centre almost coincides in position with this spot. Properly speaking, this point forms the centre of a circle, within which the respiratory impulses originate. The vagus is the chief nerve of respiration, containing both sensory and motor fibres, and it therefore plays a most important part in respiratory functions. The afferent filaments which abundantly supply the whole of the air-passages and probably the lungs, constantly transmit impressions to the centre, and incessantly modify respiratory movements. Again the muscles of the bronchi being supplied with efferent fibres of the vagus, are constantly affected by various afferent impressions, which may even arise in the air-tubes themselves. Besides the vagus, there are other nerves which also influence the expiratory and inspiratory movements. We infer that a drug acts directly upon the respiratory centre (1) if it very quickly produces its effect on respiration when it is injected into the carotid artery, (2) if its effect on respiration is not altered by section of the vagi.

1. Drugs which increase the activity of the respiratory centre

Strychnine	Ammonia	Stramonium	Atropine
Apomorphine	Hyoscyamus	Caffeine	

Of these strychnine, atropine, caffeine and ammonia are very powerful.

Substances which stimulate the central nervous system also stimulate the respiratory centre. Ammonia excites the centre reflexly by stimulating the sensory endings of the olfactory or trigeminal nerves.

2. Drugs which depress the activity of the respiratory centre.—The respiratory centre is more easily depressed than any other of vital centres. In fact in most fatal diseases

there is respiratory depression before death. Respiratory depressants make the centre less sensitive to CO_2. They are :—

Opium	Alcohol	Ether*	Saponin
Codeine	Aconite	Chloroform *	Heroin
Hydrocyanic acid	Virg. Prune	Gelsemine	Nitrites
Physostigmine	Chloral	Veratrine	

These with * excite slightly before depressing. Physostigmine is very powerful, but is never used therapeutically for this purpose. Opium, codeine, hydrocyanic acid dilute, and virginian prune are ordinarily used.

Therapeutics.—Direct stimulants to the respiratory centre are used to increase the force of the respiratory act and thus to overcome respiratory difficulty, as in bronchitis, pneumonia, phthisis, opium and chloral poisoning, etc. Direct sedatives to the respiratory centre, especially opium, codeine, heroin, hydrocyanic acid dilute are often prescribed to allay cough reflexly set up by the irritation of the lungs, stomach, liver, spleen, pleura, trachea, bronchi, larynx, nose, pharynx and œsophagus.

D. Drugs that influence the bronchi and the lungs

1. Drugs that affect the bronchial secretion and bronchial muscle

(*a*) *Drugs that increase the bronchial secretion* are :—

Alkalies (especially ammon carb.)	Senega	Antimony salts	Volatile oils
	Squill	Camphor	Sulphur
Iodine	Ipecacuanha	Pilocarpine	Balsam of Peru
Quillaia	Benzoin	Terebene	Balsam of Tolu
Apomorphine	Tar	Urginea	

(*b*) *Drugs that diminish the bronchial secretion* are acids (powerful), belladonna, stramonium, hyoscyamus.

(*c*) *Drugs that disinfect the bronchial secretion* are the antiseptic inhalations (*see* p. 133), and copaiba, cubebs, volatile oils and oleo-resins internally.

(*e*) *Drugs that depress the nervo-muscular tissues of the bronchi and thereby relieve bronchial spasms* are called *bronchial antispasmodics*. These may be either (1) antispasmodic inhalations (*see* p. 133), (2) depressants to the respiratory centre (*see* p. 134), (3) expectorants (*see* below), or the following :—

Stramonium	Sodium nitrite	Tobacco
Lobelia	Nitroglycerin	Ether
Belladonna	Grindelia	Opium
Amyl nitrite	Chloroform	Cannabis Ind.
Hyoscyamus	Chloral	Adrenalin

Therapeutics.—Respiratory spasms are instantly relieved by amyl nitrite, nitroglycerin and sodium nitrite, but they quickly return. Injection of adrenalin chloride solution is largely used in asthma. Narcotics, such as opium, cannabis indica, chloral hydrate, being powerful respiratory depressants

are objectionable, though they may relieve spasms. Potassium iodide, stramonium, lobelia, spirits of ether, chloroform, ammonia and grindelia are ordinarily used with success in asthma. Atropine and morphine hypodermically sometimes relieve when others fail. Smoking stramonium or nitre papers, etc., affords only temporary relief. If dyspnœa is caused by dyspepsia, gout, constipation, etc., remove the cause.

(*f*) *Drugs that act on the bronchial circulation.*—All remedies which stimulate the general circulation, such as digitalis, squill, alcohol, ammonia, strychnine, aromatic oils, etc., *increase the circulation of the bronchi.* All cardiac and general vascular depressants, such as aconite, antimony, ipecacuanha, iodides, alkalies, *diminish the bronchial circulation.*

E. Expectorants are remedies which facilitate the expulsion of the sputum. According to their mode of action, they may be grouped under the following heads :—

1. *Stimulant Expectorants.*—They are of two kinds, *viz.* (*a*) those that stimulate the secretion of the bronchial glands during elimination ; as in D., (*a*) p. 135), and (*b*) those that stimulate the respiratory centre and strengthen the expulsive muscles ; as strychnine and atropine.

2. *Sedative Expectorants.*—These act by diminishing the irritability of the respiratory centre, or of the tracts of afferent impulses : as opium *e.g.* pil. ipecac. c. scilla, tr. camph. co., tr. opii ammon., pulv. ipecac. co., morphine, codeine, and chloral hydrate.

3. *Mechanical Expectorants.*—These forcibly expel the sputum during the act of vomiting ; as ipecacuanha, antimony, and ammonium carbonate which also liquefy the secretion or zinc sulphate if they fail.

4. *Antispasmodic Expectorants.*—These act by relaxing bronchial spasms ; as bronchial antispasmodics (*see* p. 135).

5. *Saline Expectorants.*—These increase the fluidity and alkalinity of the sputum ; as alkalies and alkaline salts, especially potassium bicarbonate and ammonium chloride.

6. *Antiseptic Expectorants.*—Many substances, such as tar, terebene, pine-oil, sulphur, iodine, aromatic oils, balsams, and oleo-resins, are excreted by the bronchial mucous membrane, thus disinfecting and deodorising the mucus, the flow of which is increased.

7. *Reflex Expectorants.*—These promote expectoration by reflex action, through impressions produced in the mouth ; as potassium chlorate, gum acacia, sugar candy, sodium chloride (native crystal), when sucked.

F. Anti-Expectorants are drugs which diminish the amount of water of the sputum and thus dry up the secretion ; as acids, iron, atropine and opium.

Therapeutics.—The indications for the use of expectorants have been fully detailed above. The student must be careful how he prescribes narcotics which are very powerful depressants

of the respiratory and other centres. Inhalations of warm moist air, warm poultices to the chest, warm liquid food, demulcent gargles (*see* p. 70) are very useful adjuncts. If the secretion is excessive, acids, iron, bracing fresh air are useful.

CLASS III.—DRUGS THAT INFLUENCE THE BLOOD

A. Drugs that act on the liquor sanguinis or plasma.—The liquor sanguinis being the *medium of nutrition* as well as the *carrier of the products of metabolic processes*, any disturbance in its composition directly affects the nutrition and the vital activity of the tissue and organs. We can modify the constituents of the plasma either by food, drugs, transfusion or abstraction of blood.

1. *Drugs that increase the alkalinity of the plasma* are :—

Potassium salts	Lithium salts	Magnesium salts
Sodium ,,	Calcium ,,	

Of these, the action of the potassium salts is rapid and powerful but not so lasting ; and that of the sodium salts slow and weak, but more permanent. Since ammonia is converted into urea in the blood, its action differs from the fixed alkalies in not increasing the available alkalinity of the blood. With uric acid they form soluble urates, which are eliminated by the diuretic action of the alkalies.

2. *Drugs that decrease the alkalinity of the plasma.*—The liquor sanguinis is normally alkaline, and cannot be made acid, for acid plasma cannot maintain life. But we can diminish its alkalinity by acids, especially the organic acids, as benzoic acid.

3. *Drugs that modify the composition of the plasma by the abstraction of water and salts.* Purgatives, diuretics and diaphoretics remove much serum and salts from the plasma and thus materially alter its composition. Transfusion (*see* p. 103) and venesection directly affect it.

Therapeutics.—Alkaline salts are largely employed in rheumatism, gout and lithiasis. Potassium citrate is ordinarily used in lithiasis, as it does not derange digestion. Purgatives, diuretics and diaphoretics indirectly help the absorption of effusions and dropsical swellings of all kinds, as well as the removal of poisons circulating in the blood, as in uræmia.

B. Drugs that influence the blood-corpuscles

1. **Drugs that act on the red blood-corpuscles.**—Healthy red blood-corpuscles contain a uniform amount of hæmoglobin. Iron is its chief constituent. Drugs which improve the quantity and quality of hæmoglobin when deficient are called **hæmatics** or **hæmatinics.** Of course, these actions refer to pathological conditions of the blood, for the amount of hæmoglobin in healthy blood cannot be increased to any appreciable extent.

(*a*) *Direct hæmatinics* are drugs which directly increase the amount of hæmoglobin as well as the number of red corpuscles. Iron and its various preparations are the most powerful. Next to them is arsenious acid.

(*b*) *Indirect hæmatinics* are those remedial agents which act by removing the cause of the anæmia. Thus, quinine and mercury, remove the anæmia of malarial fevers and syphilis respectively. Cod-liver oil aids assimilation and removes blood dyscrasia, whilst fresh air, sunlight, nutritious food, outdoor exercises improve digestive powers. In this way they indirectly act as hæmatinics.

(*c*) *Drugs that affect the red corpuscles generally.*—Certain drugs, such as arsenious acid, phosphorus, iodine, sulphur, oil of turpentine, hydrocyanic acid, reduce *oxyhæmoglobin*, and thus impair its oxygenating power, if given in lethal doses. Citrates, acetates and tartrates of the alkaline metals are converted into carbonates at the expense of the oxygen of the hæmoglobin. Alcohol and quinine bind oxygen so firmly to the hæmoglobin, that its oxygenating property is impaired. Carbonic acid, quinine and morphine are said to reduce the size of the red corpuscles, and hydrocyanic acid and oxygen to increase it. Mercury in small doses increases their number. Nitrite of amyl, sodium nitrite, nitrous ether, phenazone, acetanilide, and phenacetin convert a portion of hæmoglobin into *methæmoglobin* in full doses. Pyrogallic acid and potassium chlorate destroy red corpuscles.

Therapeutics.—Both direct and indirect hæmatinics are employed in anæmia, but the rational method of treatment is to ascertain and remove the cause of the disease. Direct hæmatinics are only to be given when the digestive functions and powers of assimilation are in working order.

2. Drugs that affect the white blood-corpuscles

(*a*) *Drugs that arrest the migration of the white corpuscles.*—The white corpuscles are migratory in their habit. If an inflammation is set up by an irritant or disease, they wander through the capillary walls. Quinine and other cinchona alkaloids arrest this migration. Quinine is also known to reduce their number, and veratrine kills them if applied outside the body.

(*b*) *Drugs that increase the production of white corpuscles.*—Aromatics, chiefly camphor and myrrh, increase their production, probably by stimulating their absorption from the intestinal canal. Pilocarpine also is said to increase their number.

3. Drugs that alter the coagulability of the blood

(*a*) *Those that increase it.*—Carbonic acid, calcium chloride or lactate, magnesium carbonate or lactate, phosphoric acid and soluble phosphates, parathyroid gland, normal horse serum and milk.

(*b*) *Those that diminish it.*—Oxygen, alcohol, citric acid, acid fruits, acid wines, starvation, large quantities of fluid.

C. Drugs that act generally on the blood.—There are many drugs which cannot be grouped under any of the above heads, as their actions have not yet been thoroughly defined. Thus, cod-liver oil increases the solid constituents of the blood. Mercurial salts in toxic doses reduce the solids, diminish the coagulability and increase the fluidity.

Class IV.—Drugs that influence the Heart and its Mechanism

(*See* **Digitalis** Part V)

Class V.—Drugs that influence the Blood-Vessels

A. Drugs that act on the blood-vessels

1. *Local vascular stimulants* are remedies which dilate arterioles when locally applied to them. They are :—

Alcohol	Chlorine	Iodine	Warmth, as
Ammonia	Chrysarobin	Mercuric nitrate	Fomentation,
Antim. tart.	Copper sulphate	Mineral acids	Poultice, etc.
Arsenious acid	(strong)	(strong)	Volatile oils
Camphor	Creosote	Mustard	Zinc chloride
Cantharidin	Croton oil	Silver nitrate	(strong)
Capsicum	Chloroform	(strong)	
Carbolic acid	Ether		

Alcohol, ether and chloroform can only act in the above manner, when their evaporation is stopped. Stimulant, irritant and antispasmodic inhalations (*see* page 133) also dilate the arterioles of the air-passages by their local action.

2. *General vascular stimulants or vaso dilators* are drugs which, when taken by the mouth, or inhaled dilate arterioles by their remote local action on them. Certain products of metabolism cause vaso-dilatation. Thus a very slight increase of acidity of the blood is followed by vaso-dilatation. Vaso-dilators are, amyl nitrite, nitroglycerin, sodium nitrite, spirit of nitrous ether, caffeine.

3. *Immediate local astringents, local hæmostatics or styptics* are drugs which contract vessels and cause shrinkage of mucous membrane when locally applied to them. They can be grouped under the following heads according to their mode of action.

(*a*) *Drugs or measures that act by contracting the muscular fibres in the wall of the vessels.* These act when applied locally. As adrenalin and cold produced by any means, *e.g.* the evaporation of ether, ethyl chloride, methyl chloride and chloroform, ice, etc.

(*b*) *Drugs that act by coagulating the albuminous fluids in the tissues surrounding the vessels.* As alum, salts of silver, lead,

bismuth, zinc and copper; persalts of iron, tannic acid and substances containing it, *e.g.* kino, catechu, krameria, hæmatoxylum, galls, hamamelis, etc.

4. *Remote local astringents or remote hæmostatics* are drugs which contract arterioles by acting either on the vessel walls or on the nerve endings after absorption. As digitalis, ergot, adrenalin and pituitary extract.

Therapeutics.—Styptics or local hæmostatics are used

1. To stop external hæmorrhages.
2. To check excessive discharges, as leucorrhœa.
3. To constrict relaxed vessels, as in pharyngitis.
4. In diarrhœa, vegetable astringents.
5. In prolapse of the rectum or hæmorrhoids, as suppositories.

B. Drugs that act on the vaso-motor centres

1. *Drugs which stimulate the vaso-motor centre.*—All drugs which stimulate the central nervous system also stimulate the vaso-motor centre in the medulla. They cause rise of blood-pressure by constricting the vessels of the splanchnic area. The arterioles of the skin and muscles are only slightly affected. It is possible that these drugs cause an increased output of adrenalin from the suprarenal glands. They are, strychnine, caffeine, digitalis, camphor, etc. Alcohol stimulates the vaso-motor centre reflexly and causes a rise of blood-pressure. After absorption the peripheral vessels dilate and there is a fall of pressure.

2. *Drugs which depress the vaso-motor centre.*—These cause the vessels of the skin to dilate with consequent loss of heat. Alcohol, ether, chloroform depress the vaso-motor centre and cause a general fall of pressure. Coal tar antipyretics also produce the same effect.

3. *Drugs acting on the vaso-motor nerve endings.*—The normal tone of the vessels depends on the activity of the suprarenal glands, and removal or disease of these glands is followed by a fall of pressure. Adrenalin and ergotoxine cause powerful vaso-constriction by acting on the nerve endings.

C. Drugs that act on the capillaries.—The capillary vessels are the connecting links between the arterioles and the minute veins, and through these the final distribution of the blood to the tissues is effected. Therefore the capillary circulation is immensely important to the pharmacologist, as alteration in the calibre of the capillaries causes a corresponding rise or fall of blood-pressure.

Under this head, we shall describe many useful remedies ordinarily known as *irritants*. They produce greater or less degree of vascular stimulation of the part to which they are applied. They can be grouped under the following classes, according to the degree of vascular excitement they produce :—

(*a*) *Rubefacients* are drugs which cause redness of the skin when applied to it. This is characterised by capillary hyperæ-

mia, at first active later passive. The congestion is accompanied by sensory stimulation, with itching, burning and pain. If this action is prolonged or is more powerful then *rubefaction* is followed by *vesication*. All immediate local vascular stimulants (*see* p. 139) act as rubefacients in the first instance.

(*b*) *Vesicants* or *Epispastics* cause vesicles or blisters to form when applied to the skin. Hyperæmia is accompanied by a certain amount of exudation, which in the case of rubefaction is rapidly absorbed, when this limit is exceeded visible exudation occurs causing *blisters or vesicles*, *e.g.* cantharidin.

(*c*) *Pustulants* are drugs which produce pustules when applied to the skin ; *e.g.* croton oil and tartar emetic ointment.

(*d*) *Caustics* or *Escharotics* are drugs which destroy the vitality of the part on which they are applied. They cause sloughing and inflammation of the surrounding area ; *e.g.* caustic potash or soda, zinc chloride, mineral acids, silver nitrate, etc.

When any of the above irritants is applied to the skin, with a view to lessen or counteract any morbid process which may be active in some other part of the body, it is called *counter-irritant*.

Therapeutics.—For direct topical action, immediate local irritants, such as iodine, carbolic acid, cantharidin, etc., are applied to unhealthy sores and chronic sinuses to stimulate their healing. Escharotics are used to destroy lupoid, cancerous and other growths. Counter-irritants are indicated as follows :—

(1) To subdue inflammation or to afford relief to the circulation of a part or organ in direct vascular connexion with the skin, selected for the application of rubefacients or vesicants : *e.g.* the application of a blister in acute pneumonia, pleurisy, hepatitis, etc.

(2) To help absorption of subjacent or subcutaneous morbid growths or effusion in a reflex way through the vaso-motor and trophic centres in the brain and cord ; *e.g.* the application of flying blisters in pleuritic effusion and synovitis, and of iodine in enlarged glands.

(3) To relieve pain arising from the passage of renal and biliary calculi, or from neuralgia, *e.g.* sciatica and facial neuralgia.

(4) To allay central nervous irritability, as in hysteria.

(5) To reflexly stimulate the central nervous system ; as in syncope, narcotic posioning and in the lethargic condition of many acute idiopathic and inflammatory fevers.

(6) To relieve muscular irritability, *e.g.* sinapisms in choleraic cramps and lumbago.

(7) To remove any morbid process from the seat of disease to the irritated surface ; as the application of a mustard plaster to the great toe or foot when gout attacks important organs. When counter-irritants act in this manner, they are called *revulsives* or *derivatives*.

CLASS VI.—DRUGS THAT ACT ON THE URINARY APPARATUS

A. Drugs that increase the secretion of urine (*see* **Diuretics**)

B. Drugs that directly influence the urine

1. *Drugs that contribute towards the acidity of the urine.*—Benzoic acid and benzoates render the alkaline urine acid. They are converted into hippuric acid in their passage through the kidneys. Acid sodium phosphate being the normal acid of the urine is most reliable. Salicylic acid in large doses also increases the acidity.

2. *Drugs that contribute towards the alkalinity of the urine.*—We have more powerful means at our disposal of rendering the urine alkaline. All potassium, sodium, lithium and calcium salts, except the salts of ammonium are powerful in this respect. Nitric acid slightly increases the amount of ammonia and thus makes the urine feebly alkaline.

3. *Urinary lithontriptics or antilithics* are remedies employed for dissolving any concretions or calculi formed in the urinary tract or for preventing the deposition of solids from the urine. Alkalies or piperazine are used in uric acid and oxalate of lime calculi. Benzoates or benzoic acid, hexamine and acid sodium phosphate should be used when the urine is undergoing alkaline decomposition, and phosphatic calculi are liable to form. Potassium and lithium salts alkalise the blood and urine of gouty patients. Copious draughts of water or diluents are also useful.

4. *Drugs that prevent the decomposition of the urine.*—Decomposition takes place either from (*a*) retention of the urine, as in strictures of the urethra or in impacted stone, or from (*b*) inflammation of the pelvis of the kidney or bladder, thereby causing an admixture of purulent matter with the urine. Boric, salicylic and benzoic acids, uva ursi, cubebs, copaiba, sandal wood oil, urotropine and a few volatile oils act as urinary antiseptics.

5. *Drugs that alter the composition of the urine.*—They do this either by (*a*) their excretion in the original state in which they are administered, or by (*b*) the excretion of the products of their decomposition, or by (*c*) the admixture of morbid products such as blood, pus, etc., produced by the remedial agents. They are too numerous to be detailed, only a few typical ones are given below :—

Saline diuretics increase the solids of the urine.

Santonin makes acid urine greenish-yellow or yellow, and alkaline urine reddish. Carbolic acid, creosote, naphthalene, and other tar preparations render the urine dark greenish-brown. Picric acid gives it a bright yellow colour and methyl violet a dark blue. Rhubarb, senna, and chrysarobin render acid urine brownish, and alkaline urine purplish-red. Logwood makes alkaline urine violet.

All nitrites, acetanilide, potassium chlorate, pyrogallic acid, and occasionally large doses of arsenic and mineral acids render the urine dark red, from the admixture of the debris of the broken-up red corpuscles.

Cantharidin, turpentine, and salicylic acid in large doses render the urine bloody. Phosphorus in large doses causes urea, leucin, and tyrosin to appear. Turpentine imparts an odour of violets, while cubebs and copaiba convey their characteristic smells.

Appearance of albumin in the urine is caused by cantharidin, strychnine, and digitalis.

Many poisons produce glycosuria ; phloridzin or phloretin and adrenalin being the chief.

Urine of persons poisoned with carbonic oxide remains sweet for some time. Lead taken for some time causes chronic interstitial nephritis.

C. Drugs that act on the bladder and the urethra.—By correcting abnormalities in the urine, *e.g.* extra-acidity by alkalisers, and decomposition by urinary antiseptics, we can indirectly soothe the irritation of the bladder, but **urinary sedatives** such as opium, hyoscyamus, belladonna, stramonium, buchu, uva ursi, couch grass, hygrophila, etc., act directly upon the irritated mucous membrane. Of these, opium and hyoscyamus are the most powerful.

Class VII.—Drugs that act on the Cutaneous System

The skin is the chief organ of perspiration and sensation. It also performs certain other specific functions, such as the regulation of heat (*see* Antipyretics), respiration, absorption, and the secretion of *sebum*. To the pharmacologist, perspiration is the most important.

A. Drugs that act on the sweat-glands.—These glands are abundant all over the skin, but most numerous where hairs are absent, as the palms of the hands and soles of the feet. The sweat, like the urine, is an excretion and is regulated by nerves called *secreting nerves*, whose centres are in the medulla and the cord.

1. **Drugs that increase the secretion of the sweat,** but not to such an extent as would not evaporate, are called **diaphoretics.** If the perspiration is increased so much as to run down in streams, they are called **sudorifics.** They may act as follows :—

(*a*) *By directly stimulating the sweat-centres.*—This may be accomplished by (1) measures which *increase the venosity of the blood* such as narcotics—opium, chloral, chloroform and alcohol, in later stage of their action ; (2) measures which *increase the temperature of the blood*, such as hot drinks ; and by (3) the following drugs :—

Ammon. acetate	Nicotine
Ammon. citrate	Camphor

(*b*) *By stimulating the terminal ends of the nerves in the glands.*—Pilocarpine is most powerful in this respect. Dilatation of the cutaneous vessels by local warmth also aids diaphoresis. Nicotine and muscarine are said to act similarly.

(*c*) *By dilating the cutaneous vessels.*—This is done by means of local heat, such as hot fomentations, poultices, hot water or Turkish baths or through the vaso-motor centre by alcohol, salicylates, acatanilide, nauseants, etc.

(*d*) *By reflexly stimulating the sweat-centres by afferent impulses, e.g.* the impulses caused by nauseating drugs, hot spiced food and hot drinks.

Therapeutics.—Diaphoretics are indicated :—

(*a*) To reduce pyrexia.

(*b*) To cut short a threatening catarrh, or inflammation caused by specific poisons or metabolic products.

(*c*) To lessen the accumulation of fluid in the system, as in dropsy, and to relieve excretory organs, *e.g.* kidneys in albuminuria and intestines in diarrhœa.

(*d*) To eliminate excrementitious products through the skin when the action of the kidneys is suspended, as in uræmia. Pilocarpine is most useful for this purpose.

(*e*) To promote cutaneous circulation in many chronic skin diseases, *e.g.* warm water or Turkish baths in psoriasis.

2. **Drugs that diminish the secretion of sweat are anhydrotics or antihydrotics.** They may act :—

(*a*) *By depressing the excitability, or removing the cause, of excitation from the sweat-centres.*—Measures which reduce the venous condition of the blood, indirectly help the reduction of perspiration. Thus cold sweats of exhausting diseases can be checked by ammonia, alcohol, strychnine, iron, fresh air and good nourishing food.

(*b*) *By depressing the activity of the efferent or secreting nerves.*—Opium in certain combinations with ipecacuanha as Dover's powder, or with sulphuric acid checks the night sweats of phthisis.

(*c*) *By depressing the terminal ends of the secreting nerves.*—The effect of atropine, extract of belladonna, stramonium and hyoscyamine is very powerful in this respect.

(*d*) *By lessening the activity of the afferent nerves.*—Local cold applications, cool atmosphere, fanning, etc.

(*e*) *Anhydrotics whose mode of action is unknown.*—These are acids, quinine, nux vomica, zinc oxide.

Therapeutics.—Anhydrotics may be used to check either excessive general sweating, as the night sweats of phthisis, or the cold sweats of general debility, or local sweating as in hyperidrosis or bromidrosis of the hands or feet.

3. **Drugs that alter the composition of sweat.**—Certain drugs when taken internally are eliminated by the sweat. They are iodine, potassium iodide, tartaric acid, benzoic acid in the form of hippuric acid and succinic acid.

B. Drugs which soften and relax the parts to which they are applied, are called **emollients** or **protectives.**—By relaxing the contractile tissues and dilating blood-vessels they relieve

tension and pressure upon the nerves. They prevent cracking of the skin by supplying it with fat or moisture. As bland oily and fatty substances, glycerin, vaseline, lanoline, hot poultices, warm water, etc.

C. Drugs which protect mucous membranes from irritation are called demulcents.—They are glycerin, linseed, white of egg, ispaghul, gelatin, isinglass, honey, starch, etc.

D. Drugs that act on the capillaries and arterioles of the skin.—*See* page 140

E. Drugs that cause eruptions to appear on the skin.—They produce them possibly by irritating the skin during their elimination. A list of drugs and eruptions taken from "Quain's Dictionary of Medicine," is given below :—

Diffuse or patchy erythema.—Antipyrine, arsenic, belladonna, benzoate of sodium, boric acid, bromides, chloralamide, chloral hydrate, chrysarobin, copaiba, salicylic acid, stramonium, tar.

Scarlatiniform erythema.—Belladonna, chloral hydrate, copaiba, iodoform, quinine, strychnine, bromide of nickel.

Papular or morbilliform erythema.—Antipyrine, arsenic, bromides, chloral hydrate, cubebs, morphine, quinine, terebene, turpentine.

Nodosum-like erythema.—Bromides and iodides.

Urticaria.—Antipyrine, arsenic, bromides, copaiba, iodides, morphine, quinine, resin, salicylic acid, salol, santonin.

Vesicles.—Cannabis indica, chloral hydrate, cod-liver oil, copaiba, iodides, morphine, salicylic acid, quinine, turpentine.

Bullæ.—Bromides, cannabis indica, chloral hydrate, copaiba, iodides, morphine, phosphoric acid, quinine.

Pustules.—Arsenic, bromides (confluent), chloral hydrate, iodides (isolated), salicylic acid, antimony.

Purpura.—Chloral hydrate, chloroform inhalation, iodides, quinine, salicylic acid.

Pityriasis rubra (?).—Bichromate of potassium.

Psoriasis (?).—Borax, bichromate of potassium.

Eczema.—Bicarbonate of potassium, bromides, chrysarobin, iodoform.

Gangrene.—Arsenic, ergot, iodides, quinine.

Persistent desquamation.—Quinine.

Furuncles.—Arsenic, bromides, quinine.

Keratosis palmaris.—Arsenic.

Pigmentation.—Arsenic, nitrate of silver, picric acid.

Herpes zoster.—Arsenic.

F. Drugs that influence the sensory apparatus of the skin.—These are the same drugs that act on the sensory nerve terminations.

G. Drugs that affect the hair.—The hairs are epidermal growths contained in pits or *hair-follicles*. Their growth is dependent upon the nutritive supply and the nerve-power of the skin.

1. *Drugs that promote the growth of the hair.*—Measures which improve the nutrition of the hair-follicles by augment-

ing their blood-supply, especially immediate local vascular stimulants, promote growth of hair. They are liniments of ammonia, camphor, ammoniated camphor, turpentine, etc.; lotions (hair-washes) containing cantharidin, spirit of rosemary, capsicum, ammonia, pilocarpine, etc.; iodine; mercurial ointments and oils of cade and winter-green.

Therapeutics.—For baldness due to defective nutrition, *e.g.* after acute febrile attacks, stimulating hair-washes as mentioned above are useful. In obstinate cases, repeated blistering or the strong acid solution of pernitrate of mercury lightly brushed over is necessary. For syphilitic alopecia, mercurial ointments should be applied and constitutional treatment adopted.

2. *Depilatories.*—*See* page 68.

CLASS VIII.—DRUGS THAT INFLUENCE METABOLISM

Metabolism is the sum total of the chemical exchanges which occur in the tissues through the medium of the blood. The protoplasm of the tissues incorporates oxygen and other metabolic materials from the plasma and gives off carbonic acid, urea, water and other products of oxidation by the lungs, kidneys, skin and bowels. During this intake and output by the tissues, the protoplasm undergoes alterations or changes. In short, the tissues and the plasma are constantly acting and reacting upon each other, the *former altering the plasma and the latter the tissues.*

The metabolic process may be affected by various influences, such as :—

(1) Variations in the composition and the supply of blood.
(2) Variations in the supply of oxygen.
(3) Variations in the muscular activity.
(4) Variations in the activity of excretory organs.
(5) Variations of surrounding temperature, as of climate and baths.
(6) Variations in the activity of trophic centres.
(7) Medicinal agents.

A. Drugs that increase the metabolic activity are called **metabolic stimulants** or **tonics.** They may be either **local** or **general.**

1. *Local metabolic stimulants* are drugs which stimulate the nutritive process of a local area, *e.g.* the growth of hair over a bald surface, or the removal of stiffness, swelling, and atrophy of muscles in chronic rheumatism. They act :—

(1) By increasing the vascularity of the part and thus carrying more nutritive materials to the tissues.
(2) By removing more rapidly the products of nutrition.
(3) By increasing the protoplasmic activity of the tissues.

All immediate local vascular stimulants (*see* list, page 139) act as local metabolic stimulants.

Local metabolic stimulants are called *resolvents* when they cause absorption of inflammatory or other swellings.

2. *General metabolic stimulants* or *general tonics* are drugs which cause an increase in the strength and weight of the body, by stimulating the functional activity of the digestive organs as well as by improving the condition of the blood. Therefore by *tonics*, we mean remedies or measures which contribute towards the improvement of the tone of the body or any of its parts. If they promote appetite and digestion, they are called *gastric tonics*; if they enrich hæmoglobin and increase the number of red corpuscles, they are called *hæmatinic tonics* or *blood tonics*; if the imperfectly performed nervous functions are restored to a normal condition, they are called *nervine tonics*, and so on. Remedies during the metabolic process become loosely incorporated with the cells, and form certain oxidation products which are thrown off; and in thus passing through an organ, they *modify the force which it displays.* The general tonics are :—

Iron	Calcium chloride	Caffeine
Mercury	,, Hypophosph.	Guaiacum
Arsenic	Sod. Hypophosph.	Thyroid
Phosphorus	Sulphurated lime	Water
Antimony	Coca	

B. Drugs that diminish the metabolic activity are called **metabolic depressants.**—They act either by being themselves so readily oxidised that they rob the protoplasm of oxygen, or by making the oxyhæmoglobin a more stable compound, so that it cannot easily part with its oxygen. They are alcohol, quinine, phenazone, acetanilide, salicin, glycerin, resorcin, etc.

C. Alteratives are drugs which cure disease without producing any perceptible change in any of the organs. They appear to *alter morbid process*, but in the present state of our knowledge we cannot explain how they act, perhaps by improving the metabolic process through their influence on trophic centres. The most important of this group are arsenic, gold, colchicum, chaulmoogra oil, etc.

Class IX.—Drugs that act on the Body-Heat

See **Antipyretics, Part V**

Class X.—Drugs that act on the Muscular System

Elaborate experiments were made to determine the action of drugs on the muscles. Our scope does not permit us to go over them, we therefore, give a summary of results as classified by Brunton, based on the classification of Kobert.

Group I.—"*Leaves the irritability of the muscles unaffected, but diminishes the total amount of work it is able to do.*" As apomorphine, asclepidine, delphine, saponin, copper, zinc and cadmium. Antimony, arsenic, iron, and platinum in large doses.

Group II.—"*Diminish the excitability of the muscles as well as its capacity for work.*" As potassium, lithium, ammonium, quinine, chloroform, chloral, and alcohol.

Group III.—"*Diminish the capacity for work, and produce marked irregularity in its excitability.*" As lead, emetine, and cocaine.

Group IV. "*Alter the form of the muscular curve.*" As veratrine, salts of barium, strontium and calcium, digitalis, squill and oleander.

Group V.—"*Increase the excitability.*" As physostigmine.

Group VI.—"*Increase the capacity for work.*" As theobromine and caffeine.

Class XI.—Drugs that act on the Nervous System

By the nervous system, we mean the brain, the bulb, the cord, the nerves both sensory and motor and the various ganglia. The highest motor and sensory centres as well as those of volition, intellect, emotion, etc., are contained in the cerebral convolutions, while the simple automatic and reflex centres are in the basal ganglia, cerebellum, medulla and cord. All nerve-centres are connected with one another by nerve-filaments called *collaterals*, for co-ordination of impulses, and constitute the **central nervous system.** The ganglionic system, though associated with the central nervous system, is chiefly automatic in its action, and is known as the **sympathetic system.** The cerebral or highest centres are not only excitable or capable of being brought into action by afferent impulses, but possess an inherent power of spontaneously originating impulses themselves. Their action is therefore both **reflective and spontaneous.** To the pharmacologist this **reflective** or **reflex action** is very important. It is effected by (1) an afferent sensory nerve, (2) reflex centre, and (3) an efferent, motor or secretory nerve. An afferent impression excited by an irritant on the skin or other structures of the body, is conducted by an afferent nerve to a system of nerve-cells known as the *reflex centre*, where it produces a certain protoplasmic disturbance, resulting in a force, which either remains there as potential energy or is conveyed by a different tract—efferent nerve—to perform some specific action either in the muscles, viscera or the blood vessels. Remedies can affect only some of the functions of the nervous system as shown below :—

A. Drugs that act on the periphery of the sensory nerves.—

These refer only to common sensory nerves and not those of the special senses. The action of a drug on the tactile sensibility is ascertained by observing, whether it produces after application a diminution of pain if present, or a loss of sensibility, or an increase of sensibility or pain.

1. **Drugs that depress the periphery of the sensory nerves.**—These may be either **local anodynes** or **local analgesics,** or **local anæsthetics.**

(*a*) *Local anodynes.*—These can act only when pain is present. They relieve pain either by directly paralysing the terminal ends, or by depressing the nerve-centre as well as the periphery. They are :—

Aconite	Menthol	Ether	Opium
Veratrine	Acid, hydrocyan. dilute	Chloroform	Aromatic oils
Carbolic acid		Belladonna	Zinc oxide
Chloral	Creosote	Stramonium	Sodium bicarb.
Chloretone	Alcohol	Hyoscyamus	Camphor

Therapeutics.—In most of the neuralgias, aconite, belladonna, chloral c. camphor, menthol, spray of ether and alcohol, application of aromatic volatile oils are of special service. Morphine hypodermically or endermically removes superficial and deeper pains. Pruritus is relieved by lotions containing carbolic acid, diluted hydrocyanic acid and sodium bicarbonate.

(*b*) *Local anæsthetics.*—These lessen the tactile sensibility of a surface to which they are applied. In fact they are also *local anodynes.* They are carbolic acid, urea quinine, eucaine, kava, cocaine injected hypodermically ; ether, ethyl chloride, methyl chloride when sprayed, and extreme cold.

2. *Drugs that stimulate the periphery of the sensory nerves.*—When the blood-supply of a part is increased by immediate local vascular stimulants (*see* p. 139), the terminal ends of sensory nerves become irritated, giving rise to tenderness and pain (peripheral neuritis).

Therapeutics.—By stimulating the periphery of the sensory nerves by sinapisms, electricity, extreme heat or cold or local vascular irritants, we can reflexly stimulate the heart and lungs, and can rouse patients from unconsciousness, as that of syncope, opium poisoning, etc.

B. Drugs that act on the periphery of the motor nerves.—The action of this group of drugs is best exemplified by curare a South American arrow-poison which directly paralyses the motor end-plates.

1. *Drugs that paralyse the periphery of the motor nerves in muscles.*—They are *local motor paralysers* and are :—

Amyl nitrite	Hyoscyamus	Methyl quinine
Atropine	Lobeline	,, strychnine
Camphor	Methyl brucine	Saponin
Cocaine	,, cinchonine	Sparteine
Conium	,, morphine	Stramonium
Hydrocyanic acid dil.	,, codeine	

Therapeutics.—Of these, belladonna, conium and cocaine are used therapeutically to paralyse, or at least to overcome the spasmodic contraction of, the sphincter ani in rectal fissures and ulcers. They also depress the sensory terminal ends.

2. *Drugs that stimulate the periphery of the motor nerves in muscles.*—They are *local motor stimulants* and are :—

Aconite	Nicotine	Strychnine	Electricity
Pilocarpine	Pyridine	(slightly)	(faradic)

C. Drugs that act on the nerve-trunks.—The trunks of nerves are less affected than the periphery.

1. *Drugs that affect the motor terminal ends and twigs.*—Lead, mercury, arsenic and alcohol when continued for a long period, produce inflammation, fatty degeneration and other changes in the terminal ends and twigs of the sensory and motor fibres, especially those of the latter, causing tingling and pain, and later on paralysis of motion, and to some extent that of sensation giving rise to peripheral neuritis.

2. *Drugs that affect the sensory nerve-trunks.*—Opium is most powerful in this respect. It can arrest the conduction of afferent impulses either at the periphery, the trunk or the sensorium.

D. Drugs that influence the spinal cord.—The cord performs three specific functions., *viz.*—(1) the conduction of (*a*) sensory or afferent, and (*b*) of motor or efferent impressions, (2) the reflex action, and (3) the origination of impulses by special nerve-centres, as the sweat-centres, located in the cord. We do not know much of drugs acting on these normal processes, except what is given below :—

1. **Spinal stimulants.**—These drugs *increase the irritability of the anterior cornua and produce convulsions.* They are :—

Strychnine	Thebaine	Chloroform
Brucine	Ammonia	Ether

Of these, strychnine is the most powerful, which in small and moderate doses intensifies the reflex excitability, and in large doses produces tetanus.

Therapeutics.—Strychnine is largely employed in motor paralysis local or general, after the inflammatory stage is passed.

2. **Spinal depressants.**—These *depress or paralyse the activity of the anterior cornua.* They may be either *direct* or *indirect paralysers.*

(*a*) *Drugs which directly depress the reflex movements* are :—

Chloral hydrate*	Ether*	Gelsemium	Silver salts
Bromides	Cannabis Ind.*	Amyl nitrite	Carbolic acid*
Physostigmine	Emetine	Sodium nitrite	Zinc salts
Chloroform*	Alcohol*	Camphor*	Turpentine
Opium*	Ergot	Antimony salts	Colchicum

Those with * first excite slightly and then depress.

Therapeutics.—Chloral hydrate, bromides, physostigmine, calabar bean, opium, cannabis Indica, and chloroform or ether inhalation are ordinarily used to check convulsions, as in tetanus.

(*b*) *Drugs which indirectly depress the reflex movements.*—These act by arresting the circulation of the spinal cord. Aconitine, digitalin and large doses of quinine are powerful in this respect.

E. Drugs which act on the cerebrum.—The structure of the brain being even more complicated than that of the cord, our knowledge of the pharmacology of this organ is necessarily still more obscure. Although we can influence the functions of the brain more rapidly, yet we cannot localise the action of drugs. However, they are found to obey *two general laws* while acting on the brain, *viz.* :—

a. The law of dissolution.—This was first described by Jackson, and consists in the progressive action of a drug on the nerve-centres in the inverse order of their development in animal life, *i.e.*, those that are the highest and developed last are affected first, and then the next to highest, and so on, until the lowest ones are affected. Thus, alcohol paralyses first the highest centres, as of will, intellect, etc., then those of the muscles as is evidenced by staggering gait, and lastly those of the heart and respiration (*see* Alcohol).

b. The law of primary stimulation and subsequent depression.—This is well illustrated by the action of a drug which in small doses stimulates certain functions, and in large doses depresses them. Thus, chloroform in the first stage of its action stimulates the motor cells, producing tetanic movements ; but in the later stage depresses them and causes a relaxation of the muscles.

1. Drugs that affect the functions of the cerebrum or brain

(*a*) **Cerebral stimulants.**—These excite the functional activity of the brain. If the excitement becomes disorderly so as to lead to incoherence and delirium, they are called *deliriants.* If they produce mirthful and comfortable feelings, they are then known as *exhilarants.* They are :—

Alcohol	Stramonium	Tea	Quinine
Chloroform	Hyoscyamus	Coffee	Salicylic acid
Ether	Cannabis Ind.	Coca	Santonin
Belladonna	Opium	Camphor	Tobacco

Of these, belladonna, hyoscyamus, stramonium, cannabis indica are **deliriants.**

Therapeutics.—Many of these depress after primary stimulation. Some of the above are habitually consumed, *e.g.* tea, coffee, coca, tobacco, opium, ganja, and alcohol. Alcohol and opium are very powerful cerebral excitants. In cases of faint-

ing, shock due to accidents to the head, drowning, etc. alcohol, ether, chloroform, and cardiac stimulants become necessary.

(*b*) **Cerebral depressants.**—These drugs lessen the functional activity of the brain, and can be classified into (1) *hypnotics*, (2) *narcotics*, (3) *general anodynes*, and (4) *general anæsthetics*.

(1) *Hypnotics or soporifics* are remedies which induce sleep. During normal sleep, both arteries and veins remain contracted, and the brain becomes anæmic. Therefore, to produce sleep, we must (*a*) lessen its activity, and (*b*) reduce its circulation. We can do this by *direct* and *indirect measures*.

(*i*) *The direct hypnotics* act by reducing the cerebral metabolic processes either by directly acting on the nerve-cells or affecting them through the circulation. They are :—

Chloral hydrate	Paraldehyde	Chloralose	Veronal
Bromides	Chloralamide	Trional	Ural
Narcotics (q.v.)	Cannabis Ind.	Tetronal	Urethane
Hyoscyamine	General anæs-	Hedonal	Chloretone
Hyoscine	thetics (q.v.)	Somnal	Sulphonal

(*ii*) *The indirect hypnotics* act by drawing the blood away from the brain elsewhere, by increasing the activity of circulation. Thus by the application of a warm poultice to the abdomen, by warm foot-baths, warm drinks, and warm wet-pack, we can indirectly induce sleep. Digitalis by improving cerebral circulation acts as an indirect hypnotic in heart disease.

Therapeutics.—The cause of insomnia must, if possible, be removed. Sleep is better induced by combining the direct with the indirect hypnotics. Chloral hydrate, sulphonal and bromides produce almost natural sleep. Morphine or opium is an excellent hypnotic, if the sleeplessness is due to pain. Toleration is often induced by these drugs. (For further action *see* Hypnotics, Part V).

(2) *Narcotics*, as Brunton defines, are "substances which lessen our relationship with the external world." Hence, they include (*a*) the *direct hypnotics* ; (*b*) the *general anodynes* ; and (*c*) the *general anæsthetics*. Narcotics induce sleep and relieve pain in moderate doses, but are powerful respiratory and vascular depressants in large doses. (*See* Narcotics, Part V). The following act as narcotics when given in large doses :—

Opium	Cannabis Ind.	Chloral Hydrate
Heroin hydrochlor.	Alcohol	General anæsthetics

(3) *General anodynes or analgesics.*—These relieve pain by depressing the excitability of nerves or nerve-centres. They act by arresting the conduction of afferent impressions either

at the seat of origin in the course of transmission, or at the point where they affect the sensorium. They are :—

Opium	Hyoscyamus	Genreal anæsthetics
Morphine	Stramonium	(in small doses)
Belladonna	Cannabis Ind.	Phenazone
Atropine	Hyoscyamine	Phenacetin
Butyl-chloral	Gelsemium	Acetanilide
Conium	Chloral	

Of these the action of opium is most marked. It relieves pain by arresting the afferent impressions at all the points mentioned above. Belladonna does this by depressing the excitability of the sensory nerves, and chloral hydrate, butyl chloral, gelsemium, etc., by lessening the excitability of the cerebral centres.

Therapeutics.—Direct general anodynes are indicated in cases where pain is so intense as to produce loss of sleep, and to cause disturbance of the whole system. Opium or morphine in a variety of forms can be administered by various routes, the hypodermic method being the quickest and the most powerful. Belladonna in large doses is very useful in urinary colic. If we desire to have the anodyne effect produced more completely and quickly, we must use general anæsthetics, as in parturition, severe biliary and renal colic. Phenazone, gelsemium, butyl chloral, etc., relieve neuralgias.

(4) *General anæsthetics.*—These drugs abolish consciousness and voluntary action so that no pain is felt. General anæsthesia can be induced by **indirect** and **direct** measures. Indirectly it can be done (1) by arresting the cerebral circulation and thereby stopping the metabolism of the nerve-cells, either by compression or ligature of the carotids, or by combined pressure over the carotids and vagi ; (2) by diminishing the oxidation of the nerve-cells by increasing the venosity of the blood, as in poisoning by charcoal gas ; and (3) by draining the blood from the head to other parts of the body, as by suddenly lifting a patient to a standing posture after he has been laid flat on the ground. Directly, by the inhalation of chloroform, ether, ethyl chloride, nitrous oxide and several derivatives of ether and alcohol. These remedies, while acting as direct general anæsthetics, illustrate the *two general laws of cerebral pharmacology* already mentioned.

Therapeutics.—The direct general anæsthetics are given :—

(1) To produce insensibility to pain, as in biliary and renal colic.

(2) To remove consciousness, as in surgical operations.

(3) To relax or remove muscular spasm or activity, as in tetanus, hydrophobia, poisoning by strychnine, and in the reduction of hernia, dislocations and fractures.

(4) To diagnose certain obscure diseases, such as phantom tumours caused by the contraction of the abdominal muscles.

(*c*) **Drugs that act on the motor centres of the brain.**—The investigation of the pharmacology of drugs on the motor area of the brain is not difficult. The motor centres being situated on the precentral convolutions anterior to the fissure of Rolando, the cortical substance of the motor area is exposed by trephining, and stimulated by faradic current, before and after the administration of a drug, and the strength of the current necessary to produce a similar movement before and after drugging is noted. Another experiment is to expose the cortex on one side and to estimate the strength of current necessary to produce convulsion, and then to close the wound and allow it to heal. The animal is then drugged for several weeks, and the corresponding area on the opposite side is exposed, and the strength of current to produce a similar convulsion is noted. From these experiments we have been able to deduce the following results :—

(1) *Drugs that depress the excitability of the motor area* are chiefly the bromides. Alcohol, ether and chloroform have a similar effect. Chloral hydrate reduces the excitability temporarily.

Therapeutics.—Bromides and chloral hydrate, especially the former, are employed in convulsive disorders, such as epilepsy, hysteria, puerperal eclampsia, infantile convulsions, etc.

(2) *Drugs that increase the excitability of the motor area.*—It is very difficult to say whether these drugs act directly on the motor nerve-cells, or influence them by increasing the venosity of the blood, through their action on the respiratory and circulatory centres. Of this group strychnine, atropine, and absinthe are the most powerful.

F. Drugs that influence the cerebellum.—We know very little of the functions of the cerebellum, except that it controls all co-ordinated movements. Alcohol in large doses causes staggering gait, thickness of speech, and irregular movements of the hands, thereby illustrating action on the cerebellum. Apomorphine in toxic doses does not produce vomiting in animals, but makes them go round and round.

G. Drugs acting on the sympathetic and parasympathetic system.—The voluntary muscles are under the direct control of the central nervous system, but the activity of the involuntary muscles and of the glands is regulated by a more complex arrangement. The nerves supplying them do not pass directly from the central nervous system, but medullated fibres are projected from the cord and run to ganglion cells whence non-medullated fibres pass down to the different tissues. The nerves supplying these plain muscles and the glands of the body are the *sympathetic* and the *parasympathetic* (cranio-sacral). The 'outflows' from the sympathetic

arise from the dorsal and down to the fourth and fifth lumbar nerves as minute medullated fibres. These have their cell stations in the ganglia of the sympathetic cord, and in the cardiac, solar and hypogastric plexuses. The 'outflows' of the parasympathetic or autonomic system include the cranio-bulbar and the sacral outflows. The cranial group is formed by the second, the seventh, the ninth and the tenth, while the sacral group by the second, the third and the fourth sacral nerves.

The following table from Clark * shows the chief action of the sympathetic and parasympathetic nerves :—

The Action of the Sympathetic and the Parasympathetic Nerves upon the chief Organs of the Body

Organ	Sympathetic	Parasympathetic
Blood vessels	Constriction	*Nil* (except in certain special cases where dilatation occurs)
Heart	Acceleration and augmentation	Inhibition
Sweat glands	Secretion	*Nil*
Eye (ciliary muscle)	Relaxation	Contraction
Salivary glands	Slight viscid secretion	Free secretion and vaso-dilatation
Movements of stomach	Inhibition	Augmentation
Gastric secretion	—	Increase
Intestinal movements	Inhibition	Augmentation
Pancreatic secretion	—	Increase
Bronchial muscles	Inhibition	Contraction
Bronchial secretion	—	Increase
Bladder and ureter	Relaxation	Contraction
Uterus	Contraction and relaxation	

1. **Drugs acting on the nerve endings.**—It has been found that the action of a drug may be elicited on an organ whose nerves have been divided and have degenerated, and in which no nerve terminations exist. It is clear therefore that these effects are produced not by any action of the drug on the anatomical nerve ends but on some other substance lying between it and the organ, and this substance is known as the *nerve ending*. Langley suggests that this substance contains specific receptors which combine with the poisons. Some drugs produce a specific action upon the nerve endings, and their actions are confined to ends of the nerves supplying the different tissues, and are not due to any action either on the muscle or the glands. These may be classified as follows :—

(*a*) *Drugs stimulating the sympathetic nerve endings.*—Adrenalin, tyramine.

* Applied Pharmacology by A. J. Clark.

(*b*) *Drugs paralysing the motor sympathetic nerve endings.*—Ergotoxine. Its action is preceded by stimulation.

(*c*) *Drugs stimulating the parasympathetic nerve endings*—Pilocarpine, physostigmine, acetyl choline.

(*d*) *Drugs depressing the parasympathetic nerve endings.*—Atropine, hyoscine.

Class XII.—Drugs that act on the Eye

A. Drugs that act on the conjunctiva.—These may be divided into the following groups, according to their local action on this membrane :—

Astringents	**Sedatives**	**Antiseptics**	**Irritants**
Alum	Cocaine	Boric acid	Iodine
Adrenalin	Atropine	Boro-glyceride	Calomel
Lead acetate	Opium	Corrosive sublimate	Yellow mercuric oxide
Zinc sulphate	Belladonna	Carbolic acid	Silver nitrate
Tannin	Eserine	Pot. permang.	Copper sulphate
Silver nitrate	**Anæsthetics**	Quinine	
	Cocaine		

Therapeutics.—Cocaine is chiefly used in ophthalmic practice to lessen pain and produce local anæsthesia. Boric acid is used as an antiseptic wash in conjunctivitis. Astringent collyrium containing zinc sulphate, alum, silver nitrate, tannic acid, etc., reduces the inflammation, but alum and lead acetate are objectionable, as the former may dissolve the corneal cement, and the latter may be deposited as an insoluble albuminate if there is a corneal ulcer. Calomel is an effective stimulant and absorbent in pustular conjunctivitis. Iodine removes recent opacities of the cornea. Yellow mercuric oxide ointment (diluted) and copper sulphate are good applications for granular lids. Tannin removes pannus.

B. Drugs that act on the lachrymal glands.—Local irritants and pilocarpine increase the flow of tears. Prolonged use of atropine does the contrary.

C. Drugs that act on the pupil.—The iris is the regulator of the pupil. It is composed of two sets of muscular fibres, the circular which contract, and the radiating which dilate the pupil. These two sets of muscles are in constant action, and by opposing each other constitute an exceedingly sensitive balanced mechanism for the regulation of the size of the pupil. The sphincter iridis (circular fibres) is innervated by the third nerve, and the centre for the contraction of the pupil is located in the corpora quadrigemina. Stimulation of the third nerve contracts, and its section dilates the pupil. The cervical sympathetic is the nerve of the radiating fibres. Its stimulation causes dilatation, and its division contraction of the pupil. The cilio-spinal centre controls dilatation.

1. **Drugs that act on the iris**

(*a*) **Drugs that dilate the pupil** are called **mydriatics** or **pupil-dilators.** They act :—

(1) *By paralysing the terminal ends of the nerve.*—As atropine, homatropine, daturine, hyoscyamine, coniine, gelsemine, amyl nitrite, and hydrocyanic acid.

(2) *By stimulating the terminal ends of the cervical sympathetic.*—As cocaine, adrenalin.

(3) *By paralysing the oculomotor centre.*—As in asphyxia.

Many of them, such as atropine, daturine, hyoscyamine, act locally as well as when given by the mouth.

(*b*) **Drugs that contract the pupil** are called **myotics** or **pupil-contractors.** They act :—

(1) *By stimulating the terminal ends of the third nerve.*—As pilocarpine, physostigmine and nicotine.

(2) *By stimulating the centre for contraction.*—As opium, picrotoxin, and general anæsthetics in the early stage of their action.

Some of the myotics, such as physostigmine, contract the pupil if locally applied, and when introduced into the circulation. Nicotine first contracts and then dilates the pupil.

Therapeutics.—The mydriatics are used :—

(1) To break down or prevent adhesions of the iris, as in iritis.

(2) To prevent prolapse of the iris, or to restore it to its normal position if already prolapsed in corneal perforation.

(3) To dilate the pupil for ophthalmoscopic examination.

The myotics (especially eserine) are used :—

(1) To counteract the effects of mydriatics.
(2) To prevent much light entering the pupil.
(3) To lessen intra-ocular tension in glaucoma.

D. Drugs that act on the ciliary muscle.—This muscle adjusts the lens for distant and near objects of vision. During rest, the lens remains flattened, but to see nearer objects it becomes more convex owing to the drawing in of the ciliary processes by the contraction of the circular fibres. It is supplied by the third nerve.

1. **Drugs that impair accommodation.**—Drugs that paralyse accommodation by acting on the ciliary muscle are called *cycloplegic.*

The following drugs impair or paralyse accommodation :—

Atropine	Gelsemine
Homatropine	Pilocarpine
Hyoscyamine	Physostigmine

2. **Drugs that affect the intra-ocular tension.**—The normal tension depends upon, (*a*) the amount of intra-ocular secre-

tion, and (*b*) the freedom with which fluids may escape through the lymph channels (spaces of fontana) into the canal of schlem. Tension may be raised either by extra secretion or by dilatation of the pupil which shuts off the spaces of fontana. They are of two kinds :—

(*a*) *Drugs that increase the tension* are atropine, hyoscyamine, and daturine in large doses.

(*b*) *Drugs that diminish the tension* are cocaine, physostigmine and hyoscine.

E. Drugs that affect the sensory apparatus of the eye.—Strychnine increases the sensitiveness to impressions and capacity for seeing blue. Santonin affects the sense of colour, objects appearing first violet and then yellow.

F. Drugs that produce subjective sensation of sight.—Cannabis indica produces pleasant and laughable visions in some persons. Alcohol in toxic doses induces visions of a disagreeable nature (delirium tremens). Sodium salicylate does the same. Quinine, tobacco and lead cause a failure of sight for form and certain colours.

G. Drugs that act on the ocular muscles.—Gelsemium causes paralysis of the ocular muscles, particularly the levator palpebræ and rectus externus. Coniine causes ptosis, and cocaine protrusion of the eyeball.

Class XIII.—Drugs that act on the Ear

A. Drugs that act on the aural mucous membrane.—These may be classified into **local anodynes** or **local sedatives, local astringents, local antiseptics** and **emollients.** To relieve pain due to catarrhal inflammation of the mucous membrane, we use opium, morphine, belladonna, atropine, chloral c. camphor, warm boric acid lotion, cocaine (alkaloid) dissolved in warm oil, etc. In otorrhœa, lotions containing boric acid, potassium permanganate, zinc sulphate should be injected, and insufflations of powdered boric acid and iodoform separately or mixed together, may be used. Glycerin acid tannic sometimes does more good than many antiseptic injections. For dryness of the membrane, glycerin and bland oils are serviceable.

B. Drugs that act on the cerumen.—An accumulation of wax sometimes gives much trouble. Syringing the ear with plain warm water, or a warm solution of sodium bicarbonate (10 grs. to 1 oz.) greatly assists the removal.

C. Drugs that affect the sense of hearing.—Strychnine increases the excitability of the auditory nerve or the auditory centre, thereby increasing the acuteness of hearing. Quinine and salicylic acid create subjective noises, such as ringing, buzzing, etc., which can, to a great extent, be removed by hydrobromic acid dilute.

CLASS XIV.—DRUGS THAT ACT ON THE GENERATIVE SYSTEM

A. Drugs and agents which increase the sexual passion and power are called **aphrodisiacs.** These may be **direct** or **indirect.** The true genital centre being situated at the lumbar portion of the spinal cord, can normally be excited by various afferent impressions brought from various sources, such as eye, nose, ear, mamma, rectum, bladder, prostate, nates, cerebrum, and general surface of the body. Drugs can stimulate this centre in the following ways :—

1. **Direct Aphrodisiacs act :—**

(*a*) *By increasing the excitability of the nerves passing to or from the genital organs, or of the genital centre,* as strychnine, damiana and probably phosphorus.

(*b*) *By stimulating the cerebrum and reflexly the genital centre,* as opium, cannabis Ind., camphor and alcohol in small doses.

(*c*) *By irritating the nerves of the urinary, genital and adjoining structures and thereby reflexly the genital centre,* as cantharidin, acidity of urine, nitrate and chlorate of potash.

2. **Indirect Aphrodisiacs.**—They act by removing constitutional disorders and improving the general health. Thus, by curing diabetes, albuminuria, gout, chronic malarial fever, etc., we improve sexual power. Iron, general tonics, generous diet, especially meat, indirectly act as aphrodisiacs by improving general health.

Therapeutics.—In functional impotency, both the direct and the indirect aphrodisiacs should be used. Of the direct ones, strychnine, phosphorus and damiana are reliable and useful. Find out the cause and treat accordingly. These drugs sometimes do more harm than good when used indiscriminately.

B. Drugs that diminish the sexual passion and power are called **anaphrodisiacs.** They may also act *directly* or *indirectly.* Thus :—

1. **Direct Anaphrodisiacs** may act :—

(*a*) *By lessening the excitability of the nerves of the genital organs,* as by the local application of ice and cold bath. bromides.

(*b*) *By depressing the excitability of the genital centre,* as by bromides, iodides and conium ; opium, hyoscyamus, belladonna and stramonium in large doses.

(*c*) *By depressing or removing afferent impulses which reflexly excite the genital nerves and genital centre,* as alkalies if due to acid urine.

2. **Indirect Anaphrodisiacs** are measures of a moral and hygienic nature, such as exercise of the upper limbs, meagre and vegetable diet, avoidance of stimulants, of warm heavy clothing, of feather beds, of obscene works, of amorous songs,

of distension of the bladder, of fæcal accumulation, and removal of ascarides, and of uric acid crystals from the urine.

Therapeutics.—When the sexual passion is abnormally excited, we use both direct and indirect anaphrodisiacs, but the cause of excitement should be looked for and removed. Large doses of bromides are very useful in satyriasis and nymphomania.

C. Drugs that act on the uterus

1. *Drugs which cause expulsion of the contents of the uterus* are called **ecbolics** or **oxytocics.** They act by contracting the unstriped muscular fibres of the uterus either **directly** or **indirectly.**

(*a*) The direct ecbolics are :—

Ergot	Lead	Cotton root bark
Quinine	Hydrastis	Adrenalin
Caulophylum	Borax	Pituitary extract

Of these, pituitary extract and ergot are most powerful. The action of quinine is uncertain. It generally intensifies and increases the labour-pains. All direct ecbolics act as emmenagogues in moderate doses.

(*b*) *Indirect ecbolics* act by producing congestion of the pelvic viscera. They are, drastic purgatives and aloes ; irritating oils ; savine, pennyroyal ; irritants, cantharidin ; and counter-irritants.

2. *Drugs which increase or restore the menstrual flow* are called **emmenagogues.** They may be either **direct** or **indirect.**

(*a*) **Direct emmenagogues** act by gently stimulating the non-gravid uterus and thus increasing the menstrual flow :—

Ecbolics	Myrrh	Cantharidin
Asafetida	Guaiacum	Apiol

(*b*) **Indirect emmenagogues act:**—

(1) *By improving the quality of the blood, e.g.* iron, manganese and cod-liver oil.

(2) *By improving the tone of the nervous system, e.g.* nux vomica and strychnine.

(3) *By increasing the vascularity of the uterus, e.g.* hot hip-bath, hot mustard-bath, mustard poultices, and leeches to the thighs and genitals.

(4) *By irritating the adjacent organs or structures and thereby reflexly stimulating the womb, e.g.* aloetic purgatives.

(5) *By removing or neutralising any specific poison*, as of malaria by quinine and iron.

Therapeutics.—The cause of the suppression of the menstruation should be looked for and removed. If it is due to a sudden chill, aconite and hot hip-baths are very useful. If it is due to anæmia, iron is the best remedy. Delayed or absent flux is restored by permanganate, aloes and myrrh.

3. *Drugs which depress the uterine contraction* are sometimes called **uterine sedatives** or **depressants.** As opium, viburnum prunifolium, cannabis Indica, chloral, bromides.

D. Drugs that act on the mammary glands

1. *Drugs which increase the secretion of the milk* are called **galactagogues ;** as pilocarpine, pituitary extract, local application of the leaves of castor-oil plant to the breasts.

2. *Drugs which decrease or stop the secretion of the milk* are called **antigalactagogues ;** as belladonna, either applied locally or given internally.

3. *Drugs which alter the composition of the milk* :—

Several drugs are eliminated by the milk and affect suckling babes. Thus rhubarb, senna, jalap, sulphur, scammony, castor oil may produce looseness in children, when given to their mothers. By giving mercury, iodides, iron, and arsenic to the mother we can affect the infant. Opium should not be given to nursing mothers in large doses. Acids given to the mother may cause griping to her child. Copaiba, garlic, asafetida, and oil of turpentine impart a disagreeable flavour to the milk. Salts increase the saline ingredients of the milk.

CLASS XV.—DRUGS THAT ACT ON MICRO-ORGANISMS

See **Antiseptics and Disinfectants, Part V**

PART V

MATERIA MEDICA AND THERAPEUTICS

(In this part, all the official remedies proper, including their chief non-official preparations and derivatives, will be described. The composition of the official preparations will not be repeated (*see* pp. 17-62), except their strengths, doses, and in some instances, their special characteristics).

SECTION I: INORGANIC MATERIA MEDICA

GROUP I

THE ALKALIES AND METALS OF ALKALINE EARTH

Potassium, Sodium, Ammonium, Lithium, Calcium, Magnesium, Strontium

Before discussing the action of the individual drugs of this group we had better consider their therapeutic uses from a broad point of view. Certain salts of the alkalies—potassium, sodium, ammonium and lithium, and some of the salts of the alkaline earth—magnesium and calcium, are employed therapeutically as *antacids*. The salts of the former being rapidly absorbed from the alimentary canal manifest after a local action in the stomach certain systemic action, whereas the latter are absorbed with difficulty and exhibit an active action on the intestinal tract, magnesium being laxative, calcium constipating. Some of the alkaline salts are strong caustics, while others are mild antacids. The former are chiefly the hydroxides of potassium and sodium, and oxides of calcium. These act by dissolving albumin, extracting water and saponifying fats, while the others, viz.. the carbonates and bicarbonates of potassium, sodium and lithium, and the carbonates of magnesium and calcium act merely as antacids. Some are not locally antacids, but bleak down into carbonates in the blood and tissues and thus increase the alkalinity of the blood and are therefore systemic alkalisers, viz., the acetates, citrates and tartrates of sodium and potassium. Antacids are therefore of two types ;

1. *Those of alkaline reaction*, viz. (*a*) the caustic alkalies, and (*b*) the milder alkalies.
2. *Those not of alkaline reaction.*

POTASSIUM. Potassium. K (Not official)

POTASSA CAUSTICA

Potassium Hydroxide. KOH

Syn. B.P.—Caustic Potash, Potassium Hydrate.

Source.—Prepared by the interaction of potassium carbonate and calcium hydroxide. $K_2CO_3+Ca(OH)_2=2KOH+CaCO_3$. It contains not less than 85 p.c. of pure potassium hydroxide.

Characters.—Deliquescent, corrosive, alkaline, white pencils or cakes. *Solubility.*—2 in 1 of water and 1 in 3 of alcohol (90 p.c.). *Impurities.*—Lead, copper, arsenium chloride. Should not contain more than 10 p.c. of combined water and impurities.

Enters into.—The preparation of Pot. Bromid., Pot. Iodid., Pot. Permanganas, Liq. Cresol Saponatus, and the

Official Preparation

1. **Liquor Potassæ.** *Syn.—Liq. Potassii Hyrdoxidi, U. S. P.*—5 gms. in 100 mils. of potassium-hydroxide in water. A colourless, odourless, transparent, alkaline liquid, with sp. gr. 1.045. *Impurities.*—Carbonates, sulphates, chlorides, and other metals.

Dispensing hint.—To be kept in green glass bottles with air-tight stoppers.

B.P. Dose.—10 to 30 ms. or 6 to 18 decimils, well diluted. **U.S.P.—1 mil. or 15 ms.**

Non-official Preparation

1. **Pasta Potassæ cum Calce, B.P.C.** *Syn.—Vienna Paste.*—Caustic Potash and quicklime in equal weights. Add alcohol *q.s.* to form a paste.

Pharmacology

Externally.—Caustic potash or a concentrated solution of potash has a strong affinity for water, and dissolves albumin. It therefore rapidly destroys tissues with which it comes in contact, producing a greyish eschar. Hence, it is a powerful **irritant** and **caustic.** A less concentrated solution is irritant, softening and dissolving the epidermis. Still more diluted, it (1) reddens the skin, (2) neutralises acids, and (3) dissolves greasy substances. It is therefore a **rubefacient, antacid** and **detergent.** A *hot weak* solution is a **sedative.**

Toxicology of the Caustic Alkalies

Persons are not often poisoned by the caustic alkalies, but accidents occasionally happen through their swallowing by mistake either *pearlash*, which is a mixture of potassium carbonate and potash, or *soap-lees*, which contains the corresponding sodium salts.

The symptoms are a caustic taste in the mouth and burning heat in the throat, the mucous membrane of which becomes swollen, soft, and red. This is followed by pain in the stomach, vomiting, diarrhœa, feeble pulse, general collapse. On post-mortem examination, the whole mucous membrane from the mouth to the stomach is found red, swollen and excoriated.

Treatment.—Any rapidly acting emetic, or hypodermic injection of apomorphine. If no emetics available, give copious draughts of warm water and tickle back of throat with a feather. After vomiting has occurred give (1) **feeble acids** (*e.g.* vinegar, lime-juice, dilute acetic or citric acid); (2) **demulcents** (oil, linseed tea, white of egg).

N.B.—Do not wash out the stomach with the stomach-pump as there is danger of damaging the softened mucous membrane.

Therapeutics

Externally.—Caustic potash in the form of the solid stick is occasionally applied to destroy **lupus** and **epithelial cancers.** As it diffuses rapidly, care should be taken to protect the surrounding and deeper tissues, by applying blotting paper to absorb the moisture, or covering the part with two or three pieces of plaster, and applying the caustic through a hole in the centre. The hole should be *smaller* than the eschar which it is intended to produce. Acetic acid or vinegar diluted, should be applied to neutralise the caustic when further action is no longer required. The severity of its action can be better controlled by the use of *Vienna paste*, which is more manageable than the undiluted caustic potash.

A pellet of cotton-wool soaked in liquor potassæ firmly applied over an ingrowing toe-nail, so far softens it as to admit of its being easily scraped or peeled off without pain. Weaker lotions are used to partially dissolve and facilitate the removal of scales in **psoriasis,** and to allay the **itching** of **urticaria** and **eczema.** A weak hot lotion may be employed locally as a fomentation or bath to relieve the pains of **gout** and **rheumatism.** Soft or potash soaps are good cleansing agents.

Internally.—As an antacid, it is occasionally serviceable in **irritative acid dyspepsia,** but as an alkaliser of blood and urine, the bicarbonate, citrate and acetate are to be preferred, as they are less irritant to the stomach. It is given to **absorb fat** in **obesity,** but serious consequences may follow from excessive use of alkalies or their carbontaes, as they cause derangement of digestion and lessen the total amount of the solids of the blood.

POTASSII ACETAS

Potassium Acetate. $KC_2H_3O_2$

Source.—Prepared by fusing the product of the interaction of acetic acid and potassium carbonate.

$$K_2CO_3+2(CH_3COOH)=2CH_3COOK+H_2O+CO_2.$$

Contains not less than 90 p.c. of pure potassium acetate.

Characters.—White foliaceous, satiny masses, or granular particles, deliquescent, alkaline. Taste sharp, saline. *Solubility.*—2 in 1 of water, 1 in 2 of alcohol (90 p.c.). *Impurities.*—Carbonates, sulphides, and metallic impurities.

B.P. Dose.—15 to 60 grs. or 1 to 4 grms.; U.S.P.—1 grm. or 15 grs.

POTASSII CITRAS

Potassium Citrate. $K_3C_6H_5O_7$, H_2O

Source.—Prepared by the interaction of citric acid and potassium carbonate. $3K_2CO_3+2H_3C_6H_5O_7=2K_3C_6H_5O_7+3H_2O+3CO_2$. Contains not less than 99 p.c. of pure potassium citrate.

Characters.—White deliquescent powder. Taste saline, feebly acid. *Solubility.*—Freely in water.

B.P. Dose.—15 to 60 grs. or 1 to 4 grms.

POTASSII TARTRAS

Potassium Tartrate. $(K_2C_4H_4O_6)_2$, H_2O

Source.—Prepared by neutralising acid potassium tartrate with potassium carbonate. $2KHC_4H_4O_6+K_2CO_3=2K_2C_4H_4O_6+H_2O+CO_2$. Contains not less than 99 p.c. of pure potassium tartrate.

Characters.—Small, colourless, 3 or 6 sided prisms. Neutral in reaction. Taste saline, cooling. *Solubility.*—1 in 1 of water. *Impurities.*—Acid tartrate, metals.

B.P. Dose.—30 to 240 grs. or 2 to 16 grms.

POTASSII TARTRAS ACIDUS

Acid Potassium Tartrate. $KHC_4H_4O_6$

Syn. B.P.—Purified Cream of Tartar; Potassium Bitartrate, U.S.P.

Source.—Prepared from the crude cream of tartar which is deposited during the fermentation of grape juice. Contains not less than 99 p.c. of pure potassium hydrogen tartrate.

Characters.—In gritty white powder, or fragments of crystalline cakes. Taste acid. *Solubility.*—1 in 220 of cold water, not in alcohol. *Impurities.*—Sulphates, chlorides, and metals.

B.P. Dose.—15 to 60 grs. or 1 to 4 grms.; U.S.P.—2 grm. or 30 grs.

Enters into.—The preparation of Conf. Sulph., Troch. Sulph., Pulv. Jalap. Co., Pulv. Kaladanæ Co.

Non-official Preparation

1. **Imperial Drink.** *Syn.—Potus Imperialis.*—Acid. Pot. **Tartrate 1 dr., Glusidum 1 gr., Ol. Limonis 3 ms., Boiling Water to 1 pint; or Acid**

Pot. Tartrate 1 to 1½ drs., Sugar *q.s.*, Boiling Water to 1 pint, in which half the peel of a fresh lemon has been infused.

Pharmacology of Potassium Acetate, Citrate, Tartrate and Acid Tartrate

Externally.—All these salts are neutral, except the acid tartrate which is acid. They have none of the antacid or caustic properties of liquor potassæ or alkaline potassium salts.

Internally. **Gastro-intestinal tract.**—These salts are not irritant to the stomach and are therefore easily borne. Being neutral (one faintly acid), they are **not antacid** like the alkaline potash salts. In large doses (¼ to ½ oz.) they are purgatives. The tartrate and acid tartrate are typical saline hydragogue purgatives. They produce easy liquid motions without griping. They act by stimulating the secretion of succus entericus and hindering its reabsorption (*see* Saline Purgatives). A portion may possibly be converted into carbonate in the intestine and absorbed as such, but the greater portion is excreted with the fæces. A little of that which is absorbed may be re-excreted into the bowels, thus acting as a **remote purgative.**

Blood.—All potash salts made from vegetable acids are converted into carbonates after absorption into the blood, thereby increasing its alkalinity. They are therefore **indirect alkalisers** of blood. The alkalinity is not affected if the salt is acid, such as acid tartrate. Reaching the various tissues of the body containing potassium salts, they supply their wants, and thus act in a manner as **restoratives.**

Kidneys.—All these salts in moderate doses are **diuretics,** especially the acetate and citrate ; the tartrate and acid tartrate acting only in a modified degree. They are direct stimulants to the renal cells. They are speedily eliminated as carbonate, and in their passage through the kidney render the urine alkaline. They are therefore powerful and rapid **alkalisers of acid urine.** Although the urine becomes alkaline, yet the total amount of acids eliminated is increased. They have a very slight effect on the flow in health.

Skin.—All of them are mild diaphoretics, and are said to act by dilating the cutaneous capillaries, but the method of their action is obscure. Of all these salts, the citrate is considered to be the most reliable diaphoretic.

Note.—These salts act either as diuretics or diaphoretics indiscriminately. If you wish the former effect, you must keep the patient cool ; if the latter, wrap him up in blankets and administer warm drinks as adjuvants.

Therapeutics of Potassium Acetate, Citrate, Tartrate and Acid Tartrate

Internally. **Gastro-intestinal tract.**—The nascent citrate and tartrate are powerful gastric sedatives, and are therefore prescribed for **gastric irritability.** For this purpose, the carbonate or bicarbonate is given with lemon juice, citric acid and tartaric acid in an effervescing form. The tartrate and acid tartrate are used only as saline hydragogue purgatives in **constipation, piles, dysentery,** or for the abstraction of fluid in **dropsy, uræmia, ascites, pleuritic effusion,** etc. For this object they should be given in a concentrated form. Their twofold action on the bowels and kidneys renders them peculiary serviceable in this class of cases. Pulv. Jalap. Co., or the acid tartrate in lemonade can thus be given as a hydragogue.

Blood.—These salts were formerly largely given in **acute rheumatism,** because they rendered the blood alkaline, but since the salicylates have come into use they are rarely prescribed for this purpose. In **gout,** both the direct and indirect alkaline potash salts are used, with the object of not only holding in solution the excess of uric acid circulating in the blood, but of affecting the " chemistry of the tissues, causing an increased oxidation, and thereby preventing to some extent the formation of uric acid."

Kidneys.—These salts are eminently successful in **alkalising acid urine.** When we want to maintain its alkalinity for a long period, the citrate is to be selected, as it does not derange the stomach. Thus they not only prevent the precipitation of uric acid in cases of **uric acid diathesis,** but actually dissolve small **uric acid calculi** in the kidneys or bladder. They however are of no value in keeping uric acid in solution already excreted, but are a means of arresting further precipitation. Sir W. Roberts warns us against using more than 40 to 60 grs. of acetate or citrate in 4 ozs. of water, every 4 hours, for he says that in larger doses they may cause a formation of insoluble biurate on the surface of the stones. To **increase diuresis** the citrate and acetate are chiefly employed. The saline diuretics are largely given in **febrile conditions** for their diuretic and diaphoretic properties, and also in general conditions of **anasarca.** By reducing acidity of the urine they relieve irritability of the bladder, and are therefore largely used in **cystitis.**

Skin.—Occasionally the citrate and acetate are given in fevers to produce diaphoresis. The imperial drink is a pleasant refreshing beverage which is much appreciated by fever patients.

Lungs.—Because these salts are converted into carbonates in the blood, the citrate and acetate are sometimes given as expectorants in **bronchitis** with **viscid secretion.**

POTASSII BICARBONAS

Potassium Bicarbonate. $KHCO_3$

Source.—Obtained by saturating a strong aqueous solution of potassium carbonate with carbon dioxide, $K_2CO_3+CO_2+H_2O=2KHCO_3$. Contains not less than 99 p.c. pure potassium bicarbonate.

Characters.—Colourless, non-deliquescent, non-corrosive, monoclinic prisms. Taste saline, feebly alkaline. *Solubility.*—1 in 4 of water. Almost insoluble in alcohol (90 p.c.). *Impurities.*—The same as of carbonate.

B.P. Dose.—5 to 30 grs. or 3 to 20 dgrms. ; U.S.P.—1 grm. or 15 grs.

N.B.—*20 parts by weight are neutralised by 14 parts of citric and 15 of tartaric acid.*

POTASSII CARBONAS

Potassium Carbonate. K_2CO_3

Syn.—Salt of Tartar.

Source.—Obtained by the interaction of potassium sulphate and calcium carbonate. Contains not less than 81.5 p.c. of pure potassium carbonate.

Characters.—White, deliquescent, crystalline powder. Taste alkaline and caustic. *Solubility.*—1 in 1 of water. Insoluble in alcohol (90 p.c.). *Impurities.*—Sulphates, chlorides, metals.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—1 grm. or 15 grs.

Enters into.—The preparation of Decoct. Aloes Co., Liq. Arsenicalis, Mist. Ferri Co., and Ung. Pot. Iodide.

SODII BICARBONAS

Sodium Bicarbonate. $NaHCO_3$

Source.—May be obtained by exposing crystals of sodium carbonate to carbon dioxide, or by the interaction of sodium chloride and ammonium bicarbonate.

Characters.—In dry white powder of small monoclinic crystals with saline taste. Slightly alkaline. Soluble 1 in 11 of cold water. *Impurities.*—The carbonate. *Twenty grammes neutralise 16.7 grammes of citric acid or 17.8 grammes of tartaric acid.*

Incompatibles.—Acids and acid salts, *e.g.* bismuth subnitrate.

B.P. Dose.—5 to 30 grs. or 3 to 20 dgrms. ; U.S.P.—1 grm. or 15 grs.

SODII CARBONAS

Sodium Carbonate. Na_2CO_3, $10H_2O$

Syn.—Soda or Washing Soda.

Source.—From sodium chloride by interaction with ammonium bicarbonate, ignition or subsequent crystallisation. Contains not less than 99 p.c. pure sodium carbonate.

Characters.—Transparent, colourless, rhombic crystals. Efflorescent Taste caustic. Soluble 1 in 2 of cold water. *Twenty grammes neutralise 9.8 grms. of citric acid, or 10.5 grms. of tartaric acid. Impurities.*—Sulphates and Chlorides.

B.P. Dose.—5 to 30 grs. or 3 to 20 dgrms.

Enters into.—Ferri Phosph. Sacch., Magnes. Carb. Pond. and Levis, Zinci Carb.

SODII CARBONAS EXSICCATUS

Exsiccated Sodium Carbonate

Source.—Sodium carbonate deprived of its water of crystallisation by heating until it loses nearly 63 p.c. of its weight. Contains not less than 95 p.c. of pure anydrous sodium carbonate.

Characters.—A dry white powder, nearly anhydrous.

Enters into.—Pil. Ferri (carbonate of iron is formed).

B.P. Dose.—3 to 10 grs. or 2 to 6 dgrms.

Pharmacology of Carbonates and Bicarbonates of Potassium and Sodium

Internally. **Gastro-intestinal tract.**—The bicarbonates possess all the properties of potassium salts, without any local irritative effects, and are therefore usually prescribed. Like other alkalies, they momentarily **check the secretion of alkaline saliva** in the mouth. Reaching the stomach, they dissolve mucus and neutralise acid, but their effect like that of all alkalies will vary greatly according to the nature of the stomach contents at the time of administration. On the empty stomach they dissolve mucus and thus improve the condition of the stomach, and being absorbed as a bicarbonate directly increase the alkalinity of the blood. During the digestive period they have three distinct actions :

(*a*) they reduce the gastric secretion,

(*b*) neutralise some of the hydrochloric acid, and

(*c*) liberate CO_2 gas which acts as a carminative.

Dilute solutions act as mild irritants to the stomach walls and thus improve the circulation, help expulsion of gas, and reduce pain and distension much in the same way as any other mild irritants like volatile oils.

In cases of fermentation by neutralising the organic acids which tend to cause pyloric spasm they relieve that condition. In the intestine the alkalies by neutralising or diminishing the acidity of the gastric contents has a retarding influence on the pancreatic secretion which is normally stimulated by the passage of a highly acid fluid from the stomach, although the greater alkalinity of the intestinal contents tends to increase the efficiency of the pancreatic juice already secreted. In hyperacidity however the alkalies render the contents of the intestine less irritating and thus have a tendency to allay catarrh. Stadelmann has shown that alkalies have no effect on the secretion of bile, and are not excreted in it, and do not cause any change in its reaction. Very large single doses cause vomiting. Repeated large doses open the bowels by paralysing their muscular coats.

Blood.—All these salts are freely absorbed and rapidly excreted, the bicarbonate of soda sometimes acting as a purgative. They circulate as neutral bicarbonate. The reaction of the blood remains unchanged, but the alkali available for the neutralisation of acid is augmented. If given for any length of time, they cause the quality of the blood to deteriorate and reduce the body weight.

Heart and circulation.—It has been thought that potassium salts are muscular depressants and therefore tend to slow and weaken the heart. But in therapeutic doses given by the mouth these salts are non-depressant and inert. In this country (India), where a vegetable diet is widely used, very large quantity (1½ to 3 oz.) of potassium salts are ingested daily without any such effect, and, as pointed out by Dixon, they are excreted so rapidly that we get no specific action. In practical therapeutics potassium may be regarded as equivalent to the corresponding sodium ones except when they are injected intravenously.

Respiratory tract.—These salts stimulate the bronchial secretion, and make the mucus less viscid. They are therefore **expectorants.** Potassium iodide possesses this property in a very marked degree.

Kidneys, etc.—Both the bicarbonate and carbonate, as well as the vegetable potash salts, are eliminated as carbonates, and in this way they stimulate the secretion of urine, and are therefore **diuretics.** They also **alkalise** the urine and thereby increase its capacity of holding more **uric acid in solution.** Passing over the mucous membrane of the genito-urinary tract, they either exercise a direct sedative action on it, or by rendering the urine alkaline soothe any irritation that may be present.

Therapeutics of Bicarbonates and Carbonates of Potassium and Sodium

Externally.—These salts can be given in the same class of cases where liquor potassæ is used. A solution of the bicarbonate (1 dr. to 1 pint) allays the troublesome **itching** of many skin diseases, such as **urticaria, lichen,** etc., and as an injection, arrests the discharge in **leucorrhœa.** A weaker solution (½ dr. or less, in 1 pint) checks the weeping of raw, red **eczema.** For this purpose a piece of lint soaked in the lotion is applied to the raw surface and then covered with oiled silk to check evaporation.

Internally.—The bicarbonates are always used in preference to the carbonates, and sodium salts in preference to those of potassium.

While alkalies are either indifferent or disturbing to normal digestion, they are of great value in digestive troubles. In **dyspepsia,** where the gastric secretion has become

thin and watery, the bicarbonate can be given a few minutes before food ; and where there is epigastric pain, heartburn or acid eructations, it is best administered after food. In **gastric irritability,** or to render the **blood and urine alkaline,** it is best given in effervescing form (30 grs. in 1 pint). In case of **chronic gastritis,** such as the alcoholic form, lavage of the stomach with alkalies is of value to clear the stomach of its mucus and prepare it to receive food. For this purpose the bicarbonate of soda is commonly used (1 dr. to 1 pint of hot water). Given about twenty minutes before food with aromatics, it tends to call forth the " appetite juice." In cases of **hyperchlorhydria** and **duodenal ulcer** it will relieve the pain if given two hours or more after the meals, and when there is much fermentation and formation of organic acids it is often useful given shortly after eating.

When a systemic action is required alkalies are best given on an empty stomach. In severe acidosis, such as may be in **delayed chloroform poisoning, cyclical vomiting of pregnancy** very large doses are given by the mouth, by the continuous rectal drop method, or intravenously, of course remembering that sodium salts are preferable to the corresponding potassium salts. As much as 2 to 3 pints of a 3 p.c. solution being used in **diabetic coma.** The daily dose should be 1 to 1½ oz. freely diluted, and should be continued until the pH of the plasma is normal. Apart from the use of alkalies in acidosis they are useful in **diabetes** where they promote the combustion of sugar. Formerly the alkalies were largely used in rheumatism, but it is doubtful if they have any marked value in this disease. Similarly patients suffering from gout were treated by alkaline mineral waters with supposed benefit. According to Von Noorden alkalies are not only useless in this disease but perhaps harmful. As an **antidote** to poisoning by caustic acids, the carbonate or bicarbonate is to be avoided, for it creates carbonic acid gas and so causes risk of rupture of the stomach. Liquor potassæ and other alkaline salts can be used instead. The bicarbonate is used with other expectorants in **bronchitis** and **bronchial catarrh** to lessen the viscidity of expectoration.

These alkalies are largely used to render the urine alkaline in cases of **excessive acidity of the urine,** where there is pain and straining during urination. As they hold more uric acid in solution they are largely used in **uric acid diathesis.** One should not forget that alkaline urine is again very liable to cause deposits of phosphates in the bladder and thus tends to increase the calculas.

Prescribing hints.—Always prescribe the carbonate of bismuth with bicarbonate of soda and not the subnitrate, which will liberate carbonic acid gas in a mixture. The bicarbonate should be used in preference to the carbonate, and the salts of sodium in preference to potassium. Bicarbonate of soda administered with inorganic salicylates tends to prevent precipitation of the irritating acid.

POTASSII CHLORAS

Potassium Chlorate. $KClO_3$

Source.—Obtained by passing chlorine into water holding lime or magnesia in suspension, treating the clarified liquid with potassium chloride and subsequently crystallising.

Characters.—Colourless, monoclinic crystals. Cool saline taste. *Solubility.*—1 in 16 of cold, 1 in 3 of boiling water.

Incompatibles.—Explodes when rubbed with sulphur, sulphides, charcoal, sugar, tannic acid, ammonium chloride, orglycerin. Mineral acids, ferrous salts.

B.P. Dose.—5 to 15 grs. or 3 to 10 dgrms. ; U.S.P.—0.25 grm. or 4 grs.

Enters into.—The preparation of Pot. Permanganas and the

Official Preparation

1. **Trichiscus Potassii Chloratis.**—3 grs. (0.2 grm.) in each. *Dose.*—1 to 6.

Non-official Preparation

1. **Gargarisma Chlori, B.P.C.** *Syn.—Chlorine Gargle.*—Pot. Chloras 2.25, Acid Hydrochlor. 0.5, Distilled Water to 100. Generate chlorine gas by mixing chlorate and acid, and dissolve it gradually in water.

Pharmacology

The actions of potassium chlorate are not identical with those of the other potassium salts.

Externally.—Coming in contact with a septic surface, or discharge, it is decomposed, and oxygen is liberated. This nascent oxygen then acts as a **stimulant** and **antiseptic to septic tissues,** but it is not an antiseptic in the ordinary sense of the term, as outside the body in has very little effect, even upon the most sensitive bacteria.

Internally. **Gastro-intestinal tract.**—In small doses, potassium chlorate has no action, but in concentrated solution it may through its local salt action cause severe nausea and vomiting, and after absorption considerable diuresis may arise from a similar action on the kidney. About 90 to 95 p.c. of the salt being recovered in the urine.

Heart and circulation.—It has a specific action on the blood, and after a moderately large dose it disintegrates the red blood-corpuscles and converts hæmoglobin into methæmoglobin, which is set free in the serum. This effect is also observed when chlorate is added to a little drawn blood and shaken up, the mixture soon becoming reddish brown (chocolate colour) and shows the spectrum of methæmoglobin and later of hæmatin. If the blood of a patient poisoned by potassium chlorate be shaken up with air or oxygen it does not

regain its arterial colour (distinction from ordinary cyanosis). These changes in the blood are accelerated by—

(1) Addition of large quantity of sodium carbonate.
(2) Warmth.
(3) Carbonic acid and the acid phosphates.
(4) Diminished alkalinity of the blood.

These facts should be carefully remembered as they have an important bearing on the question of the treatment of disease by means of the large doses of the drug.

Kidneys.—In moderate doses (15 to 20 grs.) it acts as a diuretic and more powerfully during pregnancy. In toxic doses, the kidneys become congested, the urine becomes bloody or dark-coloured, and at last there is complete suppression. Death occurs usually from uræmia.

Secretions.—It influences peculiarly the salivary, buccal and mammary secretions, which increase if deficient and decrease if excessive. The bronchial secretion is also increased.

Toxic action.—It may give rise to dangerous symptoms in individuals after a single large dose, or from repeated small doses. 15 grs. caused death in a child, while an ounce has been taken without any bad effect. The toxic symptoms are vomiting, diarrhœa, scanty urine or complete anuria, urine becoming a deep reddish brown colour due to the presence of hæmoglobin, methæmoglobin and hæmatin in solution. Icterus may appear, and the patient may die from uræmic symptoms even as late as a week after the first symptoms have occured were noticed. All these symptoms are dependent on the action of the chlorate on the hæmoglobin of the red blood-cells. It has been thought that this action on the blood is due to the oxidising properties of the chlorate. Death may result from two causes :

1. From *asphyxia*, by a rapid breaking down of the red blood-cells and resulting inability of the blood to carry a sufficiency of oxygen.

2. From *uræmia*, owing to complete or partial suppression of urine following on obstruction of the renal tubules, by hæmoglobin and fragments of corpuscles.

As it formerly happened that, in many cases of poisoning from potassium chlorate, the symptoms were erroneously attributed to diphtheria, so on the other hand, in fatal cases of diphtheria which have been treated by the chlorate, the symptoms may very easily be mistaken for those of poisoning from the chlorate. When such cases form the subject of legal enquiry, great care and caution are necessary in forming an opinion upon them.

THERAPEUTICS

Internally.—Its chief local use is in the treatment of many mouth and throat diseases, such as **aphthous, ulcerative and gangrenous stomatitis, follicular tonsillitis, and follicular pharyngitis.** A lotion (10-15 grs. to 1 oz. of water, or any astringent infusion) is an excellent gargle for such cases.

Tablets or lozenges, of which many kinds combined with borax and cocaine are on the market, may be slowly sucked. The powdered salt locally applied to **spongy gums,** and **aphthous spots** on the gums, cheek and tongue, conduces to their rapid healing.

These catarrhal conditions of the mucous membrane of the mouth and fauces are greatly benefited if the local treatment is accompanied by internal administration, for the salt is excreted with the saliva after absorption, and thus locally influences the disease. Its efficacy is greatly increased if it is combined with borax, or in case of **hoarseness of voice,** with borax and cocaine. The late author considered this drug to be a valuable diuretic in the **suppression of urine in cholera.**

Prescribing hints.—Potassium chlorate being a strong oxidising agent when prescribed with syrup ferri iodide liberates iodine and forms a precipitate of hydroxide of iron. With iodide of potassium it forms a poisonous compound. In order to avoid misadventure, the following points must be carefully borne in mind :—(1) Pot. chloras must be *given cautiously* when the *temperature is high,* or when the *breathing or circulation is embarrassed,* for in fever the alkalinity of the blood is lessened, and if there is dyspnœa, the tension of the carbonic acid in the blood is raised. (2) *Never give a large dose on an empty stomach,* as it will then be absorbed too rapidly. (3) *Withhold it altogether in disease of the kidney,* as owing to the diminished excretion of urine, it may readily accumulate to an undesirable extent. (4) *When the patient is unable to take food,* the use of the remedy should be limited to painting the fauces with a solution which should not be stronger than 5 p.c. (5) When giving the drug in larger doses avoid the *simultaneous use both of free acids and mineral waters rich in carbonic acid.* (6) The *total amount given in* 24 *hours* should not exceed :—

(*a*)	For an infant ..	.. 20 grs.
(*b*)	For a child ..	.. 30 grs.
(*c*)	For an adult ..	.. 90 grs.

POTASSII NITRAS

Potassium Nitrate. KNO_3

Syn.—Purified Nitre, Saltpetre. **Syn. I.V.**—*Sora,* Beng. *Shora,* Hind.

Source.—May be obtained by the interaction of sodium nitrate and potassium chloride. The crude nitre is chiefly found in the surface soil of India.

Characters.—White crystalline or striated, six-sided, colourless prisms. Taste cool, saline. *Solubility.*—1 in 4 of cold, 2 in 1 of boiling water. *Impurities.*—Chlorides, sulphates, lime.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—0.5 grm. or 8 grs.

Enters into.—The preparation of Argenti Nitras Induratus and Argenti Nitras Mitigatus.

Non-official Preparations

1. **Charta Nitrata, B.P.C.** *Syn.—Saltpetre Paper.*—Are made by saturating white blotting paper in a 20 p.c. solution of nitre. The fumes are inhaled in *asthma*. **Ozone Papers** are similar in composition.

2. **Pulv. Lobeliæ Comp. B.P.C.** *Syn.—Asthma Powder.*—Potassium Nitrate 25, Boiling Distilled Water 25, dissolve and soak a mixture of Lobelia, and Stramonium leaves each 25, add Black Tea to produce 100. Mix well, dry, and add oil of anise 0.1. One teaspoonful may be burnt to fumigate a bedroom, or the fumes inhaled in *asthma*. This is a supposed imitation of **Himrod's, Bliss's, and the Green Mountain Cures.**

Pharmacology

Externally.—Potassium nitrate is slowly absorbed by the unbroken skin, and produces a local **refrigerant** action, by reducing the circulation of the part.

Internally. **Gastro-intestinal tract.**—It has a cool saline taste, and in ordinary doses the only effect produced is diuresis, but large doses taken in concentrated solution may give rise to **gastro-enteritis,** with the presence of blood in the vomit and stool, muscular weakness, collapse, even coma and death. The same large doses if taken freely diluted cause none of these symptoms. The nitrates differ from other salts by possessing some further irritant action, and this irritant effect has been thought to be due to a reduction of the nitrate in the intestine and tissues to the poisonous nitrite. This explanation is however open to doubt. In large doses most of it is excreted as nitrate in the urine and some passes out with the saliva and sweat.

Heart and blood.—Of all the potash salts, it is the most **powerful depressant** to the heart, rendering its action slower and weaker. It destroys the normal oxygenating powers of the red blood-corpuscles, and in large doses lowers the **coagulability** of the blood. The depression of the heart is due to (1) reflex irritation starting from the viscera, (2) to admission of an abnormal amount of potassium into the blood through the relaxed vessels, (3) possibly a partial reduction of the nitrate to the *poisonous nitrite.*

Skin and kidneys.—It is slightly **diaphoretic,** but has a distinct **diuretic** action. This being attributed partly to **salt action** and partly to direct stimulation of the kidney. Practically the entire quantity is excreted unchanged, a small portion may be reduced to nitrites.

Therapeutics

Internally.—Nowadays its use is almost discarded. The tablets can be slowly sucked in **relaxed sore throat.** Formerly it was employed in almost every **febrile and inflammatory** disease, but now only on rare occasions. It is no longer used

in **rheumatism,** but it is a capital remedy for arresting the onset of a **gouty attack,** or for removing the headache due to a debauch. 20 grs. of nitrate with 30 grs. of potassium bicarbonate in a tumbler of soda water is the best method of administration in such cases. As a diuretic it is chiefly used in conjunction with other diuretics, but the acetates and citrates are always preferred. As an inhalation it cuts short an **asthmatic fit** and hence it is the basis of many nostrums, such as Himrod's Cure, Green Mountain, etc. Charta nitrata or charata nitrata et chlorata can be burnt, and the fumes inhaled. As a diuretic, preference is given to potassium acetate and citrate.

Caution.—Its use is to be avoided in inflammation of the stomach, intestines, bladder and kidneys, and cardiac weakness.

POTASSII SULPHAS

Potassium Sulphate. K_2SO_4

Source.—May be obtained by purifying the crude salt, or by the interaction of sulphuric acid and potassium chloride or some other potassium salts. Contains not less than 99 p.c. of pure potassium sulphate.

Characters.—Colourless, hard rhombic prisms terminated by 6-sided pyramids. *Solubility.*—I in 10 of cold and 1 in 4 of boiling water. *Impurities.*—Chlorides, nitrates, and other metals.

B.P. Dose.—15 to 45 grs. or **1 to 3 grms.**

Enters into.—Pil. Colocynth. Co., Pulv. Ipecac. Co., and their preparations :—Pil. Colocynth. et Hyos., Pil. Ipecac. c. Scilla and Pil. Ipecac. c. Urginea.

Pharmacology and Therapeutics

Internally.—It is a mild **saline purgative,** acting by stimulating the glandular secretion of the intestine, and is a **hepatic** stimulant. In pharmacy, it is chiefly used to help pulverisation of tough substances, as ipecacuanha root. Therapeutically it is rarely used.

POTASSA SULPHURATA. *See* **Sulphur**

POTASSII BICHROMAS. *See* **Acidum Chromicum**

POTASSII BROMIDUM. *See* **Bromum**

POTASSII IODIDUM. *See* **Iodum**

POTASSII PERMANGANAS. *See* **Manganese**

SODIUM. Sodium. Na. (*Non-official*)

Source.—The metal sodium as met with in commerce. It decomposes water and must therefore be kept under naphtha in stoppered bottles.

Characters —Well known.

SODII ET POTASSII TARTRAS

Sodium Potassium Tartrate. $KNaC_4H_4O_6$, $4H_2O$

Syn.—Soda Tartarata, B.P. 1898.

Syn. Commercial.—Rochelle Salt, Seignette's Salt.

Source.—Neutralise acid potassium tartrate with sodium carbonate, and allow to crystallise out. Contains not less than 98 p.c. pure sodium potassium tartrate.

Characters.—Trimetric prisms with hemihedral facets. Taste saline, cooling. *Solubility.*—1 in 1.5 of cold water. *Impurity.*—Acid potassium tartrate.

B.P. Dose.—120 to 240 grs. or 8 to 16 grms. ; U.S.P.—10 grm. or 2½ drs.

Official Preparation

1. Pulvis Sodæ Tartaratæ Effervescens. *Syn.—Seidlitz Powder.*—Dissolve the contents of the blue paper in half a pint of water, add contents of white paper, and drink during effervescence.

SODII CITRO-TARTRAS EFFERVESCENS

Effervescent Sodium Citro-Tartrate

Source.—Sugar 15 gms., Sodium Bicarbonate 51 gms., Citric Acid 18 gms., Tartaric Acid 27 gms. Heat till the mixture assumes a granular form.

B.P. Dose.—60 to 120 grs. or 4 to 8 grms.

SODII SULPHAS

Sodium Sulphate. Na_2SO_4, $10H_2O$

Syn. B.P.—Glauber's Salt.

Source.—Obtained by the interaction of sulphuric acid with sodium chloride.

Characters.—In transparent monoclinic efflorescent prisms. Neutral. Taste bitter, saline. *Solubility.*—1 in 3 of cold water. *Impurities.*—Iron and Ammonia salts.

B.P. Dose.—30 to 120 grs. or 2 to 8 grms., for repeated administration ; or one dose of 150 to 240 grs. or 10 to 16 grms. ; U.S.P.—15 grm. or 4 drs.

Official Preparation

1. Sodii Sulphas Effervescens. B.P. Dose.—60 to 120 grs. or 4 to 8 gms. ; or one dose of 150 to 240 grs. or 10 to 16 grms.

Non-official Preparations

1. Sodii Sulphas Acidus. *Syn.—Sodium Bisulphate.*—To purify water which has been contaminated by typhoid stools. Fifteen grains to a pint of water will destroy *Bacillus typhosus* in 15 minutes.

2. Sodii Magnesii Sulphas Effervescens.—Introduced by Martindale as a substitute for *Hunyadi Janos* and *Pullna waters. Dose.*—A teaspoonful, or more, taken in half a tumbler of water half an hour before breakfast.

3. **Sal Carolinum Factitium B.P.C.**—*Artificial Carlsbad Salt.*—Dried Sodium Sulphate 44, Potassium Sulphate 2, Sodium Chloride 18, Sodium Bicarbonate 36. *Dose.*—20 to 60 grs. in warm water. 53 grs. to 1 pint of water resembles *Carlsbad Water.*

Pharmacology of Sodium Sulphate, Citro-tartrate and Tartarated Soda

Internally. **Intestines.**—The anions, phosphates, sulphates, citrates and tartrates are absorbed much more slowly, and consequently they pass on into the intestines, unabsorbed where they act as **saline purgatives,** causing soft painless motions, two or three hours after administration. Sodium sulphate is the most active of the three ; it is also a **cholagogue.** (For action of Saline Purgatives *See* page 203).

Blood and kidneys.—They render the **blood** and **urine more alkaline,** but in this respect act more feebly than potassium salts. Sodium sulphate has undoubtedly **some effect on metabolism,** and experiments on rabbits have shown that it causes an increase of 10 to 15 p.c. in the consumption of oxygen for several hours. Injected into the blood, these salts have no purgative effect.

Therapeutics

Internally. **Intestines.**—These salts are extremely valuable in the treatment of **chronic constipation,** especially when associated with **gout, congestion of the liver** or **uric-acid diathesis.** They should always be taken freely diluted in warm water, first thing on rising in the morning when the stomach is empty, and should be slowly sipped. As sodium sulphate is a cholagogue, it should be selected whenever there is **disease of the liver,** or in cases of **gall-stones.** It has almost a specific action in the treatment of **bacillary dysentery** and is less irritating to the alimentary canal than magnesium sulphate, which is also of great value in this disease. It is the active principle of *Carlsbad, Marienbad, Tarasp,* and *Condal* waters ; and it occurs in **combination with magnesium sulphate** in *Aesculap, Hunyadi Janos, Pullna, Apenta,* and *Kissingen waters. Friedrichshall water* contains **sodium chloride,** in addition to the above mentioned. **In large doses,** these salts produce **copious watery stools,** and are used to **remove dropsical accumulations,** especially when due to **cirrhosis of the liver.**

SODII CHLORIDUM

Sodium Chloride. NaCl

Syn.—Common salt.

Source.—May be obtained by purifying Common Salt.

Characters.—Small, white, crystalline grains, or transparent, cubic crystals, free from moisture. Taste saline. *Solubility.*—1 in 3 of cold water.

Dose. U. S. P.—15 grm. or 4 dr.

Non-official Preparation

1. **Liquor Sodii Chloridi Physiologicus, U. S. P.** *Syn.—Normal Salt Solution.*—Sodium chloride, 8.5 gm., water q.s. to 1000 mils.

Pharmacology

Sodium chloride is an essential constituent of the body and perhaps the chief mineral constituent of the blood serum. It is therefore essential that the necessary supply of this substance should be introduced either with the food itself or as an addition to the food. As it is always present in the body in large quantities and exerts no specific action, it presents a perfect example of **salt action,** which action varies in proportion to the concentration of salt in solution.

This salt action only affects living tissues by changing the physical properties of the fluids contained in them or surrounding them. In the body the epithelial cells of mucous membranes, the endothelial cells of vessels, and the cells of the renal glomeruli act as semipermeable membrane, *i.e.*, a membrane through which the solvent can pass, but none or very little of the dissolved substance. If two equimolecular solutions are separated by such a semipermeable membrane, the osmotic pressure is equal on the two sides, and the solutions are then said to be isotonic, and no exchange of constituents occur between the two fluids. Pharmacologically the term *isotonic* means a solution having the same osmotic tension as that of the blood. If however a given volume of one of these fluids has a higher molecular concentration than the other, it is said to be *hypertonic* (or hyperisotonic), and an interchange between the two fluids takes place, water being attracted from the hypotonic to the hypertonic solution, and to a smaller extent the substances held in solution pass from the hyper to the hypotonic solution. Thus shortly rendering the two fluids once more isotonic.

In the human body with its already noted semipermeable membrane the process of osmosis is continually going on whenever fluids of varying tonicity meet. As an example, red blood-cells shrink in size when they are placed in a solution of salt stronger than blood plasma (hypertonic); because the water is withdrawn from them. In hypotonic solution they swell up as they absorb water, while in isotonic solution they remain unaltered in size.

As these osmotic exchanges are continually going on in the human body its importance in the preservation of the balance of the constitution of the body fluids can hardly be exaggerated, and as has been pointed out it is an entirely physical process which goes on passively without the expenditure of vital activity which entails a drain of the energy of the organism. Thus the process of osmosis may be said to be a great conservator of energy of respiratory interchange and metabolism.

Salt has a characteristic taste and strong solutions are **astringents.** It has very little effect on the digestion, and the

absorption of food is very little altered when salt is added to food. It is possible, however, that a small quantity of salt in the food may render it more palatable and thus induce a **reflex flow of the gastric juice.**

Blood.—The changes on the blood after an intravenous injection depends upon the nature of the solution used, whether *isotonic*, *hypertonic*, or *hypotonic*. When a hypertonic solution is used, by osmotic attraction it draws more lymph into the blood to regain its normal composition, this increased volume of the blood in its turn tends to augment the flow of lymph, urine and sweat ; and since the normal balance of plasma and corpuscles must be restored it sets up currents between the blood and the fluid of the surrounding lymph. All these changes are accompanied by a large rise of capillary pressure in the abdominal viscera, and it is possible that the inward flow of lymph is the outcome of this pressure.

As a result of these changes in the blood and lymph there is an increased activity of the excretory organs. Thus there is a copious **diuresis** following an injection of salt solution. It is generally believed that the increased diuresis is due to the pressure of salt in excess in the blood, but the more plausible explanation is that the increased volume of blood and lymph causes an inward capillary pressure in the glomeruli which promote the escape of fluid into the capsule.

Elimination.—Excreted chiefly by the urine as potassium chloride. A small portion being lost by the fæces and sweat. Its excretion is diminished in some cases of nephritis, in pneumonia and during growths of new tissues (cancer).

THERAPEUTICS

Externally.—Cold douching with salt and water is a very valuable remedy in all forms of **muscular weakness,** especially in the *weak back* of growing girls, and in **lateral curvature of the spine.**

Sea-bathing is a **mild general stimulant.** If the patient is unable to proceed to the sea side, *Tidman's sea salt* or, in India, ordinary rock salt, is an efficient substitute. One pound of salt to three gallons of water is the proper proportion. At Droitwich and Nantwich concentrated hot salt baths are largely used for **chronic rheumatism, sciatica,** and **joint diseases,** in which conditions they give great relief. Injections of sea water subcutaneously into the buttocks have been recommended by French physicians, for the treatment of **dyspepsia, wasting, chronic skin affections** in adults, and for **gastritis** and **entero-colitis** in infants.

Eighty grains (0.9 p.c.) of common salt in one pint of water constitutes **normal saline solution,** and is isotonic with the blood, which may be injected either into the veins, the rectum,

or the loose connective tissue under the axilla or breast, in various conditions of collapse and unconsciousness. By this method of treatment many lives have been saved in **uræmia, eclampsia,** and in the **shock following severe operations** and **post-partum hæmorrhage.**

Common salt, either as a saline infusion, subcutaneously, or as enema, is largely used as a therapeutic remedy in (1) **shock** or **collapse** from any cause, such as severe **hæmorrhage** or **cholera,** (2) certain **toxæmic conditions,** *e.g.* **uræmia,** or **strychnine poisoning,** (3) **carbon monoxide poisoning,** and (4) in profound **malnutrition and prostration.** It is most commonly given intravenously, the usual quantity introduced being 500 to 1500 c.c. (1 to 3 pts.). The most commonly employed solutions are—normal saline containing a full tea spoonful of salt to 1 pt. of *ordinary water,* as this usually contains some calcium. If made up with distilled water and given intravenously pure sodium chloride may have a poisonous effect. The addition of 0.5 p.c. of sodium bicarbonate to the physiological saline solution approaches more closely the normal reaction of the blood, counteracts acidosis and ensures more lasting restoration of blood-pressure. Other solutions used are Ringer's solution which contains in addition to the sodium salt, chlorides of potassium and calcium. Ringer's solution contains NaCl 8.5 grm., KCl 0.3 grm., $NaHCO_3$ 0.2 grm.. and $CaCl_2$ 0.2 grm., distilled water 1 litre. Locke's solution contains NaCl 0.9 grm., KCl 0.042 grm., $CaCl_2$ 0.024 grm., $NaHCO_3$ 0.05 grm., dextrose 0.1 grm. distilled water to 100 c.c.

The effects of these saline infusions vary according to whether the volume of the blood have been previously decreased or not. If there has been no previous diminution in the volume of the blood, a saline infusion has no effect in raising arterial pressure and may lead to anasarca. On the other hand if the volume of blood has been diminished by hæmorrhage, a saline infusion will not only increase the volume of the blood and so maintain arterial pressure, but by shortening the coagulation time it will favour cessation of hæmorrhage. It is very largely used, and with very good results, in the modern treatment of cholera in which as much as three pints of hypertonic solutions are used. The usual formula for hypertonic solution consists of sodium chloride 120 grs., pot. chloride 6 grs., calcium chloride 4 grs. to 1 pt. of water. To this is sometimes added sod. bicarb. 40 grs. and glucose 14 grs. In toxæmic condition infusions are given with a view to promote renal activity and elimination of poison. In cases of severe shock or collapse a small infusion containing adrenalin helps to promote the maintenance of blood-pressure. Saline infusions, used either as an enema or subcutaneously, have often a very desirable effect in collapse and in promoting renal activity. But they should not be given in any form of œdema especially that of the lungs. Concentrated solutions of salines should never be used either as infusion or per rectum.

Jenning's formula for normal saline solution is rather more elaborate ; as follows :—Sodium chloride 50 grs., potassium chloride 3 grs., sodium sulphate 2½ grs., sodium phosphate 2 grs. Dissolve in 1 pint of water, and add alcohol (90 p.c.) 2 drs.

Sodium chloride also is an important constituent in the following artificial serums :—

1. *Trunecek's Inorganic Serum.*—Sodium sulphate 44, sodium chloride 492, sodium phosphate 15, sodium carbonate 21, potassium sulphate 40, water to 10,000. This is used for nervous ailments and in cases of high arterial tension. It is administered subcutaneously in doses of 1 c.c., gradually increasing by 0.2 c.c.

2. *De Renzi's Iodised Serum.*—Sodium chloride 6, iodine 1, potassium iodide 3, sterile water 1000. It is used in surgical tuberculosis, and the dose is from 100 to 300 c.c. per diem.

Internally.—Cold salt and water is an excellent **gargle** for **chronic relaxed throat,** and also a very effective nasal douche. It is a prompt and efficient **emetic,** and it may be injected into the rectum for the cure of **thread-worms.** It is an antidote in **poisoning by silver nitrate,** which it converts into the insoluble chloride. It is also useful in cases where a **leech has been swallowed or has got up the nose.**

LIQUOR SODII ETHYLATIS, B.P. 1898. (*Non-official*)

Solution of Sodium Ethylate. C_2H_5ONa

Source.—By dissolving 1 of sodium in absolute alcohol 20. Contains 18 p.c. of sodium ethylate. Sp. gr. 0.867.

Characters.—A syrupy liquid, colourless when fresh, turning brown on keeping.

Pharmacology and Therapeutics

It is used as a **depilatory,** and to **destroy warts, moles,** and **nævi.** Apply lightly with a pointed glass rod for 2 or 3 successive days till a scab forms. When this falls off, repeat the treatment, if necessary. If pain results, allow a drop of chloroform to fall upon the spot ; this converts the sodium ethylate into ether and sodium chloride, and stops all caustic action. It has been superseded by carbon dioxide snow, Rontgen rays and Finsen light.

SODII PHOSPHAS

Sodium Phosphate. Na_2HPO_4, $12H_2O$

Syn. B.P.—Di-Sodium hydrogen phosphate. *Tasteless Purging Salt.*

Source.—Prepared by the interaction of sodium carbonate and the solution of acid calcium phosphate produced on mixing bone-ash with sulphuric acid.

Characters.—Transparent, colourless, efflorescent, rhombic prisms. *Solubility.*—1 in 7 of cold water. *Impurities.*—Calcium phosphate.

B.P. Dose.—30 to 120 grs. or 2 to 8 grms. ; for repeated administration , or one dose of **150 to 240 grs.** or **10 to 16 grms. ; U.S.P.—4 grm. or 1 dr.**

Official Preparation

1. **Sodii Phosphas Effervescens.**—Prepared as the other effervescing preparations. **B.P. Dose.—60 to 120 grs.** or **4 to 8 grms. ;** or one dose of **150 to 240 grs.** or **10 to 16 grms.** in 3 to 6 ozs. of water ; **U.S.P.—10 grm. or 2½ drs.**

SODII PHOSPHAS ACIDUS

Acid Sodium Phosphate. NaH_2PO_4

Syn. B.P.—Sodium Di-hydrogen phosphate.

Source.—Obtained by the combinaton of di-sodium hydrogen phosphate with phosphoric acid. Contains not less than 70 p.c. pure sodium dihydrogen phosphate.

Characters.—Transparent, colourless, rhombic crystals, or in crystalline powder. Taste saline, acid. Readily soluble in water.

B.P. Dose.—30 to 60 grs. or 2 to 4 grms.

Pharmacology

Internally. **Gastro-intestinal tract.**—The phosphate in small doses is **antacid,** and in larger doses a **mild aperient** and **cholagogue.** It is a **powerful hepatic stimulant** to the dog.

Blood.—It is a constituent of normal human blood, and therein can combine with or give off carbonic acid, becoming converted into monosodic phosphate and vice versa, thus :—

$$Na_2HPO_4 + CO_2 + H_2O = NaH_2PO_4 + NaHCO_3$$

Kidneys.—It increases the excretion of uric acid, and is a **diuretic.**

Therapeutics

Sodium phosphate is practically tasteless ; it is therefore very suitable as a **mild aperient** for a **delicate stomach,** and for **administration to children.** Useful in **bilious sick-headache** and **jaundice.** It has been recommended for **hepatic calculi,** in doses of 60 grs. three times a day, and if gastro-intestinal catarrh be present, small doses of sodium arsenate (one twentieth of a grain) may be added.

Acid sodium phosphate, being the natural acid of the urine, is largely used to render alkaline urine acid. It is generally used in doses of 30 grs. It is successfully used in the treatment of **oxaluria** and in **cystitis,** particularly when due to coli infection, when it is combined with hexamine. Its laxative action is lessened by being administered directly after meals.

SODII SULPHIS

Sodium Sulphite. $Na_2SO_3,7H_2O$

Source.—Prepared by the interaction of sulphurous acid and sodium carbonate. Contains not less than 94 p.c. of pure sodium sulphite.

Characters.—Colourless, transparent, monoclinic prisms. Taste saline.

Solubility.—1 in 2 of water.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms.

Pharmacology and Therapeutics

Externally.—The solution (1 in 8) has been used in the treatment of various **parasitic skin diseases.**

Internally.—It is decomposed in the stomach, giving off sulphurous anhydride, and is therefore used in fermentative diseases of that organ characterised by the presence of **sarcinæ** and **torulæ.**

It is a **very feeble antiseptic,** and is not of much value in medicine.

SODII CINNAMAS

Sodium Cinnamate (*Non-official*)

Syn.—Hetol.

Characters.—Transparent micaceous crystals. *Solubility.*—1 in 11 of distilled water or normal saline solution.

Dose.—3 to 5 grs. or 2 to 3 dgrms. by the mouth, or hypodermically.

Action and Uses

This drug was brought forward with the idea of increasing leucocytosis in the treatment of **leishmaniasis** and **tuberculosis,** but it has been found to be ineffective and has been replaced by more modern methods of treatment.

SODII CITRAS, U.S.P.

(*Non-official*)

Characters.—Small granular crystals, resembling common salt.

Dose. U.S.P.—1 grm. or 15 grs.

Pharmacology and Therapeutics

It is a refrigerant and diuretic and may be given in preference to potassium citrate. It is largely used as an addition to milk in the proportion of 2 to 5 grs. to the ounce, when it renders the caseous clots more flocculent and thereby easy of digestion. This action is due to the fact that citric acid prevents in a large measure the ionic action of calcium and the curd consisting of sodium caseinate is much softer than calcium combination. Hence it is extremely valuable in the curd indigestion and diarrhœa of infants. Unlike barley water it does not cause flatulence, but it has been said

(without proof) that constipation may result from its use. Given in too large doses œdema may be caused which quickly disappears on withholding the drug. Wright has recommended a saturated solution of sod. citras grs. 2, and sod. chloride grs. 20 as a local application for **furunculosis.**

SODII HIPPURAS. B.P.C. (*Non-official*)

A white, amorphous powder, readily soluble in water.

Recommended in **gout, gravel,** and **calculus,** as a solvent of urates. If the urine of the patient be abnormally acid, add an alkaline citrate.

Dose.—5 to 30 grs. or 3 to 20 dgrms.

SODII PHENOLSULPHONAS, U.S.P. (*Non-official*)

Syn.—Sodium Sulphocarbolate.

Source.—Obtained by dissolving phenol in excess of sulphuric acid, and converting phenol-sulphonic acid into a sodium salt.

Characters.—Colourless, transparent, rhombic prisms with a saline bitter taste. *Solubility.*—1 in 6 of water, 1 in 150 of alcohol (90 p.c.).

Dose. U.S.P.—0.25 grm. or 4 grs.

Actions and Uses

Antiseptic and *antipyretic.* In **diphtheria, cholera, septic fevers, tympanites,** etc. It is used in preference to carbolic acid. Twenty grains doses, alternately with 1 gr. of quinine, every 2 hours, have been found of value in **chorea.**

SODII BICARBONAS. *See* page 168
SODII CARBONAS. *See* page 168
SODII CARBONAS EXSICCATUS. *See* page 169
SODÆ CHLORINATÆ LIQUOR. *See* **Chlorum**
SODII ARSENAS ANHYDROSUS. *See* **Arsenic**
SODII BENZOAS. *See* **Benzoin**
SODII BROMIDUM. *See* **Bromum**
SODII HYPOPHOSPHIS. *See* **Phosphorus**
SODII IODIDUM. *See* **Iodum**
SODII NITRIS. *See* **Vasodilators**
SODII SALICYLAS. *See* **Salicylic Acid**

AMMONIUM. Ammonia. (*Non-official*)

Source.—Ammonia is chiefly obtained from the liquor of the gasworks and from iron-smelting furnaces and paraffin shale, and purified.

Ammonia preparations may be grouped into two classes, (*a*) those that liberate irritating ammonia from their compounds, and whose action therefore depends upon free ammonia, (*b*) those forming salts homologous with alkali metals, potassium, sodium, lithium, and which act as salts in the body.

1. Preparations whose actions depend upon free ammonia

LIQUOR AMMONIÆ FORTIS

Strong solution of Ammonia. NH_3

Source.—An aqueous solution obtained by heating a mixture of ammonium chloride and slaked lime and passing the gas (ammonia) into distilled water. Contains 32½ p.c. of NH_3 by weight.

Characters.—A colourless, alkaline liquid; odour characteristic, very pungent. Sp. gr. 0.888. *Impurities.*—Chloride, sulphide, and sulphate of ammonia.

Enters into.—Tr. Guaiac. Ammon., and in the preparation of Ammon. Benz., Ammon. Brom., Ammon. Phosph., and the

Official Preparations

1. **Liquor Ammoniæ.** *Syn.*—*Ammonia Water.*—10 p.c. by weight. *Dose. U.S.P.*—1 mil. or 15 ms. *Enters into.*—Tr. Ergot. Ammon., Tr. Opii Ammon., Tr. Quin. Ammon., Tr. Valer. Ammon., Tr. Valer. Ind. Ammon. and

(*a*) **Linimentum Ammoniæ.** *Syn.*—*Hartshorn Liniment.*—1 in 4. Ammonia soap is formed by the mixture.

2. **Linimentum Camphoræ Ammoniatum.**—1 in 8.

3. **Spiritus Ammoniæ Aromaticus.**—*See* Ammonium Carbonate.

4. **Spiritus Ammoniæ Fetidus.**—Contains 7½ p.c. asafetida. **B.P. Dose.—20 to 30 ms. or 12 to 25 decimils** or repeated use; and **60 to 90 ms. or 4 to 6 mils** for a single dose.

Pharmacology

Externally.—A solution of ammonia when rubbed in or applied to the skin stimulates the peripheral nerves and superficial blood-vessels, producing a sensation of heat and redness. If it is concentrated and evaporation prevented, it blisters. Ammonia is therefore a **rubefacient** and **vesicant.**

Nose and air-passages.—The vapour of ammonia powerfully **irritates** the mucous membrane of the nose and air-passages causing sneezing. It also irritates the conjunctiva producing lachrymation. By exciting the nasal afferent nerves, it **reflexly stimulates circulation,** and accelerates pulse-beat. If the inhalation is prolonged or the vapour is too concentrated, inflammation of the nasal and air-passages results.

Internally.—On reaching the stomach, ammonia at once **reflexly stimulates the heart and circulation** by its action on the accelerator centre. Like other alkalies it neutralises the acidity of the gastric juice if given during digestion with the formation of ammonium chloride. It also increases peristalsis and causes a sense of warmth in the stomach. Therefore, it is an **antacid, gastric stimulant** and **carminative.** In large doses, it is a **gastro-intestinal irritant.**

Absorption.—Although ammonia is readily absorbed from the alimentary canal it does not produce any special physio-

logical effect administered through this channel. If not converted into a chloride by the acid in the stomach it appears in the portal blood as carbonate or carbamate, and carried to the liver where it is converted into urea. The liver is therefore an important factor in the disposal of ammonia, and if the organ is functionating properly, it can prevent the passage of ammonia to the systemic circulation.

Blood.—Ammonia slightly increases the alkalinity of the plasma. and is supposed to lessen the coagulability of the blood. Since ammonia is converted into urea in the blood its action differs from the fixed alkalies in not increasing the available alkalinity of the blood.

Heart and circulation.—The immediate result of the reflex effect upon the vagus vaso-constrictor and accelerator centres is a rise in the arterial pressure and stimulation of the heart. But owing to the rapid change of the drug in the system this is of momentary duration.

Lungs.—Respiration is increased by direct stimulation of the **respiratory centre** after absorption. The carbonate is largely used in cough mixtures as it is believed to render the mucus of respiratory tract more fluid except when it is changed to a chloride. As it is not excreted by the bronchial mucus or by the lungs its expectorant action is probably due to the fact that unchanged carbonate of ammonia acts as a nauseant to the stomach and thereby increases the bronchial secretion by reflexly exciting the vagus supplying the mucus glands.

Nervous system.—Ammonia is a **general stimulant,** and by its action on the medulla, it stimulates respiration, constricts the peripheral arterioles, and raises the blood-pressure. These effects are reflex from surface irritation, for they are almost instantaneous and manifest themselves before the drug can be absorbed. In toxic doses, it produces convulsions due to the stimulation of the motor cells in the cord.

Kidneys.—Ammonia and its salts are changed into urea in the liver. They differ from the fixed alkalies in not increasing the alkalinity of the blood and having no effect on the urine except to increase the urea and thus causing some **diuresis.**

Elimination.—Ammonia is thrown off with the breath, sweat, urine and bronchial secretion.

Toxic action.—If a large dose of a concentrated solution be swallowed, it may cause death within a few minutes from suffocation due to spasm of the glottis. Otherwise the symptoms are those of poisoning by a corrosive alkali.

Antidotes.—The same as those of the other alkalies.

THERAPEUTICS

Externally.—As a *local stimulant* to nerves and blood-vessels, the liniment of ammonia is rubbed into **stiff joints,** and in

various conditions of **chronic rheumatism** ; and as a *counter-irritant* on the chest in **bronchitis, pneumonia** and **pleurisy.** Ammonia may be used as a *vesicant* in cases where cantharidin is contra-indicated. A piece of lint cut slightly larger than the intended blister is moistened with the strong solution and applied, and immediately covered over with a watch-glass. Ammonia neutralises the poison of **nettles** and **insect-bites,** and thereby lessens the pain and swelling caused by them. A hypodermic injection of compound tincture of ammonia has been found efficacious **in the bites of less poisonous snakes.**

The vapour (smelling-salts) is used to rouse patients from **fainting, shock, syncope, stupor,** and **narcotic poisoning.**

Internally.—Like other alkalies, ammonia may be given in **acid dyspepsia.** Spirit of sal volatile is a useful remedy for **gastric and intestinal cramps** ; a few drops with soda and dill-water give relief to **flatulence in infants.** As a general diffusible stimulant, ammonia is extremely serviceable in **syncope, shock, fainting,** and in the low adynamic conditions of **febrile diseases, pneumonia, phthisis,** etc. It makes an excellent " pick-me-up." It softens the phlegm in bronchitis and catarrhal pneumonia, but the carbonate is better. Ammonia controls *iodism,* and is therefore combined with iodides when prescribed in large doses.

AMMONII CARBONAS

Ammonium Carbonate

Syn.—Ammonium Sesquicarbonate.

Source.—A variable mixture of ammonium hydrogen carbonate NH_4HCO_3 with ammonium carbamate $NH_4NH_2CO_2$, obtained by heating ammonium sulphate or chloride with calcium carbonate ; thus $2CaCO_3+4NH_4Cl=N_3H_{11}C_2O_5+2CaCl_2+H_2O+NH_3$.

Characters.—In volatile, translucent, crystalline masses ; odour ammoniacal ; reaction alkaline. Taste pungent, ammoniacal. Effloresces when exposed to air. *Solubility.*—1 in 4 of water. *Impurities.*—Sulphates and chlorides.

Identification.—The odour and the translucent appearance, particularly when freshly broken, help recognition. A white powdery coating forms on samples exposed to air.

Incompatibles.—Acids, acid salts, lime water, iron salts, alkaline earths, and alkaloids.

B.P. Dose.—3 to 10 grs. or **2 to 6 dgrms. U.S.P.—0.3 grm. or 5 grs.**

Enters into.—The preparation of Ammonium Chloride, Bismuth Carb. and the

Official Preparations

1. **Liquor Ammonii Acetatis,** *see* page 191.

2. **Liquor Ammonii Citratis,** *see* page 191.

3. **Spiritus Ammoniæ Aromaticus.** *Syn.*—*Spt. Ammoniæ Compositus, Spirit of Sal volatile.*—1 in 10 of carbonate and 1 in 20 of Liq. Ammon. Fort.

B.P. Dose.—20 to 40 ms. or 12 to 25 decimils for repeated use ; 60 to 90 ms. or 4 to 6 mils. for a single dose. U.S.P.—2 mils or 30 ms. Should not be prescribed with Syrupus Scillæ.

Non-official Preparations

1. **Liq. Ammon. Acet. Fort., B.P. 1885.**—1 with 5 of distilled water forms the official diluted Liq. Ammon. Acet. *Dose.*—25 to 75 ms.

2. **Liq. Ammon. Citratis Fort., B.P. 1885.**—1 to 3 of distilled water forms the official Liq. Ammon. Citratis. *Dose.*—30 to 90 ms.

Pharmacology and Therapeutics

Externally.—Ammonium carbonate is never used externally, though it has the same actions as those of Liqr. Ammonia. Spiritus Ammoniæ Aromaticus is inhaled for reflex stimulation.

Internally.—The carbonate possesses all the virtues of the liquor, and in addition is a **powerful stimulating expectorant,** facilitating the expulsion of viscid mucus. It is therefore very useful in **bronchitis,** and **catarrhal pneumonia.** It should be remembered however that given in large doses or even in small repeated doses, over a long period, it acts as an irritant to the bowels and may give rise to **diarrhœa,** it should not therefore be given in cases complicated with diarrhœa. It is an emetic in ½ dr. doses, though rarely used for the purpose. The carbonate in the form of aromatic spirit of ammonia is used as a mild stomachic in **debility** and **alcoholism,** and as a carminative in **flatulence.**

The carbonate or the spt. ammoniæ aromaticus should not be prescribed with syr. scillæ which contains acetum scillæ and will give off CO_2 gas. It forms insoluble salts with all metals except the alkalies.

2. Preparations which act as salts in the body

AMMONII CHLORIDUM

Ammonium Chloride. NH_4Cl

Syn.—Sal Ammoniac. **Syn. I.V.**—*Nishedal,* Beng. *Noshadar,* Hind.

Source.—Prepared by neutralising crude solution of ammonia or ammonium carbonate with hydrochloric acid. Thus $NH_4HO + HCl = NH_4Cl + H_2O$.

In India this is manufactured from a peculiar clay found at Karnal in the Punjab and is easily obtainable in the bazaars.

Characters.—In colourless, inodorous crystals. Taste saline cooling. *Solubility.*—1 in 3 of cold water, 1 in 60 of alcohol (90 p.c.). *Impurities.*—Iron, lead, and tarry matters.

Identification.—The peculiar fibrous, translucent appearance helps recognition.

Incompatibles.—Alkalies and their carbonates, alkaline earths ; lead and silver salts.

Dispensing hints.—It is not easy to powder ammonium chloride, and is best done by dissolving the salt in hot water and evaporating the solution to dryness with constant stirring (*see* **granulation** p. 11). The powder is granular and cannot be recognized.

B.P. Dose.—**5 to 20 grs.** or **3 to 12 dgrms.** ; **U.S.P.**—**0.3 grm. or 5 grs.**

Enters into.—The preparation of Liqr. Ammon. Fort.

Non-official Preparations

1. **Trochiscus Ammonii Chloridi, U.S.P.**—Ammon. chlor. 10 gm. ; ext. glycyrrhiza 20 gm. ; tragacanth 2 gm. ; sugar 40 gm. ; syrup of tolu *q.s.* for 100.

2. **Lotio Evaporans.**—Ammon. Chlorid. ½., Spt. Rect. 2, Water to 12. Dissolve.

3. **Vapor. Ammon. Chlor.**—Obtained by mixing hydrochloric acid and ammonia in a suitable apparatus and purifying through water or moist sponge. A useful inhalation in *bronchitis*.

Pharmacology and Therapeutics

Externally.—A solution of ammonium chloride has a **soothing refrigerant** effect when locally applied, and this is greatly increased by the addition of alcohol and potassium nitrate. Hence, the evaporating and cooling lotions are useful in *sprains*, *bruises*, *fractures*, *dislocations*, *headache*. They may also be applied to threatening mammary abscess and glandular inflammations. In the form of an inhalation, ammonium chloride increases the secretion of mucus from the pharynx, larynx, trachea, bronchi and eustachian tubes, and is therefore serviceable in chronic **pharyngitis, laryngitis, bronchitis** and **otitis media.**

Internally. **Gastro-intestinal canal.**—In the mouth it is an irritant and astringent and there is a reflex flow of saliva. It is rapidly absorbed from the stomach and is not converted into urea in the liver. Ammonium chloride in the form of lozenges when allowed to melt slowly in the mouth acts as a **reflex expectorant.** In moderate doses, 10 to 15 grs., it is a **gastro-intestinal stimulant** particularly to the intestine. It is an excellent remedy for **gastric catarrh.**

Liver.—It is used in **catarrhal jaundice,** subacute and chronic **congestion, enlargement** and **threatening abscess** of the liver, but the action is extremely doubtful.

Lungs.—Ammonium chloride makes the secretion of the bronchial mucus less viscid, perhaps more abundant, and helps expectoration. This effect is partly reflex from local irritation and partly due to the excretion of alkaline ammonium carbonate in the saliva. 10 grs. dissolved in about 3 ozs. of cold water, sipped frequently, relieves the distressing fits of coughing in bronchitis.

Excretion.—Traces have been found in different secretions, but mostly excreted as such in the urine. In bronchitis it appears in the sputum.

Prescribing hints.—It may be given in powder, compressed tablets, lozenges or in a mixture. Its taste is best disguised by chloroform water and syrup, or extract of liquorice. In the absence of an inhaler, the vapour produced by simply heating ammonium chloride on a dish may be inhaled.

LIQUOR AMMONII ACETATIS

Solution of Ammonium Acetate

Syn.—Spirit of Mindererus.

Source.—Ammonium Carbonate 50, Acetic Acid 162.5, Water to 1000.

Incompatibles.—Potassium and sodium carbonates, acids, lime water, and salts of lead and silver.

B.P. Dose.—2 to 6 drs. or 8 to 24 mils. ; **U.S.P.**—15 mils or 4 dr.

LIQUOR AMMONII CITRATIS

Solution of Ammonium Citrate

Source.—Dissolve Citric Acid 125 in 625 of Water ; neutralise with carbonate of ammonium 87.5 and add Water to make 1000.

B.P. Dose.—2 to 6 drs. or 8 to 24 mils.

Pharmacology and Therapeutics

The solutions of the acetate and citrate are **diaphoretics** and **diuretics.** The diaphoresis is due to their effect on the sweat centre. If the patient is kept cool, their action concentrates upon the kidneys and produces diuresis. For these actions, they are used as mild, non-depressant **antipyretics in fevers.**

AMMONII BENZOAS. *See* Benzoinum

AMMONII BROMIDUM. *See* Bromum

UREA. B.P.C.

$CO(NH_2)_2$. (*Non-official*)

Syn.—*Carbamide.*

Source.—It may be prepared by evaporation from ammonium cyanate, with which it is isomeric ; or may be built up synthetically in various ways.

Characters.—Silky four-sided prisms, or delicate white needles, has no action on litmus ; odourless, taste bitter and cooling like saltpetre.

Solubility.—Readily in water, but insoluble in ether.

Dose.—10 to 60 grs. or ½ to 4 grms.

Non-official Preparations

1. **Quininæ et Urea Hydrochlor. U.S.P.**—Contains 58 p.c. quinine. Used hypodermically, in *malaria* and for local *anæsthesia. Dose. U.S.P.*—Hypodermic, 1 gm. or 15 grs. (one dose only).

2. **Ursal.**—A combination of urea with salicylic acid, In white acicular crystals partially soluble in water, readily so in alcohol. Used in *gout* and *rheumatism. Dose.*—10 to 30 grs. or 6 to 20 dgrms.

PHARMACOLOGY AND THERAPEUTICS

It has been strongly recommended as a preventive and cure of **uric acid calculi,** and as a diuretic in **cirrhosis of the liver, gouty affections** and **chronic kidney** diseases. For the latter purposes the daily dose at first is 2 drs., increased later to 4 or 5 drs. Quinine and urea hydrochloride is now largely used for **local anæsthetic** purposes as a substitute for cocaine in 1 p.c. solution. It is non-toxic, soluble in water, and can be sterilised.

LITHII CARBONAS

Lithium Carbonate. Li_2CO_3.

Source.—Obtained from native silicates of lithium. Contains not less than 98.5 p.c. of pure lithium carbonate.

Characters.—In white powder, or minute crystalline grains. Taste slightly alkaline. *Solubility.*—1 in 80 of water, insoluble in alcohol (90 p.c.). *Impurities.*—Lime, aluminium, etc.

B.P. Dose.—2 to 5 grs. or 12 to 30 cgrms. ; U.S.P.—0.5 gm. or 8 grs.

LITHII CITRAS

Lithium Citrate. $Li_3C_6H_5O_7$, $4H_2O$

Source.—Prepared by the interaction of citric acid and lithium carbonate. Contains not less than 98.5 p.c. of pure lithium citrate.

Characters.—A white crystalline deliquescent salt. Taste saline, cooling. *Solubility.*—1 in 2 of water.

B.P. Dose.—5 to 10 grs. or 3 to 6 dgrms. U.S.P.—0.5 gm. or 8 grs.

OFFICIAL PREPARATION

1. **Lithii Citras Effervescens.**—1 in 20. A white granular powder. **B.P. Dose.—60 to 120 grs. or 4 to 8 grms.**

NON-OFFICIAL PREPARATIONS

1. **Lithii Benzoas.**—A white crystalline powder, soluble 1 in 4 of water. Antilithic. *Dose.*—2 to 10 grs. or 0.12 to 0.6 grm.

2. **Lithii Bromidum, B.P.C., U.S.P.**—A white deliquescent salt, soluble 1 in 1 of water. Contains not less than 85 p.c. of bromine as against 67 p.c. in potassium bromide. A good *hypnotic in gout.* Used in *insomnia, epilepsy, Brights' disease. Dose. U.S.P.*—1 gm. or 15 grs.

3. **Lithii Guaiacas, B.P.C.**—Consists of Lithium Oxide 1, Guaiacum Resin 3. Introduced by Garrod for *chronic gout* and *rheumatism. Dose.*—5 grs. twice daily.

4. **Lithii Salicylas.**—A deliquescent white powder. *Dose.*—5 to 20 grs. or 3 to 12 dgrm.

5. **Uropherin.** *Syn.—Lithium Diuretin.*—A white powder, soluble in water, powerful diuretic in *Bright's disease* and *cardiac dropsy. Dose.*—5 to 15 grs. or 3 to 10 dgrms.

PHARMACOLOGY

Internally.—Lithium salts are readily absorbed and are believed to increase the **alkalinity of the blood.** They resemble

the corresponding potassium salts in their actions. They render the **urine alkaline,** holding in solution excess of uric acid, therefore their prolonged use was considered to help the solution of **uric acid calculi.** But lithium acts as a solvent for uric acid only when present in relatively large amounts, since the quadriurate is not rendered soluble by any lithium salt except in concentrated solution. Moreover, there is no evidence, clinical or otherwise, to show that lithium is more valuable than potassium.

THERAPEUTICS

Externally.—A lotion of the carbonate (1½ drs. to 1 pint) applied on lint and covered with gutta-percha is a useful local application for removing gouty inflammation of joints, gouty ulcers and deposits.

Internally.—Lithium salts were formerly considered to be of value in both **acute** and **chronic gout,** by helping the solution of biurate of sodium, and eliminating it. For its solvent action on uric acid, they were given in **uric acid diathesis** and **uric acid calculi,** but the recent observations have now rather discredited lithium as a remedy for gout and lithiasis. The salts should be freely diluted before administration. The carbonate 5 grs. given with aerated water 10 ozs. does not irritate the stomach, but lithii citras effervescens is more agreeable, although it becomes a carbonate in the blood. Up to 1 oz. of the citrate may be given daily.

CALCIUM. Ca. (*Non-official*)

CALCII CARBONAS PRÆCIPITATUS

Precipitated Calcium Carbonate. $CaCO_3$

Syn. B.P.—Precipitated chalk. **Syn. I.V.**—*Khari,* Beng.

Source.—Obtained by the interaction of calcium chloride and sodium carbonate; $CaCl_2 + Na_2CO_3 = CaCO_3 + 2NaCl$.

Characters.—A whitish micro-crystalline powder, insoluble in water. *Impurities.*—Phosphates, sulphates, iron, and alumina.

Incompatibles.—Acids and sulphates.

B.P. Dose.—15 to 60 grs. or 1 to 4 grms. ; U.S.P.—1 gm. or 15 grs.

Enters into.—Troch. Bismuthi Co.

CRETA PRÆPARATA

Prepared Chalk. $CaCO_3$

Source.—Native calcium carbonate purified by elutriation.

Characters.—White friable masses or a white powder. *Impurities.*—Iron, aluminium, magnesium, phosphates, sulphates, silica.

Incompatibles.—Acids and sulphates.

B.P. Dose.—15 to 60 grs. or 1 to 4 grms. ; U.S.P.—1 gm. or 15 grs.

Enters into.—Hyd. c. Creta and the

Official Preparations

1. **Mistura Cretæ.** *Syn.—Chalk Mixture.*—13½ grs. in 1 oz. The powder may be kept mixed in dry condition; 40 grs. to 1 oz. of cinnamon water when required. **B.P. Dose.—½ to 1 oz. or 15 to 30 mils.; U.S.P.—15 mils. or 4 drs.**

2. **Pulvis Cretæ Aromaticus.**—1 in 4. **B.P. Dose.—10 to 60 grs. or 6 to 40 dgrms.**

3. **Pulvis Cretæ Aromaticus cum Opio.**—1 of opium in 40. **B.P. Dose.—10 to 60 grs. or 6 to 40 dgrms.; 1 gr. for a child 1 year old.**

Non-official Preparation

1. **Cholera and Diarrhœa Mixture** (Board of Health's prescription).—Pulv. Cretæ Arom. (B.P. 1864) 3 drs., Sp. Ammon. Arom. 3 drs., Tr. Catechu 10 drs., Tr. Card. Co. 6 drs., Tr. Opii 1 dr., Mist Cretæ to 20 ozs. Mix. *Dose.*—1 oz. for an adult after each liquid motion.

Pharmacology

Externally.—Chalk is a mild **astringent** and **desiccant.**

Internally. **Alimentary canal.**—It acts as a direct local **antacid,** neutralising free acids in the mouth and stomach. If not already acted upon, it passes readily into the intestine, where it acts as an **antacid** and a non-irritating **astringent,** caused by (1) the neutralisation of any acid it meets with formation of chloride or lactate and thus reducing the secretion; by (2) its mechanical action; and (3) depressant action on the intestinal canal due to Ca ion. Lime salts are feebly absorbed on account of their low diffusive power and are excreted with the fæces.

Kidneys.—Some think that calcium carbonate is a **diuretic** because certain mineral waters, such as Contrexeville and Vittel containing calcium bicarbonate and sulphate among other salts, have been found useful solvents for **uric acid.** But there is no direct evidence.

Therapeutics

Externally.—Chalk may be used as a dusting powder in **excoriations, burns** and **weeping eczema.** Duckworth uses it in the form of an ointment (1 in 1 of benzoated lard) in **erysipelas.**

Internally. **Alimentary tract.**—It is used as a basis for almost all the tooth powders. As an *antacid* it may be used in **acid dyspepsia,** but lime water acts much better. It is an excellent remedy for mild **diarrhœa,** especially that of children with sour-smelling stools. If the diarrhœa is caused by some irritating food, a dose of castor oil should precede its use. In diarrhœa chalk acts like bismuth salts by forming an insoluble coating over the mucous membrane. Lime salts are of special value in **acid poisoning,** especially in oxalic acid poisoning, as they form insoluble oxalates.

Kidneys.—It is never used as a diuretic, though Contrexeville and Vittel waters may be given before meals as solvents of **uric acid calculi.**

Prescribing hints.—Generally given in the form of chalk mixture with opium and astringent tinctures. Aromatic chalk powder with bismuth and grey powder is very useful in *infantile diarrhœa.*

CALCII CHLORIDUM

Calcium Chloride. $CaCl_2$

Source.—Formed by neutralising hydrochloric acid with calcium carbonate, and desiccating at a temperature not exceeding 200°C. $CaCO_3 + 2HCl + H_2O = CaCl_2 2H_2O + CO_2$.

Characters.—In dry, white, deliquescent masses. Taste warm, slightly bitter. *Solubility.*—1 in 1½ of water, 1 in 3 of alcohol (90 p.c.). *Impurities.*—Iron, Aluminium, magnesium and carbonates.

Incompatibles.—Carbonates, phosphates, sulphates, and tartrates.

Dispensing hints.—As the salt is very deliquescent it should be preserved in hermetically sealed bottles, or in solution with the strength marked. Crystalline calcium chloride cannot be easily weighed.

B.P. Dose.—5 to 15 grs. or 3 to 10 dgrms. ; U.S.—0.5 gm. or 8 grs.

CALCII LACTAS

Calcium Lactate. $Ca(C_3H_5O_3)_2, 5H_2O$

Source.—Obtained by neutralising dilute lactic acid with calcium carbonate and evaporating the resulting solution. Contains not less than 93 p.c. of pure calcium lactate.

Characters.—A white, almost tasteless powder. Soluble in 18.5 parts of water.

Note.—The lactate when fresh forms a clear or only faintly turbid solution with water.

B.P. Dose.—10 to 30 grs. or 6 to 20 dgrms. ; U.S.P.—0.5 gm. or 8 grs.

Official Preparation

1. Syrupus Calcii Lactophosphatis.—B.P. Dose.—½ to 1 dr. or 2 to 4 mils.

Pharmacology and Therapeutics

Externally.—Calcium chloride is rarely used, though its lotion has been found occasionally to relieve **pruritus.**

Internally.—Soluble Ca ions have certain important functions in the body. They are present in all tissues, and not only the heart but other tissues of the body are sensitive to disturbances in the amount of calcium and sodium in the blood. Given intravenously in large doses lime salts lessen the irritability of the cerebral cortex, and diminution of calcium in the blood causes increased irritability of the brain with muscular twitchings.

In small doses calcium increases slightly the **blood-pressure** and heart-rate, due to depression of the vagus, and by increasing the force it considerably augments the heart's output. Large doses paralyse the vagus.

The **pupils are contracted,** due chiefly to direct stimulation of the sphincter, probably also to partial stimulation of the nerve-endings.

All these effects are elicited by the intravenous injection, and are not so marked when administered by the mouth, due possibly to slow absorption. Calcium antagonises the effects of magnesium and potassium.

The chloride is an excellent **alterative,** and was largely employed in former years in **scrofula** with glandular enlargements of the neck, **rickets, tuberculosis** and **chronic diarrhœa** with impaired digestion. It is seldom used now in these cases. These calcium salts are supposed to **increase the coagulability of the blood,** and the fact that coagulation of the blood may be prevented by precipitating these salts in the form of oxalates led to the universal use of calcium in the treamtent of **internal hæmorrhage.** But recent observations have demonstrated that soluble lime salts administered per os have no appreciable effect upon the coagulation of the blood. The present evidence is so contradictory that it is impossible to draw too positive conclusions as to the effects of calcium salts in internal hæmorrhages, but the testimony of clinical observations seems rather to favour the view that in some cases at least the lactate is of great value. Many speak highly of it in **lobar pneumonia** in 5 to 15 gr. doses every 4 hours. It is very useful in certain cutaneous eruptions associated with diminished coagulability of the blood, espeically **urticaria** and **erythema nodosum.**

The soluble lime salts increase the resistance of the red blood-cells to certain hæmolytic serums and also to lessen the liability to **anaphylactic reaction** in sensitive animals. For these reasons they have been used in **serum disease,** and have been found useful to counteract such conditions as **hay fever** and **asthma,** which appear in some way to be pathologically allied to anaphylaxis. One of the most important specific actions of calcium salts is its power to retard inflammatory process, and that transudation and œdema are favoured by the withdrawal of calcium, which normally serves to check the permeability of the vessels. The lactate is therefore used in **serous headaches, angioneurotic œdema, chilblains,** and conditions suggesting abnormal permeability of vessels, but the results have been disappointing.

Removal of parathyroids has resulted in tetany, and both in tetany and parathyroidectomy the calcium content of the brain and blood has been found diminished. The nervous manifestations following parathyroidectomy may be checked by the use of soluble calcium salts. Combined with bromides they are of value in **epilepsy.**

Prescribing hints.—These salts may be given safely up to 30 grs. three times a day, but these large doses must not be continued for more than a few days at a time. They are best given in solution after food. But as all lime salts are feebly absorbed, we are doubtful as to the wisdom of giving in excessive doses as they may derange the stomach. These salts should not be prescribed with carbonates, sulphates, or spt. ammon. aromat. which will throw insoluble precipitates.

CALX

Lime CaO. *Unslaked Lime*

Syn. I.V.—*Chun*, Beng. *Chunam*, Hind.

Source.—It is calcium oxide obtained by calcining marble.

Characters.—In compact whitish masses, which swell and fall to powder by absorbing water.

CALCII HYDRAS

Calcium Hydroxide. $Ca(HO)_2$

Syn. B.P.—Slaked lime. **Syn. I.V.**—*Chun*, Beng. *Chunam*, Hind.

Source.—Freshly prepared by the interaction of water and calcium oxide.

Characters.—A white alkaline powder. *Solubility.*—1 in 900 of water, and 1 in 60 if sugar is added. *Impurities.*—Iron, aluminium, silica, alkalies, and their salts.

Incompatibles.—Vegetable and mineral acids, alkaline and metallic salts, tartar emetic.

Enters into.—The preparation of Calc. Hypophosph., Chloroform, and the

Official Preparations

1. **Linimentum Calcis.**—1 in 2. A substitute for **Carron oil** which is made of lime water and linseed oil.

2. **Liquor Calcis.** *Syn.*—*Lime Water.*—0.1 gr. in 110 ms. It should be kept in green bottles well corked. *Enters into.*—The preparation of Lin. Calcis, Lotio Hydrarg. Flav., and Lotio Hydrarg. Nigra. **B.P. Dose.—1 to 4 ozs. or 30 to 120 mils. ; ½ to 1 dr. for a child 1 year old. U.S.P.—15 mils or 4 drs.**

3. **Liquor Calcis Saccharatus.**—2 grs. in 110 ms. Should be mixed with the solution of sugar in distilled water. **B.P. Dose.—15 to 60 ms. or 1 to 4 mils.**

Pharmacology

Externally.—Unslaked or slaked lime is a **caustic**, but its action is localised. Lime water is a local **sedative** and **astringent** when applied to the broken skin.

Internally. **Alimentary canal.**—The chief action of the oxide and hydrate is due to the alkalinity and not to the calcium. Like chalk, lime neutralises free acids of the contents of the stomach and acts as an **antacid**, but more powerfully, and thus makes the curd of milk more flocculent. It has a

slight **sedative** property. In the intestine it acts as an **astringent** like chalk, but in a less degree. It is an **antidote** for poisoning by mineral acids, oxalic acid and zinc chloride. An injection of lime water kills thread-worm.

Heart and circulation.—Only a minute quantity enters the blood and is found in the plasma as a phosphate. It also increases the coagulability of the blood and thus acts as a mild **hæmostatic.**

Kidneys.—The greater portion is excreted by the fæces, only a small quantity passes through the kidneys, rendering the **urine alkaline.**

THERAPEUTICS

Externally.—As a *caustic* in the form of Vienna Paste (slaked lime 6, caustic potash 5, alcohol 90 p.c. *q.s.*), slaked lime may be used to destroy **warts** and small **epithelial** and other **growths.** Lime water, either with linseed oil (Carron oil), olive oil or glycerin is a soothing application to **burns, scalds** and **cracked nipples.** An addition of 1 to 2 p.c. of carbolic acid increases its efficacy. It makes a soothing astringent dressing for weeping **eczema,** and may be used as an injection to lessen the discharges in **leucorrhœa, gonorrhœa, gleet, otorrhœa,** etc., even when inflammation is present. It may be injected into the rectum in **thread-worm.**

Internally. **Alimentary tract.**—Lime water makes a good mouth-wash for **ulcerative stomatitis.** It is said to dissolve false membranes of **croup** and **diphtheria.** It may either be used as a spray or applied with a brush or swab. It is chiefly used to make the curd of milk more flocculent (1 in 3 or more) and check **vomiting.** In **acid dyspepsia, gastrodynia** and **cancer** of the stomach, it must be freely employed with milk (1 in 1) to prevent regurgitation. In the same way it may be given in **enteric diarrhœa** and other affections to prevent the milk from forming hard indigestible lumps, but it has now been replaced by sodium citrate. As an astringent it is useful in mild **infantile diarrhœa.**

Prescribing hints.—Lime water is ordinarily given in milk. If the additional bulk be an objection to its use, saccharated lime water may be substituted. To suckling babies one teaspoonful with an equal quantity of milk may be given every 3 hours before nursing, and to hand-fed ones a dessert-spoonful in each bottle.

CALCII PHOSPHAS

Calcium Phosphate. $Ca_3(PO_4)_2$

Source.—Obtained by the interaction of calcium chloride with sodium phosphate and excess of ammonia at a boiling temperature.

Characters.—A light, white, amorphous powder. No odour or taste.

Solubility.—Insoluble in water, soluble in dilute hydrochloric acid and

nitric acid. *Impurities.*—Lead, copper, arsenium, iron, aluminium, magnesium, silica, carbonates, and calcium oxalate.

B.P. Dose.—5 to 15 grs. or 3 to 10 dgrms.

Enters into.—The preparation of Ext. Euonymi, Pulv. Antimonialis, Ext. Nucis Vom. Sic., Ext. Opii Sic.

Non-official Preparation

1. **Calcii Glycerophosph, U.S.P.**—A white crystalline powder soluble in water. A most effective soluble salt. A valuable nervine tonic and alterative. *Dose. U.S.P.*—0·25 grm. or 4 grs.

Pharmacology

Internally.—Calcium phosphate forms the basis of new tissues and is found in excess where cell-growth is active whether normal or pathological. It has been experimentally observed that the withdrawal of lime salts from the food of animals renders their bones soft and spongy, and that fractures unite more speedily when calcium phosphate is administered to them. These symptoms resemble *rickets* and *osteomalacia* of human beings, and it has been thought that the use of calcium will improve these conditions. But there is no direct evidence that in rickets there is actual deficiency of lime salts in food, but it is due to a faulty metabolism whereby lime is not deposited on the bones. In the stomach it is acted upon by free acids and forms a soluble superphosphate, in which form it is absorbed in very small quantities, and the rest passes into the intestine unchanged.

Therapeutics

Internally.—As a *promoter* of nutrition and cell-growth, calcium phosphate is exceedingly useful in the case of **children** who have overgrown their strength; women weakened by child-bearing, prolonged suckling, or excessive menstruation; **anæmia** and **exhaustion** brought on by **prolonged suppuration, diarrhœa, leucorrhœa, chronic bronchitis, phthisis,** etc. It may also be given to expedite the union of **fractures** and the healing of **caries of bones.** It is an excellent remedy for those whose health has suffered from long residence in town or from overwork. It has been recommended in **rickets** where it is supposed to benefit by rectifying the faulty nutrition and inducing a more healthy growth. But it should not be commenced until the pain and tenderness of bones have subsided.

Prescribing hints.—It is useless to give this or other lime salts in large doses as they are not freely absorbed. Either the Syrupus Calcis Lactophosphatis, or the powdered phosphate in 1 or 2 gr. doses several times a day, after food, may be given with advantage. Iron or other lime salts when combined with it, as in Parrish's Chemical Food, enhance its efficacy. Calcium phosphate may be usefully added to normal saline solution in a case where transfusion is necessary.

CALCII HYPOPHOSPHIS. *See* **Phosphorus**
CALX CHLORINATA. *See* **Chlorum**
CALX SULPHURATA. *See* **Sulphur**

MAGNESIUM. Mg. (*Not official*)

MAGNESIA LEVIS

Light Magnesia. MgO

Syn. B.P.—Light Calcined Magnesia, Light Magnesium Oxide.

Source.—Prepared by exposing light magnesium carbonate to a dull red heat.

Characters.—A light bulky white powder, 3½ times lighter than heavy magnesia.

B.P. Dose.—**5 to 20 grs. or 3 to 12 dgrms. for repeated administration; 30 to 60 grs. or 2 to 4 grms. for a single dose.; U.S.P.—2 gm. or 30 grs.**

Enters into.—Pulv. Rhei Co.

MAGNESIA PONDEROSA

Heavy Magnesia. MgO

Syn. B.P.—Heavy Calcined Magnesia, Heavy Magnesium Oxide.

Source.—Prepared by exposing heavy magnesium carbonate to a dull red heat.

Characters.—A white powder, insoluble in water, but readily dissolved by acids.

Incompatibles.—All acids.

B.P. Dose.—The same as light magnesia.

MAGNESII CARBONAS LEVIS

Light Magnesium Carbonate.

Source.—Prepared by mixing *cold dilute* solutions of magnesium sulphate and sodium carbonate, boiling for 15 minutes, and filtering, washing, and drying by heat not exceeding 100°C. $4MgSO_4+4Na_2CO_3+5H_2O=3(MgCO_3)$, $Mg(HO)_2,4H_2O+4Na_2SO_4+CO_2$.

Characters.—A light, white powder consisting of amorphous particles and slender prisms. *Solubility.*—1 in 2500 of cold water.

B.P. Dose.—The same as light magnesia.

MAGNESII CARBONAS PONDEROSUS

Heavy Magnesium Carbonate.

Source.—Prepared as the light carbonate, but with *strong boiling* aqueous solutions.

Characters.—A white granular powder. *Impurities.*—Lime, sulphates.

B.P. Dose.—The same as light magnesia.

Enters into.—The preparation of Magnesia Ponderosa, Troch. Bismuthi Co, and the

Official Preparation

1. **Liquor Magnesii Bicarbonatis.** *Syn. B.P.—Fluid Magnesia.*—10 grs. in 1 oz. **B.P. Dose.—1 to 2 ozs. or 30 to 60 mils.** ; ½ dr. for a child 1 year old.

Non-official Preparations

1. **Mistura Alba, B.P.C.**—Mag. Carb. 1 dr., Mag. Sulph. 6 drs., Peppermint Water 6 ozs. *Dose.*—½ to 1 oz. or 15 to 30 mils. as an aperient.

2. **Liquor Magnesii Citratis, U.S., B.P.C.** *Syn.—Lemonade Purgative.*—Magnesium Carbonate 15, Acid Citric 33, Syrup 60, ol. lemon. 0.1, talc 5, Pot. Bicarb. 2.5, Water to 350. A pleasant refrigerant draught and saline aperient. *Dose. U.S.P.*—350 mils. or 12 oz.

3. **Red mixture** (Dr. Goodeve's).—Mag. Carb. Pond. 30 grs., Rhubarb 10 grs., Spt. Ammon. Aromat. 30 ms., Ol. Anisi 2 drops. Water to 2 ozs. Mix. *Dose.*—One teaspoonful every 3 or 4 hours till bowels operate.

MAGNESII SULPHAS

Magnesium Sulphate. $MgSO_4,7H_2O$

Syn. B.P.—Epsom Salt.

Source.—Prepared by the interaction of native magnesium carbonates and diluted sulphuric acid, $MgCO_3+H_2SO_4=MgSO_4+H_2O+CO_2$; or purifying the native sulphate. Contains not less than 97.4 p.c. of pure magnesium sulphate.

Characters.—Small, colourless, transparent, rhombic prisms. Taste bitter. *Solubility.*—1 in 1 of cold water.

Incompatibles.—Potassium and sodium carbonates and bicarbonates, lime water, lead acetate, and tartarated soda which precipitates magnesium tartrate.

B.P. Dose.—30 to 90 grs. or **2 to 6 grms.** for repeated administration ; **120 to 240 grs.** or **8 to 16 grms.** for a single dose. ; **U.S.P.—15 gm.** or **4 dr.**

Official Preparation

1. **Magnesii Sulphas Effervescens.** *Syn. B.P.—Effervescent Epsom Salts.*—**B.P. Dose.—60 to 180 grs.** or **4 to 12 grms.** for repeated use : **240 to 480 grs.** or **16 to 32 grms.** for a single dose.

Pharmacology of Magnesium Salts

Internally. **Gastro-intestinal canal.**—Both the oxide and the carbonates are **alkaline,** and neutralise the normal or the excessive acidity of the stomach, and act as antacids. Being sparingly soluble their antacid action extends down the intestine, where they are converted into soluble and therefore cathartic magnesium bicarbonate. What is unaffected is left insoluble. The carbonate sets free carbonic acid, which exerts a local sedative influence. For action of magnesium sulphate *see* Saline Purgatives page 203.

Blood—Magnesium salts enter the blood as a chloride or lactate and render the **plasma more alkaline.** If salines are used in concentrated form they draw fluid from the blood and tissues and render the blood more concentrated.

Nervous System.—Injected hypodermically or into the circulation magnesium salts act as powerful poisons, depressing the heart, muscles and the central and peripheral nervous system, death taking place from paralysis of respiration. Mg. ions in relatively small amounts are the normal constituents of the tissues, but when present in sufficient concentration abolish the excitability of all nervous organs. Injected into the spinal canal the sulphate induces anæsthesia resembling cocaine, but more lasting. All these toxic symptoms are antagonised by the use of calcium salts intravenously, which restore the equilibrium between the various ions disturbed by an excess of Mg. ions.

Urine.—What little salt is absorbed is passed out by the kidneys, **increasing the flow of urine,** rendering it **alkaline,** and to a certain extent **dissolving uric acid ;** but the diuretic effect is weaker than that of the potassium and sodium salts.

THERAPEUTICS

Externally.—A saturated solution of magnesium sulphate used as a compress relieves pain and acts as a local anæsthetic. It is also an excellent remedy for **erysipelas** and other **inflammatory affections.**

Internally.—The oxide and the carbonate are largely employed in **acid dyspepsia, heartburn, pyrosis, vomiting, sick headache,** or any other complaint attended with acidity. Their antacid property is considerably increased by combining them with sodium bicarbonate and sal volatile. As a tasteless, unirritating alkaline laxative, they are often used in combination with rhubarb, as pulv. rhei co., and Goodeve's " Red Mixture " in **constipation of children.** Liq. magnesii bicarb. is an agreeable and alkaline laxative in acid dyspepsia accompanied by constipation.

As **antidotes,** magnesia and its carbonates are used in **poisoning** by **mineral acids, oxalic acid,** and the salts of **mercury, arsenic** and **copper,** as they form insoluble compounds with them. In **alkaloidal poisoning** they hinder the absorption of alkaloids by making the contents of the stomach alkaline. But in order to get these antidotal effects, they must be given in very large doses, which is the only objection. Magnesium sulphate acts as an **antidote** to **lead** and **barium** salts by precipitating their insoluble sulphates.

As a **diuretic** and feeble alkaliser of blood and urine, they are used in **gout** and **gravel** cases, where the salts of potassium and sodium are not well borne. Many mineral waters containing magnesium are valuable diuretics, such as Harrogate, Carlsbad, Ems, Baden-Baden, etc.

Magnesium sulphate is almost daily used as a **purgative.** It can be given in the form of Mist. Sennæ Co. or in solution with aromatics. In **biliousness** or **portal congestion,** it is best given to complete the action of cholagogue pills. It

has been successfully used in **bacillary dysentery** and in mild cases of amœbic dysentery; it has no specific effect however on the amœbæ, and in all cases of any severity should give way to the ipecacuanha treatment. Large quantities of **serum** can be drained off through the bowels by giving concentrated solutions during fasting, so that **dropsy, anasarca, ascites, pleurisy,** etc., can be greatly reduced. Many popular mineral waters, such as Hunyadi Janos, Friedrichshall and Pulna owe their purgative action to the magnesium sulphate they contain. It is an excellent laxative to counteract the constipating effect of iron in **anæmia.** For its paralysing effects on the nerve tissue it has been used as intra-spinal injections in **tetanus** and for the production of **spinal anæsthesia,** but has repeatedly failed in our hands to produce any beneficial effect in tetanus.

Prescribing hints.—Epsom salts are generally given in mixtures in doses of 1 to 2 drs. as a laxative, and as hydragogue cathartic in 2 to 4 dr. doses in concentrated solution. It may also be given as an effervescent salt. The nauseous taste can very well be covered by liquorice or chloroform. To prevent their griping properties aromatics or carminatives should be combined with them. The carbonates and the light and heavy magnesia are generally administered in **pills, cachets** or **lozenges.** When in solution they are best given in the form of Mist. Alba. The heavy magnesia sometimes becomes aggregated into a solid mass when ordered in a mixture.

SALINE PURGATIVES

Under this head are included the sulphate and phosphate of sodium, the sulphate of potassium, tartrate and acid-tartrate of potassium, sodium and potassium tartrate, and sulphate of magnesium, which because of their low absorbability from the intestinal tract disturb the osmotic balance between the bowel contents and the surrounding tissues. It has been found that certain salts are absorbed readily through the intestinal tract, and that this depends upon the nature of the ion of which they are composed. Among those that are absorbed very slowly are the cations—calcium, magnesium, and the heavy metals; and the anions—phosphates, sulphates, tartrates, citrates, etc. Of these magnesium among the basic, and citrates, phosphates, tartrates and sulphates among the acid ions have cathartic properties.

Solutions of these salts have an unpleasant salt taste, and when used in concentrated form, they irritate the stomach and may produce nausea. If they remain longer they promote transudation and secretion and therefore help their own dilution. By means of cæcal fistula it has been shown that if an isotonic salt solution and a solution of sodium sulphate be administered by the mouth, little or none of the former reaches the cæcum, while most of the latter solution escapes

by the fistula, only about 10 to 20 p.c. being absorbed by the stomach and intestine. It is evident therefore that from 80 to 90 p.c. of the fluid reaches the large intestine if any of the cathartic salts be used where it remains unabsorbed. The catharsis is due to the large bulk of the fluid which distend the bowel and induce increased peristalsis. The intensity of action of these salts depends upon the concentration of the solution in which they are administered. For instance, if the salt is freely diluted more of the fluid is absorbed and less reaches the large intestine. Whereas if the solution be hypertonic it will draw fluid from the blood into the intestine, due to its higher osmotic pressure, and the blood, gives up its fluid without any sufficient compensation of salt until the solution becomes isotonic. A large amount of fluid thus accumulates with the resultant evacuation. Boas on the other hand asserts that the catharsis is less powerful when the solution used is more concentrated, and that the salt is more prone to be absorbed and to produce systemic effects. He reports several cases of poisoning from concentrated doses of magnesium sulphate. It must be borne in mind that purgation is produced only if the intestine is able to furnish a sufficiently large amount of secretions,which depends upon the amount of water present in the blood and tissues. It takes a longer time to produce purgation if a hypertonic solution is used, as the dilution results practically only from gradual secretion of the digestive juices. It may therefore take many hours before the quantity becomes large enough to produce an evacuation. A dilute solution on the other hand may cause a liquid stool, provided a large amount of it rapidly passes into the large bowel. If however there be no evacuation the salt is absorbed into the blood and excreted by the kidneys and acts as diuretic. MacCallum has suggested that salines act by precipitating calcium in the tissues and so neutralise their depressing action. The stool generally consists of

(1) the salt and the fluid derived by transudation, and

(2) some of the unabsorbed gastro-intestinal contents.

Bayliss and Starling have shown that the passage of liquids along the intestine is different from that of solid or pasty matter. Whereas solids stimulate peristalsis, liquids simply generate rhythmic intestinal segmentations ; the result being that while the liquids pass along, more or less of the solid contents of the intestine are liable to be left behind.

STRONTII BROMIDUM. *See* **Bromum**

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GROUP II

HEAVY METALS

The drugs belonging to this group have many properties in common, but individually they have some very important actions and therapeutic uses of their own. For instance, mercury is *antisyphilitic*, iron *hæmatinic*, while others are more or less *astringents* and *caustics*. In the form of pure metals they have practically no action, except a mechanical one, but become active only when used in the form of compounds, and are thus capable of dissociation into ions. The more completely dissociated the ions of the salts are, the more rapid and more intense is the action. Thus the inorganic salts are more active than the organic preparations and double salts, which are less readily ionised.

All the salts precipitate proteins and form albuminates of variable composition. In concentrated solutions the precipitate extends into the cells and may have an irritant or even a caustic effect, causing the death of the tissues. They are therefore **astringents, irritants** or **caustics,** according to the strength and preparation used. The chlorides and nitrates are dissociated most rapidly and are **corrosives,** the sulphates are dissociated less rapidly and are less irritant, while the acetates, tartrates and citrates are least corrosives. Of the different salts, lead and alum are astringents, perchloride and nitrate of mercury are irritants, and zinc, copper, silver are irritants or astringents according to the strength of the solution used.

The salts of the heavy metals are very slowly absorbed and slowly excreted, and are therefore more or less cumulative. Chronic poisoning by some of the metals may follow the repeated use for a long time even if the dose be very small. Excepting mercury they are chiefly excreted by the urine and some have been detected in the milk. In large doses they may induce nephritis. They are mostly stored up in the various organs chiefly the liver, spleen, kidneys and bone-marrow. Excepting mercury all are more or less astringents, and some, especially lead, cause constipation. The nervous system is sensitive to these metals. Disturbances of psychical centres, delirium, mania, peripheral neuritis, and sclerosis of the brain and cord are some manifestations of poisoning from heavy metals.

The heavy metals are classified as follows :—

CLASS : Antisyphilitic and antiseptic
Mercury

CLASS B : Hæmatinic and antiseptics
Iron, Potassium Permanganate

CLASS C : Astringents
Lead, Silver, Zinc, Copper, Bismuth, Alum

CLASS A : **Mercury**

HYDRARGYRUM

Mercury. Hg

Syn.—Quicksilver.

Source.—A metal obtained from native mercuric sulphide (cinnabar).

Characters.—Silver-white liquid, easily divisible into globules. Volatilises at 662° F. and solidifies at —40° F. *Impurities.*—Lead, tin, and other metals.

OFFICIAL PREPARATIONS

1. **Emplastrum Hydrargyri.**—1 in 3. A bluish solid.

2. **Hydrargyrum cum Creta.** *Syn.—Grey Powder.*—1 in 3. A greyish-blue powder. *Impurity.*—Mercuric oxide. **B.P. Dose.—1 to 5 grs. or 6 to 30 cgrms. ; ¼ to ½ gr. for a child one year old.**

3. **Linimentum Hydrargyri.**—1 in 10 of Hg. Three-fifths of mercury of B.P. 1898.

4. **Pilula Hydrargyri.** *Syn. B.P.—Blue Pill.*—1 in 3. **B.P. Dose.—4 to 8 grs. or 25 to 50 cgrms.**

5. **Unguentum Hydrargyri.** *Syn.—Blue Ointment.*—1 in 3. Three-fifths the strength of B. P. 1898.

6. **Unguentum Hydrargyri Compositum.** *Syn.—Scott's Ointment or Dressing.*—1 Hg. in 5. Three-fifths the strength of B.P. 1898.

NON-OFFICIAL PREPARATIONS

1. **Oleum Cinereum.** *Syn.—Grey Oil.*—Mercury 39, Mercurial Ointment 2, Vaseline 59. *Dose.*—1 to 2 ms. ; Not safe. May cause cellulitis.

2. **Hyrgolum.** *Syn.—Hydrargyrum Colloidale.*—Soluble in water ; said to contain nearly 73 to 80 p.c. of mercury. A 10 p.c. ointment useful in *epididymitis.*

3. **Mercurial Cream (Lambkin).**—Mercury pure 10 gms., Creo-camphor 20 c.c., palmitin basis to 100 c.c. *Dose.*—10 ms.=1 gr. metallic mercury.

To be well stirred with a sterile glass rod before use. Melting point for the tropics should be 38°C.

HYDRARGYRI IODIDUM RUBRUM

Mercuric Iodide. HgI_2

Syn. B.P.—Biniodide of Mercury. Red Mercuric Iodide.

Source and Characters.—A crystalline vermilion powder, obtained by the interaction of mercuric chloride with potassium iodide. *Solubility.*—Insoluble in water, but freely in solution of potassium iodide and ether.

B.P. Dose.—$\frac{1}{3}\frac{1}{2}$ to $\frac{1}{1}\frac{1}{6}$ gr. or 2 to 4 mgrms. ; U.S.P.—0.003 gm. or $\frac{1}{2}\frac{1}{0}$ gr.

OFFICIAL PREPARATIONS

1. **Liquor Arsenii et Hydrargyri Iodidi.**—*Donovan's Solution.*—1 p.c. of each iodide. **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils. U.S.P.—0.1 mil. or 1½ ms.**

2. **Unguentum Hydrargyri Iodidi Rubri.**—1 in 25. In India benzoated suet should be used instead of benzoated lard.

Non-official Preparations

1. **Hydrarg. et Potassii Iodidi.**—Yellow acicular crystals. 1 c.c. of 1 p.c. solution used in the treatment of *syphilis*. It is an active and safe remedy. *Dose.*—$\frac{1}{10}$ to $\frac{1}{4}$ gr. or 6 to 16 mg.

2. **Hydrargyri Iodidum Flavum, U.S.P.**—*Protoiodide of Mercury.*—A bright yellow amorphous powder, contains not less than 99 p.c. HgI. *Dose, U.S.P.*—0.01 gm. or $\frac{1}{4}$ gr.

3. **Hydrarg. Salicyl-arsenas.** *Syn.*—*Enesol.*—White powder containing 38 p.c. mercury. Solution painless on injection.

HYDRARGYRUM OLEATUM

Mercuric Oleate

Source and Characters.—A light yellowish unctuous substance obtained by the interaction of yellow mercuric oxide 20 gms., liquid paraffin 5 gms. and oleic acid 75 gms. Stir and heat to 50°C.

Official Preparation

1. **Unguentum Hydrargyri Oleati.**—1 in 4.

HYDRARGYRI OXIDUM FLAVUM

Yellow Mercuric Oxide. HgO

Source and Characters.—A yellow non-crystalline powder obtained by the interaction of aqueous solutions of mercuric chloride and sodium hydroxide. $HgCl_2 + 2NaHO = HgO + 2NaCl + H_2O$. Insoluble in water.

Official Preparation

1. **Unguentum Hydrargyri Oxidi Flavi.**—1 in 50. It is a substitute for **Golden Ointment.**

HYDRARGYRI OXIDUM RUBRUM

Red Mercuric Oxide. HgO

Syn. B.P.—Red Precipitate.

Source and Characters.—An orange-red powder obtained by heating mercurous nitrate until acid vapours cease to be evolved. Insoluble in water. Contains not less than 99.3 p.c. of pure mercuric oxide.

Official Preparation

1. **Unguentum Hydrargyri Oxidi Rubri.** *Syn. B.P.—Red Precipitate Ointment.*—1 in 10.

HYDRARGYRI PERCHLORIDUM

Mercuric Chloride. $HgCl_2$

Syn. B.P.—Bichloride of Mercury, Corrosive Sublimate, Perchloride of Mercury.

Source.—A salt obtained as a sublimate by heating a mixture of mercuric sulphate, sodium chloride, and black oxide of manganese. $HgSO_4 +$

$2NaCl+MnO_2=HgCl_2+Na_2SO_4+MnO_2$. Contains not less than 98.6 p.c. of pure mercuric chloride.

Characters.—Heavy, colourless masses of prismatic crystals. Highly acrid metallic taste. *Solubility.*—1 in 18 of water; 1 in 4 of alcohol (90 p.c.), or of ether; 1 in 2 of cold glycerin on trituration. *Impurities.*—Fixed salts, not volatilizing.

Incompatibles.—Alkalies and their carbonates, potassium iodide, lime water, tartar emetic, silver nitrate, albumen, lead acetate, soaps, decoction of bark.

N.B.—Perchloride of mercury decomposes even in distilled water, calomel being deposited. If organic substances are present, the change takes place more rapidly. Ordinary well water is therefore not a good vehicle with which to prepare solutions of the perchloride. The addition however of some free acid—such as ordinary vinegar (1 in 125) or tartaric acid—will prevent this decomposition.

B.P. Dose.—$\frac{1}{12}$ to $\frac{1}{10}$ gr. or **2 to 4 mgrms. in solution.; U.S.P.—0.003 gm. or $\frac{1}{20}$ gr.**

Official Preparations

1. **Liquor Hydrargyri Perchloridi.**—$\frac{1}{10}$ gr. in 110 ms. A colourless solution; 0.1 per cent. **B.P. Dose.—½ to 1 dr. or 2 to 4 mils.** diluted.

2. **Lotio Hydrargyri Flava.** *Syn. B.P.—Yellow Wash.*—Colour due to yellow oxide. Resembles yellow oxide ointment in action. 2 grs. in 1 oz. nearly.

Non-official Preparations

1. **Sublimate Wood-Wool or Wool.**—½ p.c. of Corrosive Sulbimate.

2. **Sal Alembroth.** *Syn.—Ammonio-mercuric Chloride.*—Prepared by interaction of ammonium chloride with mercuric chloride. Soluble 2 in 1 of water. **Alembroth Gauze.**—1 p.c. Damped with carbolic lotion before use as a dressing. **Alembroth Wool.**—2 p.c. Tinted blue.

HYDRARGYRI SUBCHLORIDUM

Mercurous Chloride. Hg_2Cl_2

Syn. B.P.—Calomel, Hydrargyri Chloridum Mite, U.S.P.; Subchloride of Mercury.

Source.—A salt obtained as a sublimate when a mixture of mercurous sulphate and sodium chloride is heated. $Hg_2SO_4+2NaCl=Hg_2Cl_2+Na_2SO_4$.

Characters.—A dull white, heavy, nearly tasteless powder. *Solubility.*—Insoluble in water, alcohol (90 p.c.), or ether. Volatilized by heat. *Impurities.*—Mercuric chloride soluble in water, and other chlorides.

Test for impurity.—Take a clean knife, put on it a drop of water and add a few grains of the suspected calomel. After the lapse of a minute wash the blade, when there should be no dark stain. If a black spot of magnetic oxide forms, that shows the presence of perchloride.

B.P. Dose.—½ to 5 grs. or 3 to 30 cgrms.; U.S.P.—Laxative, 0.15 gm. or 2½ grs.; alterative, 0.015 gm. or ¼ gr.

Official Preparations

1. **Lotio Hydrargyri Nigra.** *Syn. B.P.—Black Wash.*—3 grs. to 1 oz. The black precipitate is Hg_2O.

2. **Pilula Hydrargyri Subchloridi Composita.** *Syn.—Compound Calomel Pill, Plummer's Pill.*—1 in 4½. An orange-coloured mass. **B.P. Dose.—4 to 8 grs. or 25 to 50 cgrms.**

3. **Unguentum Hydrargyri Subchloridi.** *Syn.—Calomel Ointment.*—1 in 5. Rarely used. Twice the strength of the corresponding preparation of B. P. 1898.

Non-official Preparations

1. **Calomel Cream.**—Calomel 5 gms., Creo-Camphor (equal parts of Creosote and Camphoric Acid) 20 c.c., Palmitine basis ad 100 c.c. 10 ms. equal to ½ gr. calomel. *Dose.*—10 to 15 ms. once a week. This is obtainable in 1 c.c. sterile tubes containing 0.05 gm. (¾ gr.).

2. **Pilulæ Cathárticæ Compositæ, U.S.P.**— Ext. colocynth co., 8 ; calomel, 6 ; jalap resin, 2 ; gamboge, 1.5 ; alcohol diluted *q.s.* for 100 pills. *Dose.*—2 pills.

HYDRARGYRUM AMMONIATUM

Ammoniated Mercury. NH_2HgCl

Syn. B.P.—Ammonio-Chloride of Mercury, Mercuric Ammonium Chloride, White Precipitate.

Source.—Obtained by mixing solutions of ammonia and perchloride of mercury. Collect the precipitate and filter. White powder. Insecticide. Not used internally.

Official Preparation

1. **Unguentum Hydrargyri Ammoniati.** *Syn.—White Precipitate Ointment.*—1 in 20. This is one-half the strength of corresponding preparation of B.P. 1898.

LIQUOR HYDRARGYRI NITRATIS ACIDUS

Acid Solution of Mercuric Nitrate. $Hg(NO_3)_2$

Source and Characters.—A colourless solution of mercury in nitric acid and water. Sp. gr. 2.0. *Impurity.*—Mercurous nitrate.

Official Preparations

1. **Unguentum Hydrargyri Nitratis.** *Syn.—Citrine Ointment.*—1 in 15. Pale lemon colour. Greater care and skill are necessary in its preparation.

Dispensing hints.—Diluted with lard becomes leaden coloured, but less with spermaceti and least with paraffin ointments. **Incompatibles.**—Camphor, essential oils, lard, etc.

2. **Unguentum Hydrargyri Nitratis Dilutum.**—1 in 5.

Non-official Preparation

1. **Unguentum Metallorum.**—Is a mixture of oxide of zinc, diluted with nitrate of mercury and acetate of lead ointments in equal parts. Largely used in *chronic eczema.*

Additional Non-official Preparations of Mercury

1. **Hydrargyri Benzoas.**—A white crystalline powder. For hypodermic injection in solution which should be prepared fresh. Hydrarg. Benzoas 1 grm., Sodium Chloride ½ grm., Water 100 grm. *Dose.*—$\frac{1}{50}$ to $\frac{1}{10}$ gr.

2. **Hydrargyri Succinimidum.**—A soluble preparation used for hypodermic injection. Solution generally used is Succinimide 38½ gr., Cocaine hydrochlor 15½ gr., aqua 775 ms. *Dose.*—10 ms. for an injection.

3. **Hydrargyri Sozoiodolas.**—Used largely for injection purposes. Usual formula being—sodii iodide gr. 10, hydr. sozoiodol. gr. 5, aqua ms. 200. *Dose.*—10 to 15 ms. as an injection.

4. **Hydrargyri Lactas.**—Very soluble and non-irritant. *Dose.*—½ gr. in 15 ms. of water (hypodermically).

5. **Hydrargyri Salicylas, U.S.P.**—A white powder slightly soluble in water. Powerful antiseptic and antisyphilitic. For *syphilitic sores*, as ointment or dusting powder. Corrosive Sublimate 1, Sod. Salicylas 2, Water 1000, form a good lotion for external application. *Dose, U.S.P.*—0.004 gm. or $\frac{1}{15}$ gr.

6. **Hydrargyri Tannas.**—A green tasteless powder decomposed by weak alkalies setting free globules of mercury. Rapidly absorbed from the intestines without the disagreeable symptoms of mercurials, and producing best results in syphilis. *Dose.*—1 to 2 grs. in pill.

Pharmacology of Mercury and its Salts

Externally.—Metallic mercury and its salts are **absorbed** by the unbroken skin and may be administered either as an inunction or by fumigation. They enter easily through the hair and sebaceous follicles as an oxide or a chloride in combination with the fatty acids of the sebaceous glands. But on the denuded skin and mucous membranes, they produce certain **definite** actions which are given below:—(1) All mercurials are **antiseptic** and **disinfectant**; more especially the corrosive sublimate, which is one of the most effective of all mercurials, since it dissociates easily and gives the maximum concentration of mercuric ions which produce the antiseptic effect. In dilutions of 1 in 500,000, it prevents the growth of, and of 1 in 25,000 destroys, ordinary bacilli. The German Plague Commission at Bombay have proved that a 1 p.c. solution of sublimate kills the plague bacillus immediately. Moreover many of them, such as the ammoniate, nitrate, perchloride, oleate and oxide, destroy animal parasites, hence they are **parasiticides.** (2) Weak solutions of corrosive sublimate (½ to ¼ gr. in 1 oz.), mercurous and many mercuric ointments are **antiphlogistic, astringent, stimulant** and **resolvent.** (3) Stronger solutions, as of the acid nitrate and perchloride, cause **inflammation** and the concentrated ones **sloughing.**

Mercury arrests the movements of white blood-corpuscles and prevents suppuration. The ointments reduce swellings and promote absorption of subcutaneous effusions.

The usefulness of mercurial salts as a germicide is limited by precipitation, irritation and general poisoning effects. It

is customary to add some sodium and ammonium chloride to prevent precipitation in the water and to reduce their irritant effect. These form double salts which are less dissociated and therefore somewhat less active ; hydrochloric acid and tartaric acid are also used for the same object.

Gastro-intestinal tract.—Mercurial salts affect the mouth, gums and salivary glands, causing **salivation** and **stomatitis.** This is not the result of direct local action but takes place during the process of excretion by the salivary glands. It is an important and earliest symptom of excessive therapeutic use and of chronic poisoning. In the **stomach** they are converted into a complex albuminate containing albumin, sodium chloride and chlorine, which is insoluble at first, but becomes soluble in the excess of albumin or sodium chloride that exists in the stomach, and is then easily absorbed. In the duodenum and upper part of the small intestine, metallic mercury, such as grey powder, blue pill, and calomel **increase** the **glandular secretions** and **peristalsis.** The intestinal contents are, as the result of this action, hurried on so rapidly that the bile is not reabsorbed as happens normally, consequently the stools are **dark-green** (calomel motions). Hence mercurial salts are **purgatives.** The purgative action is greatly helped by salines. If the doses are insufficient, or sometimes from idiosyncrasy, mercury may be absorbed producing constitutional symptoms, but it is afterwards re-excreted into the bowel as a sulphide. Mercurials arrest **putrefactive changes** in the duodenum and intestine, thereby checking flatulence. As the result of the arrest of putrefactive changes, biliverdin passes unchanged, and no indol is formed. Hence calomel stools are not only grass-green but they are singularly free from putrefactive odour.

Liver.—It is a mistake to say that mercurials increase the amount of bile formed by the liver. The green calomel stools have been ascribed to the antiseptic properties of mercury checking the growth of bacteria in the gut, and so preventing the normal conversion of bile pigments into stercobilin, the normal colouring matter of the fæces. After a brisk mercurial purgative there is improvement of portal circulation and the condition of the liver is improved.

Blood.—The soluble complex mercurial albuminate freely enters the blood from the stomach and the intestines ; and on entering, it is decomposed by oxygen and albumin, forming an **oxyalbuminate.** In *minute and continued doses* mercuric chloride not only increases the **number of red corpuscles,** but increases their **hæmoglobin,** and thus adds a little to the body weight. In this sense it may be considered as a **tonic.** In *large doses* it causes **anæmia ;** but how far these actions are due to the improvement or impairment of digestion, or to its action on the blood itself, is not known.

Kidneys.—Calomel, or sometimes blue pill, in 3 to 5 gr. doses, occasionally acts as a **diuretic** in cardiac dropsy. When

purging follows the use of a mercurial less diuretic effect is observed. This action is probably due to its direct action on the renal cells. Large doses produce acute nephritis and necrosis of the epithelium of the tubules. The combination with squill and digitalis increases their diuretic action.

Absorption and elimination.—Mercurials are freely absorbed from all surfaces, and after absorption they disappear rapidly from the blood and are deposited in the different organs, chiefly the kidneys and the liver. From these depots mercury may be mobilised for several months even after the stoppage of the drug. It begins to be excreted within a few hours of its administration, and may last for several days after a single dose. It is excreted chiefly by the kidneys, and also by the cæcum and colon. The organic compounds are eliminated mainly by the kidneys while the inorganic compounds by the fæces. The elimination however is very slow.

Specific action.—Mercury is a specific for **syphilis,** especially in the primary and secondary stages. This is due to its acting as a parasiticide for *Spirochæta pallida*, the organism which is the cause of this disease.

Toleration.—Age, sex and idiosyncrasy greatly modify the action of mercurials. Children as a rule bear mercury better than adults, and males better than females. Patients suffering from granular kidney, scrofula, scurvy and malarial cachexia are peculiarly susceptible to this drug. Some are so peculiarly susceptible to this drug, that very small doses may cause salivation. The writer treated a patient in whom 3 grs. of calomel with compound colocynth extract produced severe mercurialism although he was purged by the pill. Pregnancy is no bar to the administration of mercury.

Acute toxic action.—This is generally due to accidental or suicidal swallowing of tablets, or solutions of the perchloride, and has been known to follow on the retention of strong solution used as uterine or vaginal douches. If a strong solution is swallowed there is local corrosive action of the mouth, œsophagus and stomach which are soon followed by abdominal pain, vomiting, purging, and the passage of serous and bloody stools. The urine becomes albuminous and bloody, and the total suppression follows with delirium, coma, collapse and death. In a recent case under our observation severe hæmatemesis and melæna together with anuria were prominent symptoms preceding death.

Treatment.—White of several eggs should be given immediately so as to form a non-corrosive albuminate, followed by immediate lavage of the stomach. After this a pint of milk may be introduced into the stomach which may be removed by lavage if vomiting continues. If the stomach permits, early feeds of milk alternating with potassium bitartrate mixture are useful. Irrigation of the colon morning and evening is also advisable. This is continued until no mercury is found in the urine on two successive days. There can be no doubt that the use of the alkalies seems to give the best protection against development of tubal nephritis. If the anuria is not overcome copious fluid injection may lead to pulmonary œdema.

Chronic toxic action, Hydrargyrism or Mercurialism.—This is now rare, but occurs occasionally either as the result of accident or malpraxis, and among workers in mercury. The first indications of mercurial poisoning are fœtor of the breath and soreness of the gums (the medicinal administration of mercury should not go further), soon followed by a disagreeable metallic taste ; swollen, red, spongy gums, bleeding on the least touch ; and increased salivary discharge. These symptoms increase, the tongue becomes furred and swells, the tonsils and pharyngeal glands enlarge, there is swelling and tenderness of the parotids and submaxillary glands, the teeth get loosened, the gums recede and become ulcerated, the saliva gets thick and viscid, and pours out of the mouth, fever and depression set in, etc. If the dose is large and long continued these symptoms are aggravated, and end in the falling out of the teeth, ulceration and abscess of the mouth, necrosis of the jaw-bones, great prostration, anæmia, emaciation, repeated hæmorrhages, and death.

Protracted exposure to a moderate degree of mercurial vapour produces a different train of symptoms generally known as **mercurial tremor.** Besides the cachectic symptoms there are muscular tremors, first beginning at the face, then invading the arms and the legs, extreme weakness of the affected muscles (mercurial palsy), mental weakness, and functional disturbance of special sense. These tremors differ from those of paralysis agitans in that they are increased by attempts at voluntary movement, *i.e.* they are " intention tremors."

Metallic mercury vaporizes even at the ordinary temperature and may produce poisonous effects even though the evaporating surface be small, if the emanations from it continue for any length of time

Several cases are on record in which mercurial cachexia has resulted from vaporization of the mercury with which the backs of mirrors are coated.

Therapeutics of Mercury and its Salts

The therapeutic uses of mercury are four fold : *externally* they are (1) antiseptic, (2) antiparasitic ; *internally*, (3) anti-syphilitic, and (4) cathartic.

Externally.—As an **antiseptic,** cyanide and perchloride of mercury are used, but the solution of the latter is largely employed for **disinfecting** purposes, as well as in **surgical** and **obstetric** practice. A lotion (1 in 1000) is strong enough for washing infected rooms, furniture, articles, linen, the surgeon's and gynæcologists' hands, the parts to be operated upon, and for moistening dressings, towels, wool, etc. A lotion (1 in 10,000) may be ordinarily used for washing wounds and ulcers, but the former strength can be advantageously employed if they are foul or of syphilitic origin. In obstetric practice a solution of 1 in 5000 is the strength ordinarily used for irrigation of the vagina and uterus, but its strength requires to be diminished to 1 in 10,000 if used continuously for any length of time.

Professor Lockwood prefers the lotion of the *soluble* iodide, as this salt does not combine with albumin and there is therefore less risk of absorption. Moreover it does not give the

wound that " pickled " appearance which results from the use of the perchloride.

The following are the disadvantages of perchloride of mercury as a disinfectant :

(1) It is very poisonous to man.

(2) It corrodes metals.

(3) It combines with albumin—forming an albuminate, on which account it is not good for the disinfection of fæces, unless an acid is also present.

As a parasiticide.—Citrine, oleate and white precipitate ointments and perchloride lotion (1 to 2 grs. in 1 oz. of water) are employed to destroy the fungus of **tinea,** such as of ringworm, mentagra, and **favus ;** and **animal** parasites, such as the various kinds of lice and their nits and the *Acarus scabiei.* The red oxide or citrine ointment is very effective in **tinea ciliaris.** The eyelashes should be cut short and the scabs removed before the application of the ointment, which may be diluted if necessary. The oleate is a useful application in **pityriasis versicolor.**

As a remedy for pruritus.—Blue ointment, calomel ointment (1 dr. to 1 oz.), black wash and yellow wash relieve the distressing itching of many **skin diseases,** such as urticaria, prurigo, pruritus ani, pruritus pudendi, psoriasis, lichen, pityriasis of the scalp and eczema. If applied with care and not to a large area, there is very little danger of salivation.

As a stimulant and promoter of absorption.—The plaster, the liniment and the various ointments, such as oleate, red precipitate, Scott's and red iodide are used for dispersing **glandular enlargements,** as buboes ; and for promoting the absorption of inflammatory products, as in **chronic joint disease, chronic peritonitis** and **periostitis.** Red iodide of mercury ointment is a good application for **goitre,** especially if the patient be made to sit in the sun or before a fire immediately after the application has been made. It is also said to absorb **bony tumours** and outgrowths of horses and cattle.

As an antiphlogistic.—Diluted citrine ointment if applied over **whitlows** and **boils** and then covered with plaster rapidly causes them to abort. Marshall strongly recommends oleatum hydrargyrum (liquid) 5 p.c. with morphine (1 in 60) **in synovitis, articular inflammation, mammary** and other glandular inflammations, **tonsillitis, epididymitis, threatened suppuration** or abscess, etc. Mercurial ointment is useful in **onychia** and **paronychia.** A ten minutes' application followed by a poultice every hour cuts short the inflammation.

As a specific.—Mercurial ointments, black wash and yellow wash are always prescribed for dressings over chancres and other syphilitic sores. Blackwash is an unirritating application, when the sores are kept wet with a bit of lint soaked in it. Nothing is so good as to wash all suspicious sores with a

perchloride lotion (1 in 500). According to Ringer a cyanide of mercury lotion (5 to 15 grs. in water 1 oz.) is a good local application to syphilitic sores, such as those of the penis, throat, tongue, anus, etc. Besides their use in syphilitic sores, they are of great service in all varieties of skin diseases, originating from syphilis. Local use must be combined with internal administration.

Eye.—Mercury is used in certain diseases of the eye, *e.g.*, in **conjunctivitis, blepharitis** and **keratitis.** The yellow oxide $\frac{1}{10}$ to $\frac{1}{4}$ p.c. in vaseline) is generally used. Finely powdered calomel is also applied locally in syphilitic and other affections of the eye (Phlyctenular ophthalmia). When applied in this way it is important to bear in mind that potassium iodide must not be simultaneously administered internally, otherwise it will appear in the lachrymal secretion and then, mixing with the calomel, will produce an iodide of mercury, and violent inflammation of the eye will be the result.

Internally. **Gastro-intestinal tract.**—Local **syphilitic sores** in the mouth soon heal under the use of the perchloride mouth-wash (perchloride 4 grs., acid. hydroch. dil. 10 ms. in water 10 ozs.). **Vomiting** in infants whether occurring immediately after feeding or at other times is stopped by grey powder in $\frac{1}{12}$ gr. or $\frac{1}{3}$ gr. given every two or three hours (Ringer). **Infantile diarrhœa** whether acute, subacute or chronic, with clay-coloured, offensive, or dark green, or slimy, or curdy stools, soon yields to small doses of calomel or grey powder. In **infantile cholera,** the vomiting and purging are soon arrested by an hourly dose of grey powder ($\frac{1}{2}$ gr.). While fractional doses of calomel have been found useful in the early treatment of cholera. In that form of **quinsy** or **scarlatina,** in which the difficulty in breathing is insuperable, Ringer recommends $\frac{1}{8}$ gr. of grey powder every hour. Cases of obstinate **hiccough** have been checked by small doses of calomel. Blue pill or calomel is given as a **purgative** but it should never be prescribed to habitual opium-eaters, or to a patient under opium treatment, for fear of absorption and constitutional symptoms. In every case, it is a good plan to follow the mercurial by a saline aperient. Perchloride of mercury $\frac{1}{100}$ gr. given hourly, or every two hours, has been recommended by Ringer in **chronic diarrhœa** of adults marked by pale watery stools, and in acute and chronic **dysentery.** A full dose as large as can be borne has sometimes produced wonderful results in **ulcerative enteritis.** Calomel or grey powder in small doses or as a purgative clears the thickly coated creamy tongue of many acute diseases.

In **biliousness** or **hepatic derangement** due perhaps to free living, a dose of blue pill or calomel at night, followed by a dose of compound senna mixture, or Seidlitz powder or compound liquorice powder next morning, produces excellent results.

Inflammatory diseases.—Few now prescribe mercury in **acute inflammatory diseases,** except in **iritis,** but there are many who yet use it in **meningitis** and inflammation of the serous membranes.

Dropsy and ascites.—Calomel given several times a day acts as a diuretic in **cardiac dropsy.** Its efficacy is greatly increased if combined with digitalis and squill, as in Guy's pill (*see* digitalis). It is said also to benefit, though temporarily **ascites** due to **cirrhosis** of the **liver.** It should not be given in renal dropsy.

Syphilis.—All recent investigations tend to establish even more firmly the importance of mercury in the treatment of syphilis, and without underrating the value of the organic arsenical preparations in the treatment of this disease the fact remains that we cannot do without mercury. It is true that in these modern days injections of various salts, soluble and insoluble, have somewhat replaced oral methods of administration, as in this absorption is uncertain and there is a great liability to gastro-intestinal disturbance. But if a patient cannot be kept under the close supervision which the treatment by injection or inunction necessitates, then oral administration is of value. Its efficacy is more marked in primary and secondary syphilis, but opinions differ as to its efficacy in tertiary syphilis. The adminsitration should be started as soon as the disease is diagnosed, and it is now recognised that the chances of success are greater the earlier the treatment is commenced. For the treatment of syphilis mercury may be administered by the following methods :—

1. *By the mouth.*—This is by far the most convenient route, but it is rather difficult to administer sufficient mercury on account of its effect on the digestive tract. The preparations used by this route are innumerable. Blue pill, grey powder, calomel, either with opium or as Plummer's pill, are generally used, but they are liable to bring on stomatitis and diarrhœa. Protoiodide and sublimate are probably the most reliable remedies given internally. Ricord's celebrated pills have the following formula :—

℞

Protoiodide of Mercury	3 grms.
Ext. Henbane	1 grm.
Treacle	3 grms.
Conf. Roses	6 grms.

Mix div. into 60 pills.

Each containing $\frac{1}{20}$ grm. of protoiodide.

Dupuytren's pills are an example of the use of perchloride of mercury. ℞ Hydrarg. Perchlor. $\frac{1}{8}$ gr., Ext. Opii $\frac{1}{3}$ gr., Ext. Guaiaci $\frac{2}{3}$ gr. The dose may be gradually raised avoiding salivation and always remembering variation in toleration. The mouth must be kept clean during the treatment. It is better to use the protoiodide in the early secondary and keep

the sublimate for the late secondary and tertiary stages. With the sublimate gastric intolerance is frequent but salivation is not marked, with the protoiodide gastric intolerance is infrequent but stomatitis is more common.

2. *By the rectum.*—Mercurial suppository is used for local action.

3. *Fumigation.*—Volatilized calomel is administered by this method, simultaneous diaphoresis induced either by steam or internal use of jaborandi, helps its action. Fumigation sometimes causes great weakness and prostration. It is hardly used in these days.

4. *Inunction.*—By rubbing blue ointment, liniment, or oleate of mercury into the skin, mercury can be rapidly introduced into the blood. The inner surface of the thigh or the axilla is a suitable spot for inunction. This method is specially useful for the treatment of young children ; 20 to 60 grs. of blue ointment may be rubbed in nightly or every other night. The site of rubbing should be varied for fear of local irritation. The German ointment (1 of Hg. in 3) is no doubt superior to the B.P. preparation, but much of the success of the treatment of syphilitic cases at Aix is due probably to the superior climate of the place and the regulated life of the patient. The advantage of this method is that digestion is not disturbed, but it is dirty and disagreeble. It takes a longer time and the absorption is uncertain.

5. *Endermically.*—Calomel is dusted over raw blistered surfaces or ulcers, or mercurial lotion applied. Mercury may thus be absorbed.

6. *Injection.*—This may be *intravenous* or *intramuscular.* Where a very quick effect is desired and in cases where organic arsenical preparations are undesirable the intravenous injection of 1 c.c. of 1 p.c. solution of the perchloride every other day has been suggested. but there is risk of embolism, and production of toxic symptoms. The metal is also rapidly eliminated. As regards intramuscular injections the preparations may be *soluble* or *insoluble.* The advantages of the soluble preparations are that being more speedily absorbed their effect is more rapid and the exact quantity absorbed is known. The disadvantage is that rapid absorption means frequent injections either daily or on alternate days. The advantage of the insoluble preparation is that a large dose of mercury is put in, which usually suffices for a week, and that from these " depots " the mercury continues to be absorbed for some weeks. On the other hand the disadvantages are—accuracy of dosage is impossible, toxic symptoms may continue long after suspending treatment by absorption from the above mentioned " depots." The injection is made deep into the gluteal muscle.

Amongst the soluble salts thus injected are the perchloride $\frac{1}{3}$ gr. dissolved in 17 ms. of distilled water, to which a little sodii chloride $\frac{1}{6}$ gr. is added ; or the mercury biniodide in strength of $\frac{1}{3}$ gr. The most powerful, and undoubtedly the

most effective of the insoluble salts is calomel. Formerly "Grey Oil" was used but this has been replaced by "Calomel Cream," the injection of which has the following advantages

(1) It is painless.

(2) It is absorbed slowly and slowly excreted.

(3) It is less likely to produce stomatitis and gastro-intestinal irritation.

(4) The therapeutic effects are more lasting.

Intraspinal injection of mercurialised serum has been advocated for the treatment of **cerebrospinal syphilis.** It is prepared by adding 1 p.c. of 0.13 per cent. mercuric chloride to 12 c.c. of normal human or horse serum, heating to 56°C. for one-half hour, when a clear solution is formed. This dose is injected by gravity, at body temperature. The cerebrospinal fluid is first withdrawn till its pressure is 30 mm.

Caution.—Unless appetite and digestion are good mercury should not be given by the mouth. Weak, anæmic, and scrofulous subjects and those suffering from kidney disease cannot bear mercurials. For fear of absorption it should not be employed over a large area. Concentrated solutions should not be used as injections into the vagina and uterus.

Prescribing hints.—As a purgative mercury is usually prescribed in the form of either *calomel or blue pill.* They may with advantage be used at bed time to be followed by a saline, either black draught, Epsom salt, Glauber's salt or Seidlitz powder. Grey powder in fractional doses is a valuable remedy for children's dyspepsia. As antisyphilitics mercury is prescribed in the form of grey powder gr. 1, three or four times a day. To prevent looseness of the bowels it may usefully be combined with the same quantity of Dover's powder. This combination may be given in the form of pills, powders, or tablets. The administration of mercury should be stopped, or the dose reduced, as soon as the patient begins to complain of soreness of the gums. Inunction is best suited for children, and hot baths aid absorption and elimination of mercury. To avoid irritation of the skin the same surface should not be used daily. When mercury is not tolerated by the mouth the best method is the injection, and of the different preparations calomel cream is to be preferred. Being an insoluble salt it is less painful, and as the absorption is slow the injections are given less frequently, once or twice a week, than when a soluble preparation is used. As a diuretic mercury is given in the form of Guy's pill.

For external use the oleate is a very useful preparation and is non-irritant. The white precipitate ointment is a valuable antiparasitic and may be used diluted with equal parts of boric ointment. The student should remember that Liqr. Hydrarg. Perchlor. is incompatible with alkalies, and when combined with carbonate of ammonia it forms an

insoluble precipitate of ammoniated mercury, which is poisonous. With potassium iodide it forms potassium mercuric iodide. If however the carbonate of ammonia be added after this combination no precipitate of ammoniated mercury is formed. With tannic acid or substances containing it, salts of mercury form insoluble tannates.

CLASS B : **Iron and Manganese**

FERRUM. Iron. Fe

Syn. I.V.—*Loha*, Beng., Hind. *Louha*, Sans.

Source.—Annealed iron wire having a diameter of about 0.1 millimetre or wrought iron nails free from oxide.

Iron salts group themselves into three classes—(1) Ferrous or Protosalts based upon Ferrous Oxide FeO, (2) Ferric or Persalts (sesquisalts) upon Ferric Oxide Fe_2O_3, and (3) Scale Preparations. Ferrous salts soon become ferric from the absorption of atmospheric oxygen, especially in the presence of oxidising agents, as chlorine, nitric acid, etc.

OFFICIAL PREPARATION

1. **Vinum Ferri.** *Syn.*—*Steel Wine.*—1 of iron in 20. 3 drs. are equal to 5 ms. of Tr. Ferri Perchlor. **B.P. Dose.—1 to 4 drs. or 4 to 16 mils.**

FERRUM REDACTUM

Reduced Iron. Fe and Fe_3O_4

Source.—A fine powder containing not less than 80 p.c. of metallic iron with a variable amount of iron oxide ; prepared by reducing ferric hydroxide heated to redness, by a stream of dry hydrogen.

Characters.—A greyish-black powder, attracted by the magnet. *Impurity.*—Sulphur.

B.P. Dose.—1 to 5 grs. or 6 to 30 cgrms. ; U.S.P.—0.06 grm. or 1 gr.

OFFICIAL PREPARATION

1. **Trochiscus Ferri Redacti.**—0.06 grm. or 1 gr. in each. *Dose.*—1 to 6.

1. FERROUS SALTS

FERRI CARBONAS SACCHARATUS

Saccharated Iron Carbonate

A ferrous carbonate, more or less oxidised, mixed with glucose ; contains not less than 50 p.c. of ferrous salts calculated as ferrous carbonate $FeCO_3$.

Source.—Prepared by adding sodium carbonate 105, to a solution of 97.5 ferrous sulphate in 15 glucose and water, mixing the washed precipitate with 15 parts of glucose and drying.

Characters.—A greenish-brown lumpy powder, with a sweet chalybeate taste. *Impurities.*—Sulphates, excess of iron oxide.

Incompatibles.—Vegetable astringents, acids, and acid salts.

B.P. Dose.—10 to 30 grs. or 6 to 20 dgrms. U.S.P.—0.25 grm. or 4 grs.

Non-official Preparations

1. **Pilula Ferri Carbonatis. U.S.P.** *Syn.—Vallets' Mass*—A freshly precipitated iron carbonate made into a pill with glycerin, tragacanth, althea and sugar. *Dose.*—2 pills.

2. **Troch. Ferri Carb. Sacch.**—3 grs. in each. Largely used nowadays. *Dose.*—1 to 3.

FERRI PHOSPHAS SACCHARATUS

Saccharated Iron Phosphate.

Source.—Prepared by mixing glucose with a solution of ferrous sulphate adding sodium phosphate, in solution, and sodium carbonate, in solution, and drying the washed precipitate after further addition of glucose. Contains not less than 60 p.c. of ferrous salts, and calculated as ferrous phosphate. $Fe_3(PO_4)_2,8H_2O$.

Characters.—A slate-blue, amorphous powder, partly soluble in water. Taste sweetish, chalybeate. *Impurity.*—Arsenic.

B.P. Dose.—5 to 10 grs. or **3 to 6 dgrms.**

Official Preparations

1. **Syrupus Ferri Phosphatis.**—1 gr. of anhydrous ferrous phosphate in 1 dr. **B.P. Dose.—½ to 1 dr.** or **2 to 4 mils.**

2. **Syrupus Ferri Phosphatis cum Quinina et Strychnina.** *Syn.—Easton's Syrup* (modified).—1 gr. anhydrous ferrous phosphate, ⅓ gr. quinine sulphate, $\frac{1}{30}$ gr. strychnine in 1 fl. dr. **B.P. Dose.—½ to 1 dr.** or **2 to 4 mils.**

Non-official Preparations

1. **Pilula Ferri Quininæ et Strychninæ Phosphatum.** *Syn.—Easton's Pill.*—An equivalent for **Easton's Syrup.** Ferrous Phosphate 16 grs., Quinine Sulphate, 16 grs., Strychnine ½ gr., Milk Sugar 20 grs., Concentrated Phosphoric Acid *q.s.* Mix quickly, first having triturated strychnine with milk sugar, and divide into 16 pills.

2. **Syrupus Ferri Phosphatis Compositus, B.P.C.** *Syn.—Chemical Food, Parrish's Syrup* (modified).—Iron Phosphate ½ gr., Calcium Phosphate ⅘ gr. in 1 dr. Iron wire free from oxide 37½ grs., Concentrated Phosphoric Acid (sp. gr. 1.5) 1½ oz., Distilled Water 5 drs., put all in a flask plugged with cotton and dissolve by gentle heat, iron being under the liquid. Add this to the following when the latter has cooled :—

Precipitated Calcium Carbonate 120 grs., Concentrated Phosphoric Acid 4 drs., Distilled Water 2 ozs., ; mix and add Potassium Bicarbonate 9 grs., Sodium Phosphate 9 grs., filter, and set aside.

Cochineal 30 grs., Distilled Water 7½ ozs., boil for 15 minutes and filter, pouring over the filter water *q.s.* to make 7 fl. oz. of filtrate ; to this add refined sugar 14 ozs. and heat till dissolved and strain. When cold, add

the solution of phosphates, orange flower water 1 oz., and Distilled Water *q.s.* to 20 ozs. It should be kept in bottles quite full. *Dose.*—½ to 2 drs. or 2 to 8 mils.

3. **Glyc. Ferri Quininæ et Strychninæ Phosphatum.** *Syn.*—*Glycerole Easton.*—As a substitute for Easton's Syrup where sugar is not desirable. *Dose.*—15 ms. or 1 mil.

FERRI SULPHAS

Ferrous Sulphate. $FeSO_4,7H_2O$

Syn. I.V.—*Hirakas*, Beng. *Hira Kasus*, Hind.

Source.—Prepared by the interaction of diluted sulphuric acid and iron. Contains not less than 97.5 p.c. of pure ferrous sulphate.

Characters.—In oblique, rhombic prisms, of a pale greenish-blue colour and astringent taste. *Solubility.*—1 in 1½ of water. *Impurities.*—Persalts and other metals.

B.P. Dose.—1 to 5 grs. or 6 to 30 cgrms. ; U.S.P.—0.1 gm. or 1½ grs.

Official Preparations

1. **Mistura Ferri Composita.** *Syn.*—*Griffith's Mixture* (modified).—2½ grs. in 1 oz. **B.P. Dose.—½ to 1 oz. or 15 to 30 mils.**

Dispensing hints.—The mixture may be prepared and kept without iron sulphate which (2½ grs. per oz.) may be added when dispensed.

2. **Ferri Sulphas Exsiccatus.**—3 grs. equal to 5 grs. of ferri sulphas. A nearly white powder made by heating ferri sulph. till it loses part of its weight ; and powdering it fine. Contains not less than 77 p.c. of pure anhydrous ferrous sulphate. *Enters into.*—Pil. Aloes et Ferri. **B.P. Dose.—½ to 3 grs. or 3 to 20 cgrms. ; U.S.P.—0.06 gm. or 1 gr.**

3. **Pilula Ferri.** *Syn.*—*Blauds' Pill.*—1 Ferrous Carbonate in 5. Ferri Sulph. changes into carbonate. Both ferrous sulphate and sodium carbonate should be perfectly dry. **B.P. Dose.—5 to 15 grs. or 3 to 10 dgrms.**

4. **Pilula Aloes et Ferri.**—1 of iron and 2 of aloe in 10. **B.P. Dose.—4 to 8 grs. or 25 to 50 cgrms**

SYRUPUS FERRI IODIDI

Syrup of Ferrous Iodide

This is liable to discoloration either from the oxidation of iron, which may be removed by careful manipulation or by hypophosphorous acid , or from slight caramelisation of sugar by overheating. 3¼ gr. of ferrous iodide in 1 dr.

B.P. Dose.—½ to 1 dr. or 2 to 4 mils. ; U.S.P.—1 mil. or 15 ms. 2 ms. for a child one year old.

2 Ferric Salts

LIQUOR FERRI PERSULPHATIS

Solution of Ferric Sulphate. $Fe_2{}^3SO_4$

Source and Characters.—By dissolving ferrous sulphate in sulphuric acid and water and then boiled with nitric acid and water. A dark red astringent solution.

Enters into.—The preparation of Ferri et Ammon. Cit., Ferri et Pot. Tartras, and Ferri et Quin. Citras.

Non-Official Preparation

1. **Ferri Hydroxidum c. Magnesii Oxido, U.S.P.** *Syn.—Arsenic Antidote.*—Solution of ferric sulphate 40 mils.; mag. oxide 10 grms.; water *q.s.* to 1000 mils. *Dose. U.S.P.*—120 mils. or 4 oz.

LIQUOR FERRI PERCHLORIDI FORTIS

Strong Solution of Ferric Chloride

Source.—Prepared by boiling iron wire in hydrochloric acid and water, and after filtering, adding nitric acid and more hydrochloric acid, and evaporating.

Characters.—An orange-brown solution, miscible with water and alcohol. *Impurities.*—Ferrous salts and other metals. 110 ms. contain 20 grs. of iron.

Official Preparations

1. **Liquor Ferri Perchloridi.**—1 in 4. **B.P. Dose.—5 to 15 ms. or 3 to 10 decimils.** diluted freely.

2. **Tinctura Ferri Perchloridi.** *Syn.—Steel Drops.*—1 in 4. **B.P. Dose.—5 to 15 ms. or 3 to 10 decimils.,** diluted freely.

Non-official Preparations

1. **Liquor Ferri Dialysatus, B.P. 1885.**—Contains 5 p.c. of ferric oxide. A useful antidote to arsenic. A non-irritating tasteless hæmatinic, largely prescribed. It is in reality a colloid or undialysed iron, which does not pass through the septum; hence doubts are entertained as to its assimilation. But it is certain that patients improve under its use. *Dose.*—10 to 30 ms. or 6 to 18 decimils.

2. **Liquor Ferri Acetatis, B.P. 1898.**—*Hæmatinic, astringent* and *diuretic* in Bright's disease. *Dose.*—5 to 15 ms. or 3 to 10 decimils.

3. **Liquor Ferri Pernitratis, B.P. 1898.**—*Dose.*—5 to 15 ms. or 3 to 10 decimils.

4. **Liquor Ferri et Ammonii Acetatis, U.S.P.** *Syn.—Basham's Mixture.*—Tr. ferri perchlor. 4; acid. acetic. dil. 6; liquor ammon. acetatis 50; aromatic elixir 12; water *q.s.* to 100. *Dose. U.S.P.*—15 mils. or 4 drs.

3. Scale Preparations

FERRI ET POTASSII TARTRAS

Iron and Potassium Tartrate

Syn.—Ferrum Tartaratum B.P. 1898, Tartarated Iron.

Source.—Prepared like Ferri et Ammonii Citras with Acid Pot. Tartrate instead of Citric Acid.

Characters.—In thin, transparent, garnet-coloured scales. Taste somewhat sweetish, astringent. *Solubility.*—1 in 1 of water, sparingly in alcohol. *Impurities.*—Ferrous salts, ammonia.

B.P. Dose.—5 to 10 grs. or 3 to 6 dgrms.

FERRI ET AMMONII CITRAS

Iron and Ammonium Citrate

Source.—Prepared by mixing dilute solutions of ammonia and ferric sulphate, dissolving the resulting ferric hydroxide in hot solution of citric acid, neutralising the product with ammonia, evaporating and drying in thin layers on glass sheets.

Characters.—In dark red, transparent, thin scales. Taste slightly sweet and astringent. *Solubility.*—2 in 1 of water. Almost insoluble in alcohol (90 p.c.). *Impurities.*—Tartrates, sulphates.

Incompatibles.—Mineral acids, fixed alkalies and vegetable astringents.

B.P. Dose.—5 to 10 grs. or 3 to 6 dgrms. ; U.S.P.—0.25 grm. or 4 grs.

Official Preparation

1. Vinum Ferri Citratis.—8 grs. in 1 oz. B.P. Dose.—1 to 4 drs. or 4 to 16 mils.

FERRI ET QUININÆ CITRAS

Iron and Quinine Citrate

Source.—Prepared like Ferri et Ammonii Citras, freshly precipitated quinine being also dissolved in diluted sulphuric acid.

Characters.—In greenish golden-yellow somewhat deliquescent thin scales. Taste bitter. *Solubility.*—2 in 1 of water. *Impurities.*—Alkaline salts and other alkaloids instead of quinine.

Incompatibles.—Alkalies and their carbonates, tannin, vegetable astringents, potassium citrate.

B.P. Dose.—5 to 10 grs. or 3 to 6 dgrms, ; U.S.P.—0.25 grm. or 4 grs.

Additional Non-official Preparations and Derivatives of Iron

1. Ferri Albuminas.—A scale preparation fairly soluble in water, containing 5 p.c. of ferric oxide. Useful in *anæmia* and *gastric ulcer*. Striking results from the hypodermic injection of 10 to 20 ms. of aqueous solution. *Dose.*—3 to 10 grs. or 2 to 6 dgrms.

2. Ferratin.—A tasteless brown powder prepared from egg albumen and Ferri et Sod. Tartras, containing iron 7 p.c. The most easily assimilable preparation known. *Dose.*—10 to 30 grs. or 6 to 20 dgrms. per diem.

3. Ferri Lactas.—In greenish white crystals, soluble 1 in 60 of water. *Dose.*—2 to 10 grs. or 12 to 60 cgrms.

4 Ferro Somatose.—A tasteless soluble brown powder containing albumose of meat (somatose) and ferric oxide 4.5. p.c. Easily assimilable in *anæmia and chlorosis*. *Dose.*—75 to 150 grs. daily. **Iron tropon is a** similar compound with nutrient tropon. *Dose.*—1 dr. thrice daily.

5. Ferri Succinas.—A reddish brown insoluble powder. Removes biliary calculi and relieves hepatic colic. *Dose.*—2 to 5 grs. or 12 to 30 cgrms.

6. Intramine. *Syn.—Di-ortho-amino-thio-Benzine.*—Originally prepared by oxidising o-amino-phenyl-marcaptan with ferric chloride. Later it is prepared by heating aniline and sulphur. An organic amino compound

in pale yellow crystals. Prepared for therapeutic use in 0.1 p.c. colloidal aqueous suspension or emulsion, or in sterile oily cream. *Dose.*—Intramuscularly.—2½ c.c. of the cream.

Intravenously.—20 to 100 c.c of 0.1 p.c. emulsion. In *syphilis* and other *protozoal diseases*, also in *tuberculosis* and *leprosy*.

7. **Ferrivine.**—*Ferri Sulphanilas.*—Contains iron in colloidal form; acid in reaction and does not oxidise when exposed to the air. Used in syphilis and other protozoal diseases in conjunction with **Intramine.** *Dose.*—Intravenously 100 c.c. containing 1 grm. of the compound diluted before use.

8. **Liquor Hypophosphitum Compositus, B.P.C.** *Syn.*—*Liquor Ferri-Hypophosphitis Comp.*—2 grs. each of Sodium and Calcium Hypophosphite, 1 gr. of Magnesium Hypophosphite, and 1½ grs. Ferric Hypophosphite in 1 dr. *Dose.*—½ to 2 drs. or 2 to 8 mils.

9. **Syrupus Hypophosphitum Compositus, B.P.C.**— $\frac{1}{120}$ of Strychnine in 1 dr. Strychnine 0.012, Hypophosphorous Acid 0.625. Dissolve, and add it to the following solution —Calcium Hypophosphite 10; Manganese 0.5, Potassium 0.5, Quinine 0.25, Chloroform Water 10. Add strong solution of Ferric Hypophosphite 5, Sugar 70, dissolve without heat, and add Chloroform Water *q.s.* to 100. This is intended to be a substitute for **Fellow's Compound Syrup of the Hypophosphites.** *Dose.*—½ to 2 drs. or 2 to 8 mils.

Pharmacology of Iron and its Salts

Externally.—Iron salts have no action on the unbroken skin, and are not absorbed by it. **Ferrous** and **organic salts** are **feebly astringent.** A solution of ferric salt when applied to a denuded surface, mucous membrane, sores or ulcers, **coagulates** the **albuminous secretion,** as well as the **albumin** of the tissues. It also coagulates **blood** and **plasma.** Thus, the circulation of the part is greatly reduced by the compression of the coagulated albumin from outside and not by the contraction of the muscular fibres of the walls of the blood-vessels. If there is any **hæmorrhage,** it is readily arrested by (1) the compression of the blood-vessels from without, and (2) the plugging of the bleeding vessels by the clotting of the blood within them. Therefore it is a powerful **styptic.** The perchloride, the pernitrate and the persulphate of iron are all strong **local astringents.** The oxides of iron convert oxygen into ozone and are therefore **disinfectant.**

Internally. **Mouth.**—Iron **blackens** the **teeth** and the **tongue,** from the deposition of iron sulphide. This is supposed to be due to tannic acid of the food precipitating black tannate of iron, or to the sulphide of iron formed by the action of hydrogen sulphide present in carious tooth. It has a styptic taste, and the ferric salts have a similar action here as on the raw skin.

Stomach.—All iron preparations, in whatever form they are taken by the mouth, are mostly **converted** into **ferrous chloride** in the stomach, and not into an albuminate as has

been generally supposed. Even an albuminate is decomposed into a chloride. If given in excess, or if the food or the gastric juice is deficient, all iron salts (except the ferric chloride) will abstract the hydrochloric acid from the gastric juice, and impair digestion. On the other hand, strong acid salts set free an excess of acid, after the formation of the ferric chloride which acts as an **irritant** to the mucous membrane. Even the preparations of perchloride do this as they contain a large amount of free acid. The astringent effect of iron salts depends no doubt upon the amount of ferric chloride in the stomach.

Intestines.—Here too the iron salts undergo decomposition. The ferrous chloride coming in contact with the alkaline fluid becomes an oxide of iron, which remains dissolved in the intestinal fluid because of the presence of organic matters. The subchloride becomes the ferrous carbonate which is also soluble. Lower down they are again converted into sulphides and tannates by the sulphuretted hydrogen and tannic acid, this being derived from the vegetable food, and are passed out with the fæces, which are coloured black. Doubts are entertained as to whether the iron salts are absorbed by the intestines, but from the following it will be evident that they are.

Absorption.—There is a consensus of opinion that **organic compounds of iron** are absorbed by the gastro-intestinal canal, for the growing child derives all the iron necessary for its increasing growth and weight from its food. But opinions widely differ as to the absorption of inorganic compounds of iron. Indeed one school holds that inorganic preparations are not taken up by the gastro-intestinal tract. Buchheim's view is that inorganic compounds of iron are not absorbed, but exert their beneficial effect in anæmia by a stimulating action on the gastro-intestinal mucous membrane, whereby appetite and digestion are improved, and the extra food taken supplies the necessary iron to reconstitute the blood.

Bunge's theory is somewhat similar. He holds that inorganic iron cannot be absorbed, and that iron only in organic combination, as found in foodstuffs, can be utilised for the formation of hæmoglobin. He says that, in anæmia, digestion is greatly disturbed, and that alkaline sulphides are produced, which combine with the organic iron in the food, producing Fe_2S, which is an inorganic salt and therefore incapable of absorption. He argues that when iron is given in this condition, it combines with, and neutralises, the alkaline sulphides, thus protecting the organic iron of the foodstuffs and allowing it to be absorbed. The chief argument in support of these views is that when iron salts are given by the mouth they do not cause excretion of more iron in the urine or the bile. But it has been shown that the absence of iron from the urine and the bile is fully accounted for by its retention in the liver and subsequent excretion through the intestinal mucous membrane. Moreover it has been proved that mere stimulation of the

intestinal mucous membrane by other tonics does not cure anæmia, and Stockman has shown (*a*) that sulphide of iron, which cannot absorb alkaline sulphides, will cure chlorosis, (*b*) that bismuth which can neutralise more sulphides than iron, is quite useless for this purpose. The views of Bunge and Buchheim may therefore be rejected, and the modern view founded on histological evidence is that iron salts are **absorbed by the intestinal epithelium** and transferred to the white corpuscles of the blood, which convey them to the liver, where they are deposited and gradually elaborated into more or less complex organic substances, one of which is certainly Ferratin. These organic compounds then slowly pass into the general blood-stream, and are utilised by the great blood-forming organs, *viz.*, the spleen, the lympahtic glands and the red bone marrow. It will be seen that the liver must be regarded not only as a storehouse for iron, but as a place where iron is worked up into complex ferruginous organic compounds.

Blood.—In health iron has very little effect upon either the quantity or the quality of the blood-corpuscles, but increases the reserve iron, so that its transformation into hæmoglobin occurs only as required by the body. Thus in cases of anæmia both the number of corpuscles and their hæmoglobin value are markedly increased. In cases of this kind it is probable that iron acts in the following way: (1) The functional activity of the blood-forming organs, which is lowered or suppressed in anæmia, requires a stimulus or impulse. (2) Iron, when carried in the circulation to these organs, acts as a *chemical stimulus*, and not being an entirely foreign constituent is less injurious in its action than other stimulants. Hence iron is a splendid **hæmatinic.** An adult man contains about 3.0 to 3.5 gms. or iron, of which about 2.4 to 2.7 gms. are in the form of hæmoglobin. About 20 mgm. is excreted daily, and this loss is replaced by the iron of the food, and a minimum of 6 to 12 mg. is required to maintain this equilibrium. In the inorganic salts the iron exists in an ionic form. The organic preparations on the other hand contain the metal in the non-ionisable state. The various double salts contain iron in non-ionic form, but are easily dissociated. The food iron is exclusively organic iron and is generally in combination with neucleo-proteins.

Metabolism.—With the improvement of the red blood-corpuscles in anæmia, there is necessarily an increased absorption of oxygen, and an increased oxidation of tissues. Hence, the functional activity of all the organs of the body is stimulated, leading to the general improvement and the tone of the body. Iron is therefore a most valuable **general tonic.** As the whole system shares in this benefit, the menstrual flow, if it had been stopped, is re-established, and many disordered functions are rectified. Although these results are mainly indirect, depending upon the improvement of hæmoglobin,

the fact remains that iron is a constituent of all cells and some effects must be direct.

Kidneys and bladder.—Iron salts are feebly excreted by the renal cells. One milligramme is eliminated daily, and this seems to remain almost constant in all circumstances. The ferric salts slightly diminish the secretion of urine, while the other preparations have no effect, except the tartrate and the acetate, which slightly increase it. They may sometimes **irritate the bladder,** and may cause **nocturnal incontinence** of the urine in children.

Elimination.—Iron is excreted almost entirely by the rectum, a very small quantity passing out in the urine. Traces are also found in the gastric secretions. That it is absorbed and excreted in the manner described is proved by microscopical, chemical, and operative tests. The first is *microscopical.*—An animal is given a meal containing iron, and after sometime is killed and parts of the alimentary canal are hardened in alcohol and sections cut; the duodenum and rectal sections only will show under the microscope *distinct evidence of iron* (either prussian blue or black granules according to stain used) in process of absorption and elimination. The second is *chemical.*—An animal has a meal containing iron and is killed, the alimentary canal is slit up, pinned out and painted with ammonium sulphide solution when two zones stained black are noticed. The third is *operative.*—An animal upon which colotomy has been performed is treated with iron by the mouth. The lower part of the intestine is washed out daily and the washings analysed, although the upper bowel discharged by way of the colotomy wound, yet a small amount of the iron is found in the lower bowel, where it can only arrive by a *process of elimination.*

Therapeutics of Iron and its Salts

Externally.—Organic iron salts and ferrous salts except ferrous sulphate are not locally used. Iron undoubtedly has a strong astringent and styptic action, but it results in a dirty coagulation and irritation to the tissues, hence is not used in modern practice. The solution or the tincture of perchloride mixed with equal quantity of glycerin makes an excellent paint in **enlarged tonsils, diphtheria** and **sore throat.** The same may be used as a gargle well diluted. A solution of ferrous sulphate (10 grs. to 1 oz. of water) is an extremely useful local application in **erysipelas** and **erythema,** but it deserves to be noted that its stain on the linen is not removed by washing. Sometimes the tincture of perchloride may be painted for the same purpose. Ferrous sulphate or copperas has been used as a disinfectant for cesspits, water closets, etc. It acts by precipitating the proteins which mechanically carry down the bacteria.

Internally. **Gastro-intestinal tract.**—As a rule the organic preparations are more easily assimilable than the inorganic. **Chronic diarrhœa,** rebellious to all manner of treatment, is sometimes wonderfully checked by the solution of pernitrate. **Chronic constipation** may often be successfully removed by ferrous sulphate and extract of nux vomica or extract of belladonna. Humid peroxide of iron is an antidote to **arsenical poisoning.** It can be prepared fresh by mixing a solution of perchloride 3 ozs., with bicarbonate of soda 1 oz., in solution, half an ounce being given every 5 or 10 minutes. Ferri Hydroxidum c. Magnesii Oxido, U.S.P. may be given in its stead in half ounce doses diluted. An enema of the tincture of perchloride of iron (1 dr. in 1 pint of water) kills **thread worms.**

Blood.—As a hæmatinic tonic, iron salts stand on a high level, and are used in endless aliments, such as **anæmia, chlorosis, scrofula, cardiac diseases, syphilis, Bright's disease, amenorrhœa, malarial cachexia, convalescence** from **acute** or **chronic illness,** etc. A few of them require more than a passing notice.

Anæmia and *Chlorosis.*—Ordinary forms of anæmia traceable to some definite cause, such as **scurvy, malaria, protracted discharges** or **recurrent passive hæmorrhage, lead poisoning, ankylostomiasis,** etc., are materially benefited by a course of iron, as well as by the removal of the cause, if possible. Iron is the most valuable remedy for **chlorosis.** Pilula ferri, ferrous sulphate and ferric perchloride are the preparations generally selected. If the anæmia is due to malaria, ferri et quininæ citras, Easton's syrup or pill may be given with advantage. The same preparations may also be employed as a tonic during convalescence after an acute-febrile attack or any other protracted illness. Iron, particularly the perchloride, is very useful in **recurrent passive hæmorrhage** from the nose, uterus or respiratory tract, or in **discharge** from the same or allied parts, as leucorrhœa. Iron is quite useless in the treatment of **pernicious anæmia,** and its value is doubted in the anæmia of *leucocythæmia, Hodgkin's disease* and *exophthalmic goitre.*

Bright's disease.—Acetate of iron is the most valuable remedy in this disease. It not only removes the anæmia, but lessens or removes the albumin. Basham's mixture is a very useful preparation in **chronic albuminuria.** With many the steel drops is a favourite remedy.

Amenorrhœa due to anæmia often yields to iron especially when given with potassium carbonate or aloes, as for example, Blaud's pill, Pil. Aloes et Ferri and Mist. Ferri Comp. with equal parts of decoction of aloes.

Scrofula, and other tubercular affections, are benefited by a course of iodide of iron.

Erysipelas, diphtheria and many forms of bad sore throat, such as **hospital sore throat,** are remarkably benefited by large doses (15 to 30 ms.) of tr. ferri perchloridi given every one or two hours. Many recommend steel drops in **puerperal fever.** But the tendency of the present day is to ignore the value of this tried drug.

Nervous system.—Iron cannot directly influence the nervous system, but indirectly it does by improving the nutrition and the general functions of the bodily organs. It has been found efficacious in **chorea, hysteria, neurasthenia,** and in many nervous and subjective symptoms commonly associated with the climacteric period. Easton's syrup or pill, syr. hypophosph. comp., syr. ferri hypophosph., may be selected with advantage.

Caution.—The following points should always be remembered during the administration of iron :—

1. Iron sometimes irritates the stomach even of healthy persons.
2. Begin with one of the milder preparations and give it after meals.
3. Use it very cautiously in plethoric subjects, or in those who are predisposed to apoplexy.
4. Change your preparation from time to time during a long course of iron treatment, or stop it at intervals.
5. If iron causes constipation, combine it with purgatives.
6. If iron causes headache or indigestion, stop it at once.

Prescribing hints.—The choice of a preparation sometimes becomes difficult to a young practitioner. He should distinguish an astringent from a non-astringent preparation, and bear in mind that there are a few, such as the iodide, arsenate, phosphate, and citrate with quinine, whose value depends, mainly or to some extent, upon the other ingredients they contain. The organic salts are non-astringent. Of the inorganic salts, the ferrous salts are less astringent than the ferric salts. Although both organic and inorganic preparations are absorbed and produce therapeutic effects, the ionised iron is more active therapeutically. All iron preparations should be given after meals except reduced iron, which should be given before meals to enable the gastric juice to act upon it. These salts may be given in powder, pill, mixture or hypodermically. The perchloride is largely employed in various ways, as a gargle, pigment, spray, dressing (*e.g.* cotton or lint soaked in solution 15 p.c.), rectal or urethral injection, or mixture. If given in a mixture, glycerin or lemon juice pretty well covers the ferruginous taste. The infusion of quassia, calumba or chiretta may be used as a vehicle as they do not contain tannin. The constipating property of iron salts is best removed by magnesium sulphate, if given in a mixture ; or by aloes or rhubarb if in pill. The inky colour which results if they are combined with cinchona or digitalis, is cleared by the addition

of a few drops of diluted phosphoric acid. The action of iron is not affected by this chemical change. By addition of alkali the acid reaction of the iron salts and their astringency are lessened, and therefore Blaud's pill and Griffith's mixture are so well borne. Syr. Ferri Phosph., and Syr. Ferri Iodidi should be given alone diluted. Syr. Ferri Iodidi when prescribed with acids liberates iodine, and with alkalies will throw down insoluble iron compounds. When combined with Fowler's solution carbonate of iron is precipitated. Ferrous sulphate is given in pill and if it is intended for action on the intestine it should be coated with keratin. To prevent the blackening of the teeth, the iron mixture should be swallowed through a glass tube or a quill. Ferri et ammonii citras 5 p.c. solution, arsenite of iron, or ferri cacodylas are largely used hypodermically for the treatment of anæmia. Parrish's chemical food is an excellent preparation for children and delicate women. Citrate of iron and quinine should not be mixed with alkalies or alkaline carbonates as the quinine is precipitated. Being acid the tincture of perchloride should not be used with iodides as iodine will be liberated.

MANGANESIUM

Manganese. Mn. (*Not official*)

POTASSII PERMANGANAS

Potassium Permanganate. $K_2Mn_2O_8$

Source.—May be prepared by the interaction of potassium chlorate, potassium hydroxide and manganese dioxide. $6KHO+KClO_3+3MnO_2=3K_2MnO_4+KCl+3H_2O$. Contains not less than 99 p.c. of pure potassium permanganate. The potassium manganate becomes permanganate by boiling thus :

$3K_2MnO_4+2H_2O=K_2Mn_2O_8+4KHO+MnO_2$.

Characters.—Dark purple, slender, prismatic, iridescent crystals ; taste sweet, astringent. *Solubility.*—1 in 20 of cold water. *Impurities.*—Carbonates, chlorides, sulphates, and dioxide of manganese.

Incompatibles.—Oxidisable substances, especially organic ones, and any reducing agent.

B.P. Dose.—1 to 3 grs. or 6 to 20 cgrms.; U.S.P.—0.06 grm. or 1 gr.

Official Preparation

1. **Liquor Potassii Permanganatis.**—1 in 110 ms. Of a disagreeable taste. **Condy's fluid** is only of half the strength, and contains soda salt. **B.P. Dose.—2 to 4 drs. or 8 to 16 mils.**

Non-official Preparation

1. **Calcium Permanganate.** *Syn.*—*Monol.*—Brown, deliquescent crystals, soluble in water. Sterilises water (1 in 100,000). Useful in *enteritis* and *cholera*. *Dose.*—1 to 2 grs.

Pharmacology

Externally.—Potassium permanganate in its solid form is an irritant and even caustic, and in solution a stimulant. Apart from its local actions on the human body, it is a valuable **oxidising agent,** giving off oxygen when moist and in the presence of organic matter, thus destroying decomposing ferments and septic germs. Therefore, it is an **antiseptic, deodorant** and **disinfectant.** The only drawback is that the article is expensive and yields up oxygen too quickly, rendering it inert after a short time ; consequently its germicidal powers are limited.

Internally.—It is an unstable compound, being decomposed into manganese dioxide in the stomach, in which form it is probably absorbed. Manganese salts have no **hæmatinic** property as was once supposed ; in fact, nothing definite is known of their action on the blood and tissues. When injected into the blood, or subcutaneously they are excreted by the intestine and kidneys. Ringer considers it a useful **emmenagogue.**

Therapeutics

Externally.—For rapidly disinfecting stools and foul discharges, washing bed-pans, articles, and hands after contact with infectious diseases, for flushing water-closets and drains, potassium permanganate in solution (1 in 150) is used as an antiseptic and deodorant. Being odourless and non-irritant, it is best suited for use at the bedside. Fabrics are stained by it, but the stain is easily removed by sulphurous acid ; but they must to immediately washed, otherwise they would be damaged by the sulphuric acid formed. A weaker lotion (2 grs. to 10 ozs. of distilled water) can be used as a wash for **foul or suppurating ulcers, abscesses, ozæna ;** or as a uterine or vaginal douche after **parturition** or in **cancer of the os.** Potassium permanganate is very largely used in the local treatment of **gonorrhœa.** Irrigations commencing with a strength of 1 in 8000 to 1 in 6000, and subsequently rising to 1 in 4000 or even 1 in 3000 are the favourite methods. Many substances have been used for this purpose, chiefly preparations of silver and zinc, proflavine and acriflavine, but it may be safely said that for all round work no better results are obtained than with potassium permanganate. A saturated solution (1 in 20) is an excellent application in **bites** by poisonous snakes and rabid dogs, if it can be immediately applied. A 15 p.c. solution can also be freely injected into the subcutaneous tissues for this purpose, but it must be noted that its contact with the virus is essential, and therefore it is useless to try it some hours after the bite has been inflicted and when the virus has entered the circulation. Its use in the bites of poisonous snakes has been strongly advocated by Lauder Brunton and Rogers.

Internally.—Potassium permanganate makes a very effective gargle (2 grs. to 10 ozs. or the official solution diluted to 1 in 50) in **foul and ulcerative** diseases of the gums, mouth and throat, such as **ulcerative** and **gangrenous stomatitis.** On account of its powerful oxidising property, it is supposed to render certain poisons harmless, and therefore has been recommended in phosphorus, hydrocyanic acid, opium, morphine and other alkaloidal poisonings. An an emmenagogue it is recommended in **delayed, deficient** or **arrested menstruation.**

Rogers strongly urges the administration of a drink of calcium permanganate gr. 4 to the pint of boiled water in cholera. It may be given *ad libitum*, at the same time he administers pills of 2 grs. of potassium permanganate, made up with kaolin and coated with salol, every ½ hour until the stools become greenish in colour, and then at longer intervals. This treatment combined with injection of hypertonic saline solution has yielded brilliant results.

It can be given in pill or solution. There is a danger of ulceration being caused by the tablets. Liqr. Pot. Permanganatis is disagreeable to swallow.

CLASS C

Lead, Silver, Zinc, Copper, Bismuth, Alum

PLUMBUM. Lead. Pb. (*Not official*)

Syn. I.V.—*Sisa*, Beng. *Sisak*, Sans.

PLUMBI ACETAS

Lead Acetate. $Pb(C_2H_3O_2)_2, 3H_2O$

Syn.—Sugar of Lead.

Source.—Obtained by dissolving lead oxide or lead carbonate in acetic acid. $PbO+2HC_2H_3O_2=Pb(C_2H_3O_2)_2+H_2O$. Contains not less than 99.5 p.c. of pure lead acetate.

Characters.—Small, white, monoclinic prisms, slightly efflorescent; odour acetous; taste sweet, astringent. *Solubility.*—1 in 2.5 of water, 1 in 30 of alcohol (90 p.c.). *Impurities.*—Carbonates, chlorides, nitrates, and other metals.

Incompatibles.—Mineral and tannic acids and their salts, alkalies, lime water, chlorides, iodides, preparations of opium, mucilage of acacia, and albuminous fluids.

B.P. Dose.—1 to 5 grs. or 6 to 30 cgrms.; U.S.P.—0.06 grm. or 1 gr.

OFFICIAL PREPARATIONS

1. Pilula Plumbi cum Opio.—12 p.c. opium, **B.P. Dose.—2 to 4 grs. or 12 to 25 cgrms.**

2. Suppositoria Plumbi Composita.—3 grs. (0.2 grm.) of lead and 1 gr. (0.067 grm.) of opium in each.

LIQUOR PLUMBI SUBACETATIS FORTIS

Strong Solution of Lead Subacetate

Syn. B.P.—Goulard's Extract.

Source.—Prepared by boiling together lead acetate, lead oxide, and water. $PbO + Pb(C_2H_3O_2)_2 = Pb_2O(C_2H_3O_2)_2$ lead subacetate.

Characters.—A clear colourless liquid, becoming turbid from exposure; taste sweet, astringent; reaction alkaline. 24 p.c. of subacetate.

Official Preparations

1. **Liquor Plumbi Subacetatis Dilutus.** *Syn. B.P.—Goulard's Lotion. Goulard Water.*—1 in 80 of liquor. A colourless liquid.
2. **Glycerinum Plumbi Subacetatis.**—Sp. gr. 1·48.
3. **Unguentum Plumbi Subacetatis.**—12·5 p.c. of liquor.

PLUMBI IODIDUM

Lead Iodide. PbI_2

Source.—Obtained by the interaction of lead nitrate or acetate and potassium iodide.

Characters.—A heavy, bright yellow powder. *Solubility.*—1 in 2000 of cold water, and 200 of boiling water.

Official Preparation

1. **Unguentum Plumbi Iodidi.**—1 in 10. In India benzoated suet may be used instead of benzoated lard.

PLUMBI OXIDUM

Lead Oxide. PbO

Syn. B.P.—Litharge. **Syn. I.V.**—*Mudra sung*, Beng., Hind.

Source.—Prepared by the action of air on melted lead. $Pb_2 + O_2 = 2PbO$.

Characters.—Pale yellowish-red, heavy scales. *Solubility.*—Completely in dilute nitric and acetic acids, insoluble in water. *Impurities.*—Iron, copper, carbonates.

Enters into.—The preparation of Liq. Plumbi Subacet. Fort., Plumbi Acetas, and the

Official Preparation

1. **Emplastrum Plumbi.** *Syn.—Diachylon or Litharge Plaster.*—A pale yellow solid, being a crude oleate, palmitate, and stearate of lead. Speaking *chemically* it is *soap*.

Enters into.—Emp. Hydrarg., Emp. Resinæ, Emp. Saponis.

Non-official Preparation

1. **Ung. Diachyli, B.P.C.** *Syn.—Hebra's Ointment.*—Lead Plaster 50, Ol. Lavender (by weight) 1, Olive Oil (by weight) 49, melt with heat. Useful in *eczema*, excessive perspiration of feet and *sycosis*.

Actions and Uses of Lead Oxide

The oxide has desiccant properties but it is scarcely ever used. Emplastrum plumbi is the basis of most of the plasters. It serves mechanically to hold the lips of *wounds* together, to protect **irritable surfaces,** and by its pressure to help the absorption of **effused products** or **indolent enlargements.**

Pharmacology of Lead Salts

Externally.—Lead salts have a feeble action on the unbroken skin, but on denuded and exposed mucous surface, wounds and ulcers, they produce the following definite effects. They (1) **precipitate the albumin of discharges,** and form an impervious coating on the surface; (2) **coagulate the albumin of the tissues** and condense them; and (3) act as local sedatives and allay itching. Thus they are local **astringents, antiphlogistics,** and local **sedatives.**

Internally. **Gastro-intestinal tract.**—Insoluble lead salts are tasteless. Soluble salts have a sharp astringent and sweetish taste. The same local actions as on the skin, occur in the mouth, stomach and intestines. Soluble salts are converted into an albuminate, partly in the mouth, and partly in the stomach and intestine, and are absorbed as such. Whatever remains unabsorbed is eliminated as a sulphide with the fæces, to which it imparts a leaden hue. In the intestines, lead salts perform two distinct functions, *viz.*—(1) they check the secretion of succus entericus, and (2) arrest or retard peristalsis. They are therefore powerful **intestinal astringents** and **hæmostatics,** producing constipation and arresting any hæmorrhage that may exist. They diminish the secretion of bile.

Blood.—Lead salts are supposed to enter the blood as an albuminate, chiefly by the gastro-intestinal tract and skin, but occasionally by the respiratory tract. Reaching the blood more rapidly than any other heavy metal except mercury, and being excreted slowly, they are apt to cumulate. The plasma is said to become more watery, hæmoglobin is diminished, and the red blood-corpuscles are reduced in number. Thus they induce **anæmia.**

Tissues.—Lead is freely taken up by, and remains in, the tissues of the body. The central nervous system, liver, kidneys and bones, are the principal seats of deposit. Thus being intimately connected with growing cells, it produces certain pathological effects, which are known as "*Plumbism.*"

Elimination.—Lead is slowly excreted by the urine, bile, sweat, milk, and especially by the intestines. It checks **excretion of urates** and predisposes to gout.

Acute toxic action.—Concentrated solutions of lead salts are irritant. Acute poisoning is rare, but has recently not been infrequently seen on account of the use of diachylon plaster as an abortifacient. Abortion

certainly follows its administration, but acute plumbism leading to paralysis, blindness, insanity, and death also sometimes occur. Burning pain in the stomach, dryness of the throat, thirst, vomiting, colic, constipation with slate-coloured stools, cold sweats, cramps in the legs, collapse; sometimes even stupor, coma, and convulsions are some of the symptoms induced by the acetate.

Antidotes.—Stomach-pump, zinc sulphate both as an emetic and antidote, followed by milk or the white of egg; dilute sulphuric acid. Sodium and magnesium sulphates are chemical antidotes, for they produce insoluble sulphates and open the bowels. Morphine or demulcent drinks to relieve colicky pain.

Chronic toxic action or "Plumbism."—Chronic poisoning by lead is very common and originates from the slow absorption and retention of minute quantities of the drug. Lead is therefore a **cumulative poison.** Workers in lead factories, and those who constantly handle lead, are very prone to poisoning, for they generally contaminate their food by their unwashed hands. Some wines, cosmetics, hair-dyes, snuff packed in lead-foil, and drinking-water stored in lead cisterns and pipes are also sources of danger.

The **symptoms** are characteristic. Besides impaired digestion, constipation, a sweetish taste in the mouth, intestinal colic, the formation of a **blue line** on the edge of the gums, most marked near the incisors, are the early symptoms. It is due to the deposit of the sulphide, the sulphur being obtained from the food and the tartar of the teeth. For the same reason a blue line may be noticed round the anus. **Severe cramps** in the calves of the legs next appear, followed by **paralysis of the extensors of the forearm,** leading to **wrist-drop.** The latter symptom is due to chronic peripheral neuritis of the motor nerves supplying these muscles. The affected muscles become the seat of fatty degeneration, but it is to be noted that the supinator longus usually escapes. The paralysis may extend to other muscles, and there may be general paraplegia or hemiplegia.

Saturnine lunacy and **saturnine epilepsy** may arise as the result of the action of the poison upon the nervous centres. Also **optic neuritis** and **blindness.** As lead prevents the **excretion of urates** from the blood, gouty inflammation of joints often ensues, especially in patients with a gouty diathesis. Chronic lead poisoning is also a very common cause of **granular kidney,** but we do not know whether this is due to the irritation caused by the lead salts, or to the gouty conditions produced by them. **Abortion** is a frequent complication, and for this reason diachylon plaster is often administered with criminal intent.

Treatment.—Avoidance of the poison. Atropine or belladonna to relieve pain and constipation. Potassium iodide to dissolve insoluble compounds and magnesium sulphate to remove them from the system, and prevent their re-absorption after they have been eliminated into the intestines. Morphine subcutaneously for colic, sulphur baths to help elimination by the skin, electricity and friction to paralysed muscles.

Lemonade, made with acid. sulph. dil. instead of tartaric or citric acids, milk diet, and strict personal cleanliness are the best methods of prophylaxis.

Therapeutics of Lead Salts

Externally.—Generally speaking, lead salts are useful in a variety of diseases:—(1) To *soothe irritation and control excessive discharge*, the lotions and ointments are employed in inflamed, painful, weeping **eczema,** irritable **ulcers** and **wounds.** The injection may be used with benefit in **vulvitis, leucorrhœa, gonorrhœa, gleet, otorrhœa,** etc. A lead and opium lotion (Ext. opii. 5 grs., Liq. Plumb. subacet. dil. 1 dr., and water to 1 oz.) is a good sedative and antiphlogistic application to **bruises, sprains** and other **cutaneous inflammations** such as **erysipelas,** etc. Diachylon ointment, alone or combined with zinc oleate or mercuric oleate ointments, makes a very effective non-irritant application. Lead collyria should never be used in **ulcerated cornea,** as a deposit of white lead may form, causing permanent opacity and blindness. (2) To *allay irritation and itching*, a lotion or ointment is used in **pruritus pudendi** (the cause being first removed), **urticaria,** etc. (3) As a *parasiticide*, iodide of lead ointment is used in **ringworm.**

Internally.—For its local astringent effects, glycerinum plumbi subacetatis, or gargle can be used in **tonsillitis, pharyngitis,** etc. Lead acetate is the only salt that is used internally. Its chief use is to check severe **diarrhœa** and **hæmorrhage** from stomach and bowels as in **typhoid fever** and **tuberculosis.** Pilula plumbi c. opio is a very valuable preparation in such cases. Lead suppository or an enema of acetate of lead may be employed to arrest **rectal hæmorrhages** and as an **astringent** in **chronic dysentery.** It is doubtful whether lead has any effect in **hæmoptysis,** though many physicians still prescribe it for this purpose, in combination with morphine.

ARGENTUM

Silver. Ag. (*Not official*)

ARGENTI NITRAS

Silver Nitrate. $AgNO_3$

Syn. B.P.—Lunar Caustic.

Source.—Prepared by the interaction of nitric acid and silver, $3Ag_2 + 8HNO_3 = 2NO + 6AgNO_3 + 4H_2O$.

Characters.—Colourless tabular crystals. Taste bitter, metallic. *Solubility.*—2 in 1 of water. *Impurities.*—*Other nitrates.*

Incompatibles.—Alkalies and their carbonates, bromides, chlorides, phosphates, iodides, acids (except nitric and acetic), alkaloids, and solutions of arsenic and tannin.

Dispensing hints.—It should be stocked and dispensed in amber-coloured or uranium bottles, and its pill massed with kaolin and paraffin ointment.

B.P. Dose.—¼ to ½ gr. or 16 to 30 mgrms. **U.S.P.**—0.01 gm. or ⅙ gr.

Official Preparations

1. **Argenti Nitras Induratus.** *Syn.—Toughened Caustic.*—Greyish-white or white cylindrical rods or cones. Obtained by fusing silver nitrate 95 grms. and potassium nitrate 5 grms., and pouring into moulds.

2. **Argenti Nitras Mitigatus.** *Syn.—Mitigated Caustic.*—Greyish-white or white rods or cones obtained by fusing silver nitrate 20 gms. and potassium nitrate 10 gms. as above.

Non-official Preparations

1. **Argenti Oxidum, U.S.P.**—In heavy dark brownish-black powder. Odourless with a metallic taste. Slightly soluble in water. *Dose. U.S.P.*—0.6 gm. or 1 gr.

Argentum Colloidale (Crede's). *Syn.—Collargol.*—Metallic silver in a colloid state. Its ointment (Argen. Coll. 15., Cera Alba 10, Adep. Benz. 75,) is rubbed in septic and inflammatory diseases with doubtful results.

2. **Protargol.** *Syn.—Argentum Proteinicum.*—A silver-protein compound. Contains 8 p.c. of silver. A powerful germicide. A ¼ to 1 p.c. solution makes a painless injection in *gonorrhœa.* A solution (¼ to 1½ gr. in 1½ ozs. of water) has been successfully used as a prophylactic against *gonorrhœal infection,* and internally in continued acute *catarrhal diarrhœa.* ¼ to 1 p.c. or up to 10 p.c. useful in *ophthalmia.*

3. **Albargin.**—Silver Gelatose. Contains 15 p.c. of silver. A 0.2 p.c. solution useful as an injection in *gonorrhœa.* 0·16 p.c. solution as a bowel wash in dysentery.

4. **Argyrol.** *Syn.—Vitellin.*—A combination of a silver salt with a protein obtained from wheat, contains 30 p.c. of metallic silver; very soluble in water, but not in alcohol. An excellent non-irritating application for mucous membranes. In *colitis* 1 p.c. solution as enema. For *cystitis* use 1 in 5000 solution. As a mild caustic 1 in 100. In ophthalmic practice 5 to 20 p.c. solution.

Pharmacology of Silver Salts

Externally.—Soluble silver salts unite chemically with the albumin of the tissues and discharges to form albuminates. but their action does not penetrate into the deeper tissues and is promptly checked by sodium chloride which changes it into an inert silver chloride. Applied to the unbroken skin in the form of a stick or concentrated solution, silver nitrate produces at first a white stain which soon becomes blackened by exposure to light. This stain peels off as a dry black-scale if the application is very light, or as a black slough if the application is prolonged. Hence it is a **caustic.** On a raw surface a solution of silver nitrate acts as an **excitant** and is (1) decomposed by the albumin of the plasma and discharges, and is precipitated as an albuminate which coats its surface, and (2) coagulates the blood both within and without them. It is therefore a local **astringent, hæmostatic** and **antiphlogistic.** All silver salts are powerful **antiseptics.** The nitrate 1 in 400 solution destroys typhoid bacillus in 24 hours, and 1 in 2500 will kill diphtheria bacillus.

Internally. **Mouth.**—Silver nitrate is decomposed by the albumin and chlorides of the saliva, and imparts an astringent taste. In a concentrated form it acts in the same way as on the skin. If the administration is prolonged, it produces a dark bluish discoloration at the edges of the gums and on the inside of the cheeks.

Stomach and intestine.—The undecomposed portion reaching the stomach is again acted upon by the hydrochloric acid and mucus, forming a double chloride of silver and sodium. In moderate doses it acts as an **astringent,** though this is doubted by some authorities, and in large doses it acts as a **gastro-intestinal irritant.** Peptones dissolve the nitrate readily, and the solution does not precipitate albumin. Silver is not absorbed in sufficient quantity from the gastro-intestinal tract to produce any general effect. Long continued use however produces discoloration of the skin, which shows that minute quantities are really absorbed.

Nervous system.—Many believe that silver in minute doses acts as a **nervine tonic** like copper or zinc. In toxic doses it is a **convulsant,** the convulsions being like those in strychnine poisoning followed by paralysis, with pulmonary œdema. According to Gowers, it blunts the polarity of the nerve-centres so that they are less easily influenced by external stimuli.

Skin.—If administered continuously, silver causes a leaden discoloration of the skin, due to the deposition of the reduced metal in all tissues of the skin except the *rete Malpighii*. Once deposited, it causes permanent disfigurement. It is believed that recovery from argyria is hastened by the use of hexamine.

Elimination.—Silver salts are excreted with the fæces as a sulphide, staining them dark-brown, and by the intestinal secretion and bile. A portion is deposited in the organs, particularly the kidneys and liver.

Acute toxic action.—Severe vomiting, general prostration, and nervous symptoms, particularly convulsions, are the chief symptoms.

Chronic toxic action.—If silver is given internally for a long time it causes impairment of digestion and nutrition, albuminuria, irregular cardiac action, paralysis as in lead poisoning, fatty degeneratian, and discoloration of the skin and other organs (*argyria*).

Antidotes.—In *acute poisoning* from accidental causes, mucilaginous drinks, such as thick gruel, should be immediately given to envelope the caustic; this should be followed by an emetic or stomach syphon. Common salt is the *chemical antidote*. White of egg, milk and water, and other demulcents may be given freely.

THERAPEUTICS OF SILVER SALTS

Externally. **Skin.**—The solid silver nitrate or mitigated caustic is of little value for destroying small **warts** or **excrescences.** It may be applied to **exuberant granulations, callous,**

indolent or **lupoid ulcers, fistulæ, chancres,** etc., because of its limited caustic and after-stimulating effects on them. It is a valuable caustic for **post-mortem wounds,** but not a reliable one for bites by poisonous snakes and rabid animals, as its action does not penetrate into the deeper layers. It arrests **bleeding** from **leech-bites.** It is a capital remedy (1 to 2 drs. in 1 oz.) for arresting the progress of **erysipelas** and threatening **boils.** A milder solution (5 to 20 grs. in 1 oz.) disperses threatening **bed-sores, herpes** and **eczema** if painted over the erythematous patches. It allays the itching of **pruritus.**

Eyes and nose.—A solution of silver nitrate (5 to 10 grs. in 1 oz.) cures **granular conjunctivitis** and **ophthalmia neonatorum.** The conjunctiva must first be rendered anæsthetic by means of cocaine. The silver solution is then applied with a camel-hair brush, and the excess of caustic afterwards neutralised by irrigation with normal saline solution. A weaker solution (1 to 4 grs. in 1 oz.) may be used as a collyrium in **purulent conjunctivitis.** A weak solution makes a valuable irrigation in **rhinitis.** Protargol 8 grs. to 1 oz. is largely used in conjunctivitis as eye-drops.

Ear.—Brushing the meatus with a strong solution of silver, avoiding the membrana tympani, often relieves intolerable **pruritus** of the meatus.

Genitals.—Solid caustic is still used for cauterising **granular** or **ulcerated os** and **cervix.** A strong solution may be injected into or painted within the womb in **endometritis** or **endocervicitis.** A weaker solution (1 to 2 grs. in 1 oz.) makes an effective injection in **gonorrhœa, leucorrhœa** and **pruritus pudendi** due to leucorrhœa. Irrigation (1 in 1000 to 10,000) has been successfully used in many cases of gonorrhœa. Injections of protargol are also useful in gonorrhœa.

Internally. **Alimentary canal.**—Unhealthy or chronic **ulcers** in the mouth quickly heal after being touched with mitigated caustic. A solution (10 to 20 grs. in 1 oz.) is an excellent application for **sore throat** acute or chronic, **pharyngitis, follicular tonsillitis** and **tubercular** and other **ulcerations** of the **larynx.**

Chronic diarrhœa, rebellious to other drugs, sometimes yields to silver nitrate. As an enema (10 grs. to 1 pt.), it has been successfully employed in **chronic dysentery** and **ulcerations** of the **bowels.** Albargin 1 to 2 grains to 1 oz. makes an excellent injection in cases of chronic bacillary dysentery and in colitic conditions.

Nervous system.—As a tonic it was formerly much esteemed in many nervous diseases, such as **locomotor ataxy, hemiplegia** and **epilepsy,** but the unpleasant symptoms of **argyria** are the chief barrier to its use, and on that account nitrate of silver is now very rarely used by neurologists.

Silver oxide is less irritating and has sometimes been found very useful in **gastrodynia.**

Caution.—To avoid **argyria,** the use of the drug must be suspended as soon as a dark line is noticed on the edges of the gums which may be removed by a course of acid tartrate of potassium. Its administration must be stopped for two weeks after two months' use, however small the dose may be. 100 grains should be the maximum dose per month.

Prescribing hints.—Silver salts are given in pills (*see* p. 87) after food, but if their local action on the stomach is desired they should be given on an empty stomach, preferably in solution. For application to the skin, a solution of the nitrate in nitrous ether is the best, as it does not run in drops, and it is a stronger preparation than the aqueous solution. The ordinary silver preparations are largely replaced by the argyrol, protargol and colloidal preparations.

ZINCUM. Zinc. Zn. (*Not official*)

Syn. I.V.—*Dasta*, Beng.

ZINCI CHLORIDUM

Zinc Chloride. ZnCl

Source.—Obtained by the interaction of zinc and hydrochloric acid.

Characters.—Colourless opaque deliquescent rods or tablets, or in granules, powerfully caustic. *Solubility.*—Freely in alcohol, water, and ether. *Impurities.*—Iron, lead, calcium, and sulphates.

Official Preparation

1. **Liquor Zinci Chloridi.**—1 ms.=3 grs. zinc chloride. Sp. gr. 1.53. *Note.*—On diluting this liquor with water a white precipitate of *basic oxychloride* is formed which may be redissolved by adding a trace of hydrochloric acid.

Pharmacology and Therapeutics

It is a powerful **caustic,** distinguished by its property of **burning deeply** and not spreading sideways like caustic potash and soda. It is also painless. The paste, made with zinc chloride, pulv. opii and hydrochloric acid mixed with flour or gypsum to prevent the action from extending too far, was formerly applied to **cancers, sloughing** or **unhealthy sores,** and **nævi.** Diluted it is applied to **ulcers.**

It has been used to destroy the **exposed pulp in carious teeth, warts, condylomata,** and **lupus,** and also as an **antiseptic in the treatment of wound,** which are covered with a mixture of zinc chloride 5 parts, zinc oxide 50 parts, water 50 parts. This causes them to heal without suppuration.

A solution of zinc chloride 1 part in 11 of distilled water is particularly useful as an antiseptic when applied to the cut surfaces in cases of **excision of the tongue, removal of the jaw, or operations about the anus and after amputations, and excisions in parts affected with putrid sinuses.** Under these circumstances it renders the wound incapable of putrefaction for

2 or 3 days, even though it be exposed to septic influences. Zinc chloride will also render aseptic a wound that has become septic, and an 8 p.c. solution is more energetic than a 5 p.c. solution of carbolic acid. At the same time it is useful in **checking parenchymatous oozing** after operation.

A weak solution of one or two grains *in a pint* of water is strongly recommended by Ringer, who states that if this solution be injected hourly during the day at the beginning of a **gonnorrhœa,** it will cure the disease in 24 to 48 hours.

An impure solution, known as **Sir W. Burnett's Disinfecting Fluid,** is a powerful deodorising solution, especially useful for disinfecting the utensils in the sick-room of fever patients ; it quickly permeates or disintegrates all organic matter with which it comes in contact. The chief objection to its use is that, although it is a violent poison, it is both odourless and colourless, and it is *by the accidental drinking of this fluid that most cases of zinc poisoning occur.* Zinc chloride is **never given internally.**

Toxicology.—The symptoms and treatment of poisoning by zinc chloride are practically the same as already described under the head of the caustic alkalies (*see* p. 164).

ZINCI SULPHAS

Zinc Sulphate. $ZnSO_4,7H_2O$

Syn.—White Vitriol.

Source.—By the interaction of zinc and diluted sulphuric acid.

Characters.—Colourless, transparent, prismatic crystals, with a strong metallic styptic taste. *Impurities.*—Lead, copper, iron, arsenic.

Incompatibles.—Alkalies and their carbonates, lime-water, lead acetate, silver nitrate, vegetable infusions and decoctions, and milk.

B.P. Dose.—1 to 3 grs. or **6 to 20 cgrms.** (tonic) ; **10 to 30 grs. or 6 to 20 dgrms.** (emetic). **U.S.P.—1 gm. or 15 grs.**

Official Preparation

1. **Unguentum Zinci Oleatis.**—1 in 2. With white vaseline as a basis.

ZINCI OLEOSTEARAS

Zinc Oleostearate

Source.—Prepared by dissolving hard soap and curd soap in water by aid of heat, then adding solution of zinc sulphate, washing and drying to a fine powder.

Characters.—A white amorphous powder with a faint odour of fat. Insoluble in water, in alcohol (90 p.c.), and ether.

ZINCI CARBONAS

Zinc Carbonate

Syn.—Zinc Hydroxycarbonate.

Source.—By the interaction of zinc sulphate and sodium carbonate.

Characters.—A white tasteless inodorous powder. *Solubility.*—It is insoluble in water; soluble with effervescence and without residue in dilute nitric acid. *Impurities.*—Sulphates, chlorides, copper.

Dose.—1 to 3 grs. (tonic); 10 to 30 grs. (emetic). Rarely used, except to make the oxide and acetate.

Non-official Preparations

1. **Calamina Præparata, B.P.C.** *Syn.—Prepared Calamine.*—Prepared by calcining native carbonate of zinc and reducing it to an impalpable powder. A pale pinkish brown powder, without grittiness.

2. **Ceratum Calaminæ, B.P.C.** *Syn.—Turner's Cerate.*—Calamine and yellow wax of each 15, olive oil 40. A useful application to *burns.*

3. **Lotio Calaminæ.**—Levigated Calamine 40 grs., zinc oxide 20 grs., glycerin 1½ ms., rose water to 1 oz. Elutriate the calamine and zinc oxide by triturating them in a mortar with successive portions of the water and decanting from the siliceous matter, and add the glycerin. Used in *eczema,* and *to conceal acne spots on the face.*

ZINCI OXIDUM

Zinc Oxide. ZnO

Syn.—Chinese White.

Source.—Prepared by the combustion of metallic zinc, or by heating the carbonate to redness in a crucible.

Characters.—A soft, nearly white, tasteless and inodorous powder, becoming pale yellow when heated. Insoluble in water. *Impurities.*—The carbonate and its impurities.

B.P. Dose.—3 to 10 grs. or 2 to 6 dgrms.

Official Preparation

1. **Unguentum Zinci.**—3 in 20. Made with Adeps Benzoata.

Non-official Preparations

1. **Pasta Zinci et Gelatini, B.P.C.** *Syn.—Unna's Paste, Gelatinum Zinci.*—Gelatin 4, water 16; soak 12 hours, then heat to dissolve, and add zinc oxide 6, previously rubbed down with glycerin 12. For use it is melted and applied with a brush to *eczematous* surfaces. This *gelatin basis* may be combined with ichthyol or resorcin.

2. **Pasta Zinci Co., B.P.C.** *Syn.—Lassar's Paste.*—Zinc oxide 24, starch 24, salicylic acid 2, vaseline 50.

3. **Pilula Zinci cum Belladonna, B.P.C.**—Zinc oxide 2 grs., extract of belladonna ½ gr. *Dose.*—1 or 2 at bed time. In *night-sweats of phthisis.*

4. **Zinci Phenolsulphonas, U.S.P.** *Syn.—Zinc Sulphocarbolate.*—Colourless, transparent, efflorescent crystals. Soluble 1 in 2 of water. As an injection in *gonorrhœa* (2 to 3 grs. to 1 oz.) *Dose. U.S.P.*—0.125 gm. or 2 grs.

ZINCI ACETAS

Zinc Acetate. $Zn(C_2H_3O_2)_2, 2H_2O$.

Source.—By neutralising zinc carbonate with acetic acid.

Characters.—Thin, translucent, colourless, crystalline plates, of a pearly lustre, and with a sharp unpleasant taste. *Solubility.*—1 in 2.5 of water. *Impurities.*—Those of the carbonate.

Incompatibles.—The same as of the sulphate.

B.P. Dose.—1 to 2 grs. or 6 to 12 cgrms. ; U.S.P.—0.125 gm. or 2 grs.

Pharmacology of Zinc Sulphate, Oleostearate, Carbonate, Oxide, and Acetate

Externally.—Their action resembles that of the lead and silver salts, *i.e.* they precipitate the albumin in the discharges and in the tissues, and are therefore **astringents** and **mild hæmostatics.** On the whole however they are less powerful, and the astringent action of the carbonate and oxide is very weak.

Internally. **Gastro-intestinal tract.**—All of them **have an** astringent action on the mucous membranes, and in large doses, with the exception of the oxide, they act as **direct emetics** ; their action being very prompt and not followed by depression.

Remote effects.—Very little is known on this point, nor do we know how zinc salts act on the blood, in which fluid they undoubtedly remain for a time, probably in the form of albuminates. They are gradually eliminated in the fæces and slightly by the kidneys. After a prolonged course of zinc salts symptoms of chronic poisoning may show themselves, closely resembling those of plumbism. They are said to have **a sedative action on the nervous system.**

In the zinc mines of Silesia the workmen suffer from obstinate catarrh of the respiratory and gastro-intestinal tracts, in consequence of inhaling the dust of zinc oxide, and this is followed by general cachexia, and occasionally by all the symptoms of tabes dorsalis. Experiments on animals have shown that another effect of the chronic toxic action of zinc is inflammation and fatty degeneration of the epithelium of the renal tubules.

Therapeutics of Zinc Sulphate, Oleostearate, Carbonate, Oxide, and Acetate

Externally.—Lotio rubra, or *red wash* (zinc sulphate 2 grs., tincture lavandulæ co. 15 ms., water 1 oz.) is an excellent stimulating and astringent application to all sorts of **wounds and ulcers,** and is used as an injection in **gonorrhœa, leucorrhœa, ulcers,** and **otitis.** The ordinary strength is 2 grs. to the

ounce, but 3 grs. is a better strength for leucorrhœa, and 1 gr. for otitis. Without the addition of the compound tincture of lavender, zinc lotion (1 or 2 grs. to the ounce) is used as a collyrium in **conjunctivitis,** provided that there be no ulceration of the cornea. The oleate, oxide or carbonate should be used in any of the various forms described above. Oxide of zinc is particularly useful for all the **skin affections of children** and the cremor zinci (zinc oxide 3, white vaseline 17, perfume *q. s.*) is invaluable for nursery use as a substitute for violet powder. Lassar's paste and the unguentum metallorum (*see* p. 209) are good applications for many varieties of **eczema.** Equal parts of zinc oleate, mercuric oleate, and diachylon ointment form an ointment which is a great improvement on the old unguentum metallorum, as it is transparent and the progress of healing can be watched without removing the dressing. All the preparations of calamine are excellent "drying applications" for the treatment of **intertrigo** and **skin diseases,** and Turner's cerate is especially good for **burns.** The gelatinum zinci often relieves obstinate **pruritus.**

Internally. **Gastro-intestinal tract.**—Sulphate of zinc is an *excellent emetic in cases of poisoning,* and is occasionally used for this purpose in croup and bronchitis, but it is not a safe emetic for very young children. When however an urgent action is required, a dose of 2½ to 3 grs. may be given to a child one year old, and the dose may be repeated in 15 minutes. To a child of 5 years old as much as 10 grs. may be given followed by copious draught of water. Small doses of the sulphate or oxide are occasionally given as **astringents** in **diarrhœa.**

Remote effects.—As nervous depressants, both the sulphate and oxide have been given internally in **hysteria, epilepsy, whooping cough,** and **chorea,** but it is probable that they are not of any value in the treatment of these diseases. Oxide of zinc, in combination with belladonna, is occasionally useful for checking the **night-sweats of phthisis.**

ZINCI VALERIANAS. *See* Valerian

CUPRUM. Copper. Cu. (*Not official*)

CUPRI SULPHAS

Copper Sulphate. $CuSO_4,5H_2O$

Syn.—Blue Vitriol, Blue Stone. Cupric Sulphate. **Syn. I.V.**—*Tutia,* Beng., Hind.

Source.—Obtained by the interaction of water, sulphuric acid, and copper or copper oxide.

Characters.—In blue triclinic prisms. ***Solubility.***—1 in 3.5 of cold water. Solution acid. ***Impurities.***—Iron and other metals.

Incompatibles.—Alkalies and their carbonates, lime water, mineral salts (except sulphates), iodides, and many vegetable astringents.

B.P. Dose.—As an astringent, ¼ to **2 grs. or 16 to 120 mgrms.** ; as an emetic, **5 to 10 grs. or 3 to 6 dgrms.** ; **U.S.P.—0.25 gm. or 4 grs.** as an emetic.

Non-official Preparations

1. Lapis Divinus, B.P.C. *Syn.—Cuprum Aluminatum.*—Powdered copper sulphate, potassium nitrate and alum, of each equal parts fused in an earthen crucible, $\frac{1}{10}$th part of powdered camphor being added towards the end. 2 grs. in 1 oz. of distilled water makes a good **eye-wash.**

2. Ung. Cupri Oleatis, B.P.C.—Copper oleate 1, lard 9 ; melt and mix. An excellent antiseptic and parasiticide. Useful in *ringworm*, hard and horny *warts* and *corns*.

Pharmacology

Externally.—Copper sulphate has no action on the unbroken skin, but is a **caustic** when applied to a raw surface or a delicate mucous membrane, such as that of the conjunctiva. In **dilute** solutions it constricts local blood-vessels, and it is therefore a **local astringent.**

Internally. **Gastro-intestinal tract.**—It combines with the tartar of the base of the teeth, when long continued, and causes a characteristic green line. This line is not in the gums themselves as it is in Plumbism. In small medicinal doses, it acts as an **astringent,** and in large doses, 5 to 10 grs., as an **emetic** like zinc sulphate. Emesis is caused by its direct local action on the stomach, and causes nausea and salivation. If it fails to induce vomiting, the stomach must be quickly emptied by other means, otherwise **gastro-enteritis** may result with symptoms of acute corrosive poisoning.

Remote action.—In minute doses copper sulphate is absorbed as an albuminate, and is said to act on the body like arsenic. It promotes assimilation and increases strength and flesh. Hence it is an **alterative** and **nervine tonic.** It paralyses the cardiac and the respiratory centres. It is stored in the liver.

Elimination.—Copper salts are thrown off by the gastro-intestinal mucous membrane, bile, urine, saliva, and sweat.

Acute toxic action is rare. In large doses copper salts produce violent gastro-intestinal irritation, with paralysis of the cardiac and respiratory centres.

Antidotes.—Emetics or stomach pump if there is no free vomiting ; white of egg, milk, or demulcent drinks, yellow prussiate of potassium, followed by opium and a warm poultice over the stomach.

Chronic toxic action.—Workers in copper or brass may suffer from anæmia, headache, debility, emaciation, indigestion, tremors, laryngeal and pharyngeal catarrh, occasional hæmoptysis, salivation, a green line at the bases of the teeth and occasional colic. In short a condition not unlike that of lead-poisoning.

THERAPEUTICS

Externally.—Copper sulphate in the form of sticks is used to destroy **exhuberant granulations,** and as a lotion 2 to 4 grs. to 1 oz. to stimulate **indolent ulcers.** Being not so strong as silver nitrate, it causes less pain when applied to **granular lids,** and to the edges of the eyelids in **tinea tarsi.**

Internally.—Very rarely used internally, but has been recommended in ¼ to 1 gr. doses in **actinomycosis** and **sporotrychosis.** For its **emetic** action, it is occasionally used in narcotic poisoning, and to expel false membranes or mucus from the air-passages in **diphtheria, laryngitis, croup** and **bronchitis,** especially where ipecacuanha fails. It is a valuable **antidote in poisoning** by **phosphorus,** for copper is deposited over phosphorus which is rendered inert. 3 grs. of copper sulphate should be given every few minutes until vomiting is induced and then a saline laxative. As a tonic it has been given in **epilepsy,** but without much success.

BISMUTHUM. Bismuth. Bi. (*Not official*)

BISMUTHI CARBONAS

Bismuth Oxycarbonate. $(Bi_2O_2CO_3)_2, H_2O$

Source.—May be prepared by the interaction of bismuth nitrate and ammonium carbonate (Bismuth nitrate is not official).

Characters.—A heavy whitish powder insoluble in water, soluble in nitric acid and water. *Impurities.*—The same as those of the subnitrate.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—0.5 gm. or 8 grs.

OFFICIAL PREPARATION

1. **Trochiscus Bismuthi Compositus.**—2 grs. in each. *Dose.*—1 to 6.

BISMUTHI SALICYLAS

Bismuth Salicylate. $BiOC_7H_5O_3$

Source.—May be prepared by the interaction of bismuth hydroxide and salicylic acid.

Characters.—A white, heavy, amorphous powder insoluble in water and alcohol (90 p.c.). *Impurities.*—The same as those of the bismuth subnitrate.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—0.5 gm. or 8 grs.

BISMUTHI SUBNITRAS

Bismuth Oxynitrate. $BiONO_3,H_2O$

Source.—Prepared by the interaction of bismuth nitrate and water, $(Bi3NO_3)+H_2O=(BiONO_3)+2HNO_3$.

Characters.—A heavy, white, inodorous powder consisting of minute crystalline scales ; reaction slightly acid. *Solubility.*—Insoluble in water. *Impurities.*—Nitrates, chlorides, tellurium, arsenic, lead.

Incompatibles.—Alkaline carbonates, potassium iodide.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—0.5. gm. or 8 grs.

Official Preparation

1. Liquor Bismuthi et Ammonii Citratis. *Syn. B.P.—Liquor Bismuthi.*—3 grs. of Bismuth Oxide in 1 dr. A colourless, neutral or slightly alkaline solution with a metallic taste. **B.P. Dose.—½ to 1 dr. or 2 to 4 mils.**

Non-official Preparations

1. Pasta Bismuthi et Iodoformi. *Syn.*—B.I.P.P.—Mix bismuth subnitras 1, iodoform 2, and stir in liquid paraffin 1 or *q.s.*

2. Pulv. Bismuthi Co. *Syn.—Ferrier's Snuff.*—Bis. Subnitrate 180, Morph. Hyd. 1, Powdered Gum Acacia 60. Mix. Useful in *coryza*. A pinch each time till the nostrils are cleared.

Additional Derivatives of Bismuth

1 Trepol.—Tartro-Bismuthate of Potassium and Sodium. Contains about 64 p.c. of active bismuth. Perfectly stable and does not produce any symptoms of toxicity. Mainly used in the primary and secondary stages of *syphilis*.

2. Neo-Trepol.—Contains 90 p.c. of bismuth. Gives better and quicker results than trepol. Both are used intravenously and intra-muscularly, and the injections are painless. Useful in tertiary stages and in old cases with no apparent lesions but with a positive Wassermann reaction.

3. Bis. Beta-naphtholate. U.S.P. *Syn.—Orphol.*—Less irritating than naphthol. A gastro-intestinal antiseptic and astringent. *Dose. U.S.P.*—0.5 gm. or 8 grs.

4. Bis. Oxychloride.—Impalpable non-irritating powder used as a cosmetic and as a sedative coating in irritable conditions of the mouth, throat, vagina, and rectum. *Dose.*—5 to 20 grs. or 3 to 12 dgrms.

5. Bis. Oxyiodogallate. *Syn.—Airol.*—A greyish-green powder used as a substitute for iodoform, and injected as an emulsion with glycerin (10 p.c.) in *gonorrhœa*.

6. Bis. Pyrogallate. *Syn.—Helcosol.*—A yellow powder soluble in alkaline secretions. Used as an antiseptic in skin diseases. *Dose.*—2 to 8 grs. or 12 to 50 cgrms.

7. Bis. Phenolate.—A greyish neutral powder, may be used as a substitute for iodoform and as an intestinal antiseptic. Contains 20 p.c. phenol. *Dose.*—10 to 30 grs. or 6 to 20 dgrms.

8. Bis. Sulphocarbolate.—An intestinal atiseptic. *Dose.*—4 to 8 grs. or 25 to 50 cgrms.

9. Bis. Subgallate. U.S.P. *Syn.—Dermatol.*—A yellow, odourless, non-irritating and non-poisonous powder, superior to iodoform as a dressing. It may be applied as a paste, powder, collodion, glue, or ointment. Found invaluable in *tubercular diarrhœa*. Has been used also in *gastric ulcer* and *cancer*. *Dose. U.S.P.*—0.5 gm. or 8 grs.

10. Bismuth Tannate.—A yellow powder, insoluble in water. Useful in *diarrhœa* and *dysentery*. *Dose.*—10 to 30 grs. or 6 to 20 dgrms.

11. Bis. Tribromophenol. *Syn.—Xeroform.*—A greenish-yellow powder. Powerful intestinal antiseptic, recommended in *cholera*. Used also as a dusting powder in place of iodoform. *Dose.*—5 to 20 grs. or 3 to 12 dgrms.

Pharmacology of Bismuth Salts

Externally.—Bismuth salts have no action on the unbroken skin, but applied to wounds they dry the secretions and form a protective covering and help healing. The action is purely mechanical. On the denuded surface they act as a **sedative,** mild **astringent** and **antiseptic.**

Internally. **Gastro-intestinal tract.**—Bismuth salts blacken the tongue, have no taste and produce a feeling of roughness in the mouth. The sparingly soluble salts in large doses and the soluble salts in small doses act as direct **sedative** to the mucous membrane of the stomach and intestine. They act physically by shielding the nerve-terminations from the irritating secretions, by forming an adhesive coating on the wall of the stomach and intestines, and so protect them from the irritation of food and secretions. As a consequence of this sedative effect, they act as **antiemetics** and **mild astringents.** They also control fermentation, especially the salicylate, sulphocarbolate, phenolate, etc., and are therefore **intestinal antiseptics.** Bismuth subnitrate splits up into bismuth oxide and nitric acid in water, liberating nitrous fumes which tend to contribute toward the antiseptic property of the drug. It passes out with the fæces as a sulphide, colouring them leaden black.

Remote action.—Bismuth salts are slowly absorbed. According to some authorities they are carriers of oxygen like arsenic, especially the oxide, But this is certain, that soluble salts when taken for long periods produce fatty degeneration of the liver in the same way as phosphorus and arsenic. But how far these effects are due to arsenic as an impurity in the drug is not easy to say. Sometimes we observe a purplish line on the gums and onion-like smell in the breath. The latter is believed to be caused by traces of tellurium—also an impurity in bismuth preparations.

Elimination.—Bismuth is eliminated in the cæcum and neighbourhood. A small quantity is absorbed and eliminated by the urine, saliva and large intestine. But the quantity absorbed is not sufficient to produce any systemic effect. A portion is deposited in the liver, spleen, kidneys and nervous system.

Therapeutics of Bismuth Salts

Externally.—Bismuth is a **cosmetic,** the oxychloride being preferred for this purpose, as it can be reduced to the finest powder. As a **local sedative, astringent** and **antiseptic,** bismuth may be applied in the form of powder, lotion or ointment to **chapped hands** and **nipples, irritable ulcers, intertrigo, herpes, eczema,** etc. Bismuth salicylate, dermatol and many non-official derivatives may be used as substitutes for iodoform. Bismuth has been used as a bismuth-iodoform paste (B.I.P.P.) in the treatment of tubercular sinuses, cavities and fistulæ.

It is injected into these and very good results have been obtained, but in some few cases the salt has been gradually absorbed, and has given rise to poisoning symptoms. Ferrier's snuff checks **coryza** and **chronic nasal catarrh.**

Internally.—As a *gastric sedative* bismuth salts are remarkably efficacious in all **irritable** and **painful gastric disorders,** such as catarrh, vomiting, indigestion, gastrodynia, pyrosis and ulcers, simple and malignant. The only draw back to their use is that they cause constipation. If the pain is intense they may be combined with morphine, and if the gastric irritability is great, with hydrocyanic acid dilute.

As an *intestinal sedative* and *astringent* they are largely employed in all forms of **diarrhœa,** acute or chronic, either in children or adults. The salicylate is a useful remedy for children's diarrhœa due to the decomposition of food, because it has the properties of both bismuth and salicylic acid. Occasionally it may with advantage be combined with grey powder. It has also been found very useful in **summer, tubercular, enteric** and **lienteric diarrhœas** and **cholera.** The bismuth salts are most effective remedies in **mucus diarrhœa** and **dysentery.** In the last disease they may be given with Dover's powder to check the after diarrhœa.

Syphilis.—Sauton and Robert have shown that tartrobismuthate of sodium and potassium is preventive and curative of fowl **spirillosis** as well as **trypanosomiasis.** Subsequently it has been found by French physicians to be of value in human **syphilis.** The advocates of this remedy maintain, that in doses which can be given intramuscularly safely, bismuth preparations have greater and more rapid therapeutic effect than mercury, that they may not be so quickly acting as arsenical preparations. They are of special value in those manifestations of the disease which are resistant to both mercury and arsenic. The usual dose in the treatment of human syphilis is 0·2 to 0·3 grm. twice weekly, to a total of 2 to 3 grm. in 10 to 15 injections. In doses totalling from 0.4 to 0.6 gm. weekly, spironemes disappear from the serum of early lesions after the second or third injection. Since bismuth has been found in the cerebro-spinal fluid of treated cases, and being neurotropic favourable results are expected in the syphilis of the central nervous system.

Toxic Effects.—Since the introduction of bismuth in the treatment of syphilis certain toxic effects have been observed. These are chiefly stomatitis, nephritis and enteritis. Occipital headache, restlessness, mental depression and tingling of the hands followed the use of a certain number of injections of bismogenol (basic bismuth salicylate). The commonest sign of intolerance is a slaty-blue line on the gum before the incisor and foul breath. If the injections are still continued, this line extends to the rest of the gum margins and perhaps to the cheeks, and stomatitis characterised by ulcers covered

with false membrane follows. In severe cases a condition of cancrum oris may supervene.

Other uses.—In association with the Rontgen rays bismuth has been largely used for diagnostic purposes in connection with diseases of the *gastro-intestinal tract*, but its place is now being taken by barium sulphate, which is less expensive and just as effective.

(*a*) In *stricture of the œsophagus* a bolus of bismuth and flour is given, and its passage down the œsophagus and arrest at the seat of stricture observed under the " X " rays.

(*b*) 2 ozs. of bismuth subnitras with 6 ozs. of rice pudding when administered enables the outlines of the stomach to be determined, the presence of hour-glass contraction seen, and the position of the pylorus located.

(*c*) Injected into the rectum suspended in starch important facts for diagonosis can subsequently be learned by " X " ray examination.

Prescribing hints.—As the less soluble preparations allay irritation better than the soluble ones, they are to be preferred when gastric or intestinal irritability is a prominent symptom. For this purpose we use either the carbonate or the subnitrate. If they are given in a mixture they should be suspended by the compound tragacanth powder, and not by the mucilage of acacia, as the latter may convert the mixture into a jelly-like mass. Again the subnitrate should not be combined with any alkaline carbonates, for bismuth oxynitrate slowly parts with nitric acid in water and gives off carbonic acid (*see* p. 80), but this objection does not apply to the carbonate. Neither should they be mixed with iodides in a mixture as they turn yellow from free iodine and from formation of iodide of bismuth. These salts should not be used with preparations containing tannin which form insoluble tannate of bismuth. Liq. bismuthi et ammon. citratis is more astringent and irritant than the carbonate, subnitrate and oxide, and may be given with acids or alkalies.

ALUMEN PURIFICATUM. Purified Alum

Potassium Alum—$Al_2(SO_4)_3$, K_2SO_4, $24H_2O$

Ammonium Alum—$Al_2(SO_4)_3$, $(NH_4)_2SO_4$, $24H_2O$

Syn. I.V.—*Fatkiri*, Beng. *Fitkari*, Hind.

Source.—Prepared by combining aluminium sulphate with potassium sulphate or with ammonium sulphate.

Characters.—Colourless transparent regular octahedral crystals. Taste sweetish, astringent. *Solubility.*—1 in 10 of cold and 1 in 3 of boiling water, freely in glycerin, insoluble in alcohol (90 p.c.). *Impurities.*—Silicates and iron sulphate.

Incompatibles.—Lime, alkalies, salts of lead, mercury, iron, tartaric acid, tartrates, and tannic acid.

B.P. Dose.—5 to 10 grs. or 3 to 6 dgrms. ; U.S.P.—0.5 gm. or 8 grs.

Official Preparation

1. **Glycerinum Aluminis.**—1 in 6. By trituration and gentle heat, if necessary.

ALUMEN EXSICCATUM

Exsiccated Alum

Source.—Prepared by heating potassium alum till aqueous vapour ceases to be disengaged, and the salt loses 45 p.c. of its weight.

Characters.—A white soluble powder absorbing moisture on exposure to air. Soluble in 20 parts of water.

Non-official Preparations and Allied Derivatives

1. **Aluminii Aceto-Tartras.** *Syn.*—*Alsol.*—In shining masses, soluble in water. Astringent and antiseptic. 1 or 2 p.c. solution as gargle, lotion or douche.

2. **Alumnole.** *Syn.*—*Aluminium Naphthol sulphonate.*—A whitish soluble powder. A ½ to 2 p.c. lotion is useful in *ozæna, pharyngitis, gonorrhœa, leucorrhœa.* A 20 p.c. solution is caustic.

Pharmacology

Externally.—Alum has no action on the unbroken skin, but coagulates the albumin of discharges and tissues. It therefore forms a covering on ulcers and sores, and arrests bleeding. Hence, it is a valuable **local astringent** and **hæmostatic.** Dried alum is a mild **caustic** because it abstracts water.

Internally. **Mouth and throat.**—Alum is a local **astringent** to the mouth and throat, imparting an astringent taste, and a feeling of dryness to the throat.

Stomach and intestine.—In small doses (1 to 8 grs.) it has the same astringent action on the stomach and intestine as on the raw skin, producing **constipation.** Its **hæmostatic action** is entirely local. In 30 to 60 grs. it causes **vomiting** by directly stimulating the peripheral nerves of the stomach, and in still larger doses it is a **gastro-intestinal irritant** causing vomiting and purging. When injected per rectum, it kills **thread-worms.**

Elimination.—Alum is probably absorbed into the blood as an albuminate, and has no remote action on the tissues in medicinal doses. It is chiefly eliminated with the fæces and partly by the skin and kidneys.

Acute toxic action.—Poisoning by alum is rare. When it occurs, the symptoms are those of gastro-intestinal irritation—vomiting, purging, etc.

Antidotes.—Emetics or pumps. Small doses of sodium carbonate in tepid water decompose alum.

Chronic toxic action.—Anorexia, constipation, gastro-intestinal catarrh are the prominent symptoms.

THERAPEUTICS

Externally. **Skin.**—Being cheap and easily available, alum is used in various minor complaints. In powder or in a concentrated solution, it stops bleeding from **leech bites, wounds,** and **superficial cuts.** Exsiccated alum destroys weak exuberant **granulations.** A weak solution of alum and borax (1 p.c. of each) checks the discharge of a **weeping eczema.**

Nose.—Its solution makes a useful **collunarium in ozæna.** Powdered alum either sniffed up or blown in by means of a paper funnel, or its lotion (10 grs. in 1 oz.) injected into the nostrils, arrests **epistaxis.**

Eyes.—Alum makes a useful **collyrium** (4 to 8 grs. in 1 oz.) for ordinary or purulent **conjunctivitis.**

Genitals.—It makes a capital wash (1 dr. in 1 pint) for **vulvitis of children,** if the parts are frequently irrigated and a piece of lint soaked in the lotion is left in situ. It also relieves **pruritus.** A douche (10 grs. to 1 oz.) removes **leucorrhœa,** checks slight **hæmorrhage** from **patulous os** after abortion or delivery, and benefits **prolapsed uterus.** A weak solution (3 grs. in 1 oz.) is successfully employed in **gonorrhœa** as an injection.

Internally. **Mouth.**—Alum is commonly used as a dentifrice in **ulcerated and spongy gums.** A solution (5 to 10 grs. in 1 oz.) is a useful gargle in **sore throat, elongated uvula, tonsillitis, salivation,** and **aphthous** and **ulcerative stomatitis,** but Glyc. Aluminis is a better application in these cases. In the form of a spray, alum may be employed in **hoarseness** and **chronic coughs.**

Stomach and intestine.—Alum is considered to be an efficient non-depressant **emetic** in **croup** and **bronchitis.** As an astringent, it is used in **chronic diarrhœa** and as a local hæmostatic in **gastro-intestinal hæmorrhage.** Alum-whey obtained by curdling 1 pint of milk with 2 drs. of alum may be given with benefit in enteric and other **diarrhœas.** In 30 gr. doses frequently repeated, it is of special value in **lead poisoning** and relieves **colic** by precipitating lead salts as insoluble lead sulphates.

Lungs.—Alum is vaunted as a remedy for **whooping cough,** but it is doubtful whether it is really of any use in this disease.

KAOLINUM

Kaolin

Source.—A native aluminium silicate, powdered, and freed from gritty particles by elutriation.

Characters.—A soft whitish powder insoluble in water or in dilute acids.

Enters into.—Pilula phosphori.

Non-official Preparation

1. **Unguentum Kaolini.**—Soft paraffin 1, Hard Paraffin 1, melt, and add Kaolin 1 ; stir till cold. An emollient application to abraded surfaces and a useful excipient for silver nitrate, potassium permanganate, and bichromate pills (*see* p. 86).

Uses

Besides its use as an **excipient,** it can be employed as a dusting powder in **intertrigo, weeping eczema,** etc.

GROUP III

Arsenic, Antimony, Chromium, Uranium, Phosphorus

ACIDUM ARSENIOSUM

Arsenious Anhydride. As_4O_6

Syn. B.P.—Arsenic. White Arsenic. Arsenic Trioxide, U.S.P. Arsenious Acid. **Syn. I.V.**—*Sankhia.* Hind. *Sanko,* Beng.

Source.—Prepared by roasting certain arsenical ores. Contains not less than 99.8 p.c. arsenious oxide.

Characters.—A heavy white powder or in stratified opaque masses. *Solubility.*—1 in 65 of cold, 1 in 10 of boiling water, and 1 in 5 of glycerin. *Impurities.*—Lead, antimony, tin, cadmium, gypsum, and chalk.

Tests.—(1) Its aqueous solution gives a canary-yellow precipitate with silver ammonio-nitrate, readily dissolved by ammonia solution and nitric acid. (2) Sprinkled over ignited charcoal it emits a garlic-like odour. (3) In organic solution, arsenic is detected by adding HCl and distilling, when the volatile chloride is found in the distillate. (4) Acidulated with HCl it gives a yellow precipitate with H_2S. (5) Marsh's and Reinsch's special tests.

Incompatibles.—Lime water, iron salts, magnesia, and astringent substances.

B.P. Dose.—$\frac{1}{64}$ to $\frac{1}{16}$ **gr. or 1 to 4 mgrms. ; U.S.P.—0.002 gm. or** $\frac{1}{30}$ **gr.** *M. S. Dose.*—$1\frac{1}{2}$ gr. *Daily Dose.*—About $\frac{1}{8}$ to $\frac{1}{4}$ gr.

Official Preparations

1. **Liquor Arsenicalis.** *Syn.*—*Liq. Potassii Arsenitis, U.S.P., Fowler's Solution.*—1 gr. in 110 ms. or 1 grm. in 100 mils. Pinkish, *alkaline* with a lavender odour. **B.P. Dose.—2 to 8 ms. or 12 to 50 centimils ; U.S.P.—0.2 mil or 3 ms.**

2. **Liquor Arsenici Hydrochlorici.** *Syn.*—*Liq. acidi arsenosi, U.S.P.* —1 gr. in 110 ms. or 1 grm. in 100 mils. This is three times the strength of De Valangin's Solvent. A colourless *acid* liquid. **B.P. Dose.—2 to 8 ms. or 12 to 50 centimils diluted ; U.S.P.—0.2 mil. or 3 ms.**

ARSENII IODIDUM

Arsenious Iodide. AsI_3

Source and Characters.—Small, soluble, orange-coloured crystals, prepared by the direct combination of iodine and arsenic and purifying the product by crystallisation.

B.P. Dose.—$\frac{1}{20}$ to $\frac{1}{5}$ **gr. or 3 to 12 mgrms. ; U.S.P.—0.005 gm. or gr.** *M. S. Dose.*—$\frac{1}{12}$ gr. *Daily Dose.*—$\frac{1}{2}$ gr. in pill or solution.

Official Preparation

1. **Liquor Arsenii et Hydrargyri Iodidi.** *Syn.—Donovan's Solution.*—1 gr. in 110 ms. or 1 grm. in 100 mils. A colourless acid liquid. **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils ; U.S.P.—0.1 mil. or 1½ ms.**

SODII ARSENAS ANHYDROSUS

Anhydrous Sodium Arsenate. Na_2HAsO_4

Syn.—Sodii Arsenas, B.P. 1898.

Source and Characters.—A soluble white powder obtained by exposing to 150° C. crystallised sodium arsenate, which may be prepared by treating with water the product of the fusion of arsenious anhydride with sodium nitrate and sodium carbonate. Contains not less than 98 p.c. of pure anhydrous di-sodium hydrogen arsenate.

B.P. Dose.—$\frac{1}{40}$ to $\frac{1}{10}$ **gr. or 1.5 to 6 mgrms ; U.S.P.—0.005 gm. or** $\frac{1}{12}$ **gr.**

Official Preparation

1. **Liquor Sodii Arsenatis.**—1 gr. in 110 ms. or 1 grm. in 100 mils, (Pearson's Solution is 1 in 600). A *colourless* solution having half the strength of Liq. arsenicalis. **B.P. Dose.—2 to 8 ms. or 12 to 50 centimils. ; U.S.P.—0.2 mil or 3 ms.**

Non-official Preparations of Arsenic

1. **Ferri Arsenas, B.P. '98.**—A tasteless, amorphous greenish powder. *Dose.*—$\frac{1}{15}$ to $\frac{1}{4}$ gr. or 1 to 16 mgrms.

2. **Liq. Auri et Arsenii Bromidi.**—Oxybromide of arsenium 3 grs., Auric bromide 1½ grs., Distilled Water *q.s.* to 1 oz. In syphilis, neurasthenia. *Dose.*—5 to 10 ms. or 3 to 6 decimils.

3. **Injectio Sodii Arsenitis et Ferri.** *Syn.—Iron and Arsenic injection.*—Used hypodermically in two strengths in *anæmia*. *Dose.*—1 c.c.=$\frac{1}{2}$ mgrm. and 1 mgrm. of arsenious acid.

Pharmacology

Externally.—Arsenic is a local **irritant** acting slowly on the tissues producing inflammation which may be so intense as to cause sloughing. It is therefore a **caustic.**

Internally. **Alimentary tract.**—In minute doses ($\frac{1}{80}$ to $\frac{1}{15}$ gr.) it increases the gastric vascularity and secretion, and thus improves appetite and digestion. It is therefore a **local gastric stimulant and stomachic.** In large doses it is a powerful **gastro-intestinal irritant.** It is excreted into the stomach after absorption, even when subcutaneously injected.

Blood.—Arsenic is used in various forms of anæmias, but the exact mode of action is yet uncertain. Some believe that it diminishes the number of red-cells in normal persons

while the hæmolgobin remains unaffected. After hæmorrhage the blood is said to regenerate more quickly under arsenic. It is possible that the improvement may be due to some specific effect on some yet undiscovered toxin or parasites. Arsenic increases the leukoblastic elements of the bone-marrow and the leukocytes in the blood.

Heart and circulation.—In very small doses (½ to 1 m. of the solution), it increases the force and the number of cardiac beats. Arsenites are more toxic than arsenates, and the inorganic preparations more than the organic ones. In large doses it lowers the blood pressure due to vaso-dilatation.

Metabolism.—In minute doses administered for a long time arsenic enjoys the reputation of increasing **growth** and **nutrition.** It is difficult to say how it brings about these changes, since the results of different observers have been different. While improvement in nutrition has been reported by some workers, others like Stockman and Grieg observed no change in the growth of animals under prolonged use. On the tissues arsenic has effects similar to those of phosphorus but of a milder nature. Prolonged use lessens the activity of the liver and reduces the formation of glycogen. There is increased protein destruction, and although the total nitrogen of the urine is not much changed there is increased amount of urea and ammonia, as also leucin, tyrosin, etc. Fatty degeneration of the liver, kidneys, heart and muscles generally is evident. Binz and Schulz explain the action by supposing that it acts as a carrier of oxygen, which it receives and gives up, by the transformation of arsenious into arsenic acid in the tissues and by the reduction of the arsenic into arsenious acid. This theory however does not explain the effects of arsenic.

Respiration.—We do not know much about its action on respiration except that habitual eaters of arsenic, such as the Styrian peasants, can undergo great bodily exertion without much difficulty and distress of breathing.

Nervous system.—In minute doses it acts as a **nervine tonic.** In large doses it diminishes the sensibility and reflex excitability of the centres, and is found in the grey matter of the cord. Motor nerves and muscles are affected later on (peripheral neuritis).

Skin.—Arsenic has a marked effect on the nutrition of the skin, it improves the cutaneous nutrition and subcutaneous fat. It is eliminated with the sweat, and causes itching and **eruptions,** which may be erythematous, papular, pustular, furuncular, pigmentary or urticarial. Darkening of the skin, "*arsenical melanosis,*" is also seen, and this may vary from slight pigmentation to a deep brownish-red. The skin of a frog poisoned by arsenic can be stripped off easily.

Bone.—In growing animals it increases the compact tissue at the expense of the medullary. This may be due to increased vascularity of the bone-marrow.

Micro-organism.—It is believed to affect the life-processes of the micro-organisms of certain diseases, such as malaria, phthisis, etc.

Elimination.—It is excreted chiefly in the urine and to some extent in the fæces. A small percentage is also excreted in the bile, sweat, saliva, tears, and milk. Its elimination is very slow, and traces may be recovered two or three weeks after stoppage of its use. The excretion begins within two to eight hours after administration. Given by the mouth it is excreted by the intestine, while used hypodermically it is eliminated largely by the kidneys.

Toleration can be induced, though instances of death from an over-dose are not infrequent.

Acute toxic action.—Colicky pains, severe vomiting and purging, cramps of the legs, intense thirst, prostration, and collapse are the prominent symptoms, which may be mistaken for those of cholera. At the *post-mortem* the stomach and intestine are found inflamed, with occasional patches of softening of the mucous membrane. *Fatty degeneration of the liver, kidneys, and heart* is found if the patient survives long enough. Sometimes there may not be any gastro-intestinal irritation, death taking place during profound coma.

Antidotes.—Emetics, apomorphine. The pump must be used with great caution. Moist peroxide of iron freshly prepared by mixing tincture of steel with sodium or ammonium carbonate and straining rapidly through muslin, or dialysed iron in 1 oz. doses diluted, or in their absence magnesia, animal charcoal, olive oil, lime water freely. Demulcents, and castor oil to clear the intestine, stimulants, hot-water bottles, etc.

Chronic toxic action.—Chronic poisoning occurs amongst those who either handle arsenical pigments, inhale arsenical dust from wall-paper, dresses, etc., or consume wines* containing traces of arsenic. Loss of appetite, nausea, vomiting, colic, mild diarrhœa, œdema of the lower eyelids, conjunctivitis, swelling of the joints are the symptoms generally observed, when arsenic is continued long medicinally in large doses. Peripheral neuritis, muscular paralysis of the limbs, ataxic gait, muscular atrophy, bronzing, and patchy pigmentation of the skin and darting pains in the limbs are also noticed in many cases of slow poisoning.

THERAPEUTICS

Externally.—An arsenical paste is used for destroying new growths, such as **lupus, condyloma, epithelioma,** etc., but it must be concentrated, and only a limited surface is to be treated if the disease is extensive. The cancer-curers of North Ireland use arsenic as the chief basis of their remedies. Small **warts** and **corns,** after the paring of the hard skin, can be removed by painting with liquor arsenicalis. Arsenical cigarettes are sometimes smoked for the relief of **asthmatic fits,** and **phthisical dyspnœa,** but such inhalation must be given with caution.

* Peripheral neuritis was a marked symptom in an outbreak of arsenical poisoning in England, due to drinking contaminated beer.

Internally. **Gastro-intestinal tract.**—Dental arsenical paste is employed to destroy the tooth-pulp in **caries** of the tooth, before stopping. In minute doses *before* meals, arsenic may be given in **irritative dyspepsia, vomiting of habitual drunkards, vomiting** or **diarrhœa** excited by food, and **gastric neuralgia.** For other diseases of the alimentary tract, it is given *after* food.

Heart and lungs.—In minute doses (¼ to 1 m. of the solution), it **tones** up the heart in **angina** and exhausting febrile and other diseases. Prolonged administration checks the repetition of **asthmatic fits.** It gives signal benefit in paroxysmal **coryza, hay asthma** and wheezing of **emphysema, spasmodic bronchitis** and **chronic catarrhal pneumonia.** According to Brunton, it arrests **incipient phthisis,** by causing degeneration of the inflammatory nodules, and thereby preventing the bacillus from finding a suitable nidus.

Malaria.—Arsenic is used in the treatment of **malaria,** and its value is more marked in chronic cases accompanied by anæmia and cachexia. It is generally used in combination with iron and quinine. The writer considers arsenic to be a useful remedy for arresting the paroxysmal febrile attacks of **elephantiasis arabum,** but it must be continued for a long time.

Nervous system.—In large doses, arsenic is used in **chorea,** but with our advancing knowledge of the ætiology of this disease, its place has partly been taken by salicylates. The disadvantages of giving arsenic in big doses are: (1) It sets up gastro-intestinal irritation; (2) it may cause severe neuritis. Children over 4 or 5 years of age can bear as large doses as adults. Gowers speaks highly of it in **locomotor ataxy.** Many other spasmodic diseases, especially **pertussis** and **angina,** are markedly benefited by it.

Lymphomas.—In **Hodgkin's disease** (general lymphadenoma), no remedy is known to be of any use except arsenic. Large **lymphomas** are said to have been absorbed by the continued use of arsenic internally and hypodermically.

Anæmia.—Arsenic is of great value in **primary anæmia.** In **pernicious anæmia** it materially improves the number of red blood-corpuscles and the hæmoglobin, in **leukæmia** it is often used in large doses, but the beneficial effects of arsenic in these conditions appear to be only of a temporary nature. Arsenic is also useful in anæmia following an attack of **malaria,** and some clinicians use it in **chlorosis,** but it appears that beyond the general improvement of nutrition and lessening breathlessness and to a certain extent acting as a heart tonic, it has no specific action in chlorosis when used alone. Combined with iron, however, it is said to hasten the cure by increasing the formation of red blood-corpuscles.

Skin.—Chronic skin diseases, especially **scaly and papular** varieties, are wonderfully benefited by arsenic. **Psoriasis,**

lichen, chronic eczema, acne, pemphigus, etc., yield to it. It seems to act specially well in diseases affecting the epidermis rather than other portions of the skin.

Caution.—(1) Never use arsenic during the inflammatory stage of any cutaneous disease.

(2) Always administer after food and well diluted, except where its local action on the stomach is desired.

(3) Arsenites are more active than arsenates.

(4) As soon as itching, smarting, or irritation of the conjunctivæ, œdema of the lower eyelids, pain on the pit of the stomach, or symptoms of neuritis are noticed, the dose must be reduced to one fourth or one-fifth. If the irritation does not subside, it must be further diminished, or stopped altogether.

(5) If the skin becomes irritated, a laxative may be given, rather than the treatment be stopped.

(6) For the radical cure of a chronic skin disease it must be continued for some months after the final disappearance of eruptions.

(7) Children over 5 years of age can bear as large doses as adults.

(8) Old people bear it badly.

Prescribing hints.—Solid arsenic is given in pills. In an alkaline mixture, Fowler's solution should be prescribed, and with an acid one, Liqr. Arsenici Hydrochlor. Sometimes it is used hypodermically, as in multiple sarcomas, but with doubtful benefit. For prolonged use Fowler's solution is the best preparation, and the dose should be slowly increased to its therapeutical limit of tolerance. It is contra-indicated when gastric or intestinal irritation is present, such as nausea, loss of appetite, etc. Liq. arsenicalis should not be prescribed with syr. ferri iodide as ferrous carbonate will be precipitated.

Organic Arsenic Compounds. (*Not official*)

These compounds have come to occupy an important position among the therapeutical agents in recent years. In these compounds the arsenic exists in the non-ionic form. They are of two distinct classes, viz. those derived from

(1) The Aliphatic or Fatty series, and

(2) The Benzoal ring compounds or Aromatic compounds.

The distinctive feature of these compounds lies in the fact that the arsenic in them is in direct chemical combination with a carbon atom, and this appears to greatly lessen their toxic properties, and makes it possible to administer arsenic with safety in much larger quantities than is otherwise possible, and its therapeutic utility is consequently greatly extended.

Arsenic acid, $AsO(OH)_3$, is capable of having one or more of its hydroxyl (OH) radicals replaced by an organic group, and generally speaking the greater this substitution the greater is the reduction of its toxicity. The arsenic in arsenic acid

exists as a *pentavalent*, while in salvarsan it is *trivalent* and thus acts more powerfully on the parasites. *Arsonic Acid* indicates arsenic acid in which one of the hydroxyls is replaced by an organic radical—the salts of this acid are called *arsonates* ; if the substituted radical belongs to the aromatic or benzol series, the compound is called **Aryl-***arsonic acid*, and its salts are called *Arylarsonates*.

1. Aliphatic Series

ACIDUM CACODYLICUM

Dimethylarsinic Acid. $(CH_3)_2$ AsO.OH

Dose.—½ to 2 grs. or 3 to 12 cgrms.

It will be seen that this acid has only one OH group, hence it is not so toxic as its parent arsenic acid, $AsO(OH)_3$. It is soluble 2 in 1 of water and 1 in 1 of alcohol (90 p.c.). The effects of cacodylic acid are more or less those of inorganic arsenic to which it is partly reduced in the body. But the change takes place slowly and therefore the action is prolonged. It is less toxic, and the local irritant effects are less. Given by the mouth the cacodylates impart an odour of garlic to the breath, sweat and urine. They are used under the same conditions as inorganic salts. The cacodylates appear in an unaltered condition in the urine, or are broken down in the body so little that they may be administered over prolonged periods, and in big doses without producing any toxic effects. The chief cacodylate preparations are :—

1. **Ferri Cacodylas.**—A yellowish powder, soluble 1 in 15 of water. *Dose.*—¼ to 5 grs. (0·05 to 0·3 gm.) *per os* per diem ; and ½ to 1½ grs. (0·03 to 0·1 gm.) *hypodermically* per diem. Chiefly used for *anæmia* and *chlorosis*.

2. **Guaiacol Cacodylas.** *Syn.*—*Cacodyliacol.*—Chiefly used in *tuberculosis*. *Dose.*—½ to 2 grs. or 3 to 12 cgrms. per os ; or dissolved in sterile oil hypodermically.

3. **Strychninæ Cacodylas.**—A white crystalline powder practically insoluble in water. Chiefly used in those conditions in which a combination of strychnine and arsenic are required. *Dose.*—$\frac{1}{30}$ to $\frac{1}{10}$ gr. or 2 to 6 mgrms.

4. **Sodii Cacodylas. U.S.P.**—*Sodium Dimethylarsinate.*—In white colourless deliquescent prisms or as granular powder. It is used in all cases in which arsenic has been used, and is valuable in chronic skin affections and *phthisis*. Given in doses of 1 to 2 grs. *intramuscularly*. Therefore can be used with less danger of upsetting the stomach. It may also be given in pill form.

Dose.—Hypodermically ½ to 1 gr. (3 to 6 cgrms.), but it may be increased to 3 grs. as *maximum single dose*, and as *maximum dose* in 24 hours. If given by mouth or per rectum it may cause renal congestion with a fall of urinary secretion. *Dose. U.S.P.*—0·06 gm. or 1 gr.

5. **Di-Sodium Methylarsenate.** *Syn.*—*Arrhenal, "New Cacodyle."*—$Na_2AsCH_3O_3 5H_2O$. Soluble 1 in 1 of water and sparingly in alcohol. Its arsenic content in 27·35 p.c. Its uses are the same as sodium cocodylate.

Dose.—½ to 2 grs. or 3 to 12 cgrms. by mouth, or hypodermically; the *maximum dose* (single or in 24 hours) being 3 grs.

6. **Magnesii Cacodylas.**—A white amorphous powder, soluble 1 in 3 of water. *Dose.*—¼ to ½ gr. or 15 to 45 mgrms. hypodermically. Uses similar to those of sodium cacodylate.

2. Aromatic (Benzol) Series

In recent years the Benzol ring series of organic arsenic compounds have rapidly come to the front, and in a great measure have supplanted the cacodylates.

1. **Sodii para-aminophenylarsonas.** *Syn.*—*Soamin, Atoxyl, Arsamin.*—$C_6H_7N.AsO_3Na$. A white crystalline powder with a saline taste, soluble 1 in 3 of water at body temperature. Solutions, which should be freshly prepared, may be sterilised by boiling for five minutes without becoming decomposed. Its arsenic content should be at least 22.8 p.c.

Dose.—*Per mouth* ½ to 3 gr. or 0.05 grm. to 0.2 grm. twice or thrice daily after food. *Maximum daily dose.*—3 grs. *Hypodermically,* 1 to 3 grs. or 6 to 20 cgrm., *intramuscularly* high up into upper third of buttock on alternate days. The salt should be dissolved in sterile water. *The maximum of 3 grs. cannot be exceeded with safety.*

Uses

It has been used very successfully in **syphilis** when given intramuscularly, and provided the precautions to be hereafter noted are attended to, no bad effects or signs of toxicity should follow. It appears to be of value in all stages of syphilis, specially where mercury has had no effect.

In **trypanosomiasis**—human and animal—soamin has been largely used and with much success, but in many cases recurrence of the disease has occurred. It seems to do more permanent good when combined with mercury as the **Hydrargyri Arsenilas,** ½ to 1 gr. (Mercury atoxylate).

Soamin and the cacodylates have been used with much success in anæmic conditions, locomotor ataxy, relapsing fever, pellagra, cerebro-spinal meningitis, tuberculosis and chronic skin diseases (psoriasis and lichen).

Hypodermically it has been found to be of great value in **bronchial asthma** in 1 gr. doses given twice a week, increased to 3 grs. Administration of alkalies helps in its action.

Precautions.—Valuable as is the drug, several cases are now on record of blindness due to optic atrophy following its use. This possibly was due to an unsafe dosage being used, but as idiosyncrasy and previous optic degeneration are important factors, it is necessary to proceed with caution when using the remedy. The following are the points to which attention should be paid :—

1. Always examine the retina and the discs for degenerative changes before commencing a course of treatment, and if

normal, periodically test the vision and look for any contraction of the fields—if any contraction is noticed stop use of the remedy.

2. In cases of renal and hepatic disease, and in arteriosclerosis, do not use the drug, and only use it with great caution for this reason in old patients.

3. When 100 grs. have been given stop for four weeks.

The earliest toxic symptoms to be carefully watched for are insomnia, gastric pain and haziness of vision.

2. **Arsacetin.** *Syn.—Sodium Acetyl - para - amino - phenyl - arsonate.*—$C_2H_3O.NH.C_6H_4AsO(ONa)(OH),5H_2O$. It has been used with much success in *syphilis* and *trypanosomiasis*. In syphilis the cases respond in a marked manner, in trypanosomiasis it is therapeutically the equal of atoxyl, and is a more stable preparation. It is also useful in *anæmias*; in such cases however a smaller dose, viz. 0.1 grm to 0.5 grm., should be given subcutaneously. As with atoxyl caution in its use is to be recommended, as cases of blindness have been reported after its use.

Dose.—½ to 3 grs. Per os 0.05 grm. or ½ gr. three to four times daily. *Intramuscularly* a maximum of 3 grs. in 10 p.c. solution should not be exceeded, and for syphilis and trypanosomiasis a dose of 0.6 grm. in 10 p.c. solution is a good average dose. If administered hypodermically the solution, needle and syringe should be warmed.

3. **Hectine.** *Syn.—Sodii Benzo-sulpho-p-aminophenylarsonas.*—Colourless needles, very soluble in water.

Dose.—Ampoules "A" 0.1 grm. in 1 c.c.—for 15 to 30 daily intragluteal injections. *Ampoules* "B" 0.2 grm. in 1 c.c. for more advanced cases.

Hectine Pills.—0.1 gm. each. 1 or 2 daily for 10 days.

ARSENOBENZOL

Dioxy-diamino-arseno-benzol Di-hydrochloride
Salvarsan. Arsphenamine

$$C_{12}H_{12}O_2N_2As_2(HCl)_2$$

Arsenical preparations have been largely employed from early times in the treatment of syphilis, and the great endeavour in modern days has been to find a preparation which would have a *parasitotropic* effect, *i.e.*, a chemical affinity for the parasite and one which at the same time will not have an *organotropic* effect, *i.e.*, which would not enter into a chemical composition with the cells of the body. After hundreds of experiments Ehrlich and his workers brought forward the drug commonly known as Salvarsan or "606." This was later followed by a modified compound called Neo-Salvarsan or "914." These two drugs possessing a maximum parasitotropic with a minimum organotropic effect. They are administered either intravenously or intramuscularly, but the former method is much more rapid and effectual in its action.

Intramuscular injections have the disadvantage that they cause much pain, and abscess formation may result. At

first serious complications and even fatal results have followed on the use of these drugs. But with increased knowledge and improved technique these complications have now become extraordinarily infrequent.

During the war when the original German salvarsan was not available, various preparations were placed upon the market. The commonly used preparations are

1. **Arsenobenzol Billon** and **Novarsenobenzol Billon.**

2. **Gallyl,** a compound of arsenic and phosphorus.

3. **Ludyl,** a compound of salvarsan with a molecule of benzene disulphonic acid.

4. **Sulfarsenol,** a sodic salt of acid sulphurous ether of methylol-amino-arsenophenol. It is five times less toxic than salvarsan and four times less than 914. May be given hypodermically. On account of the easy administration and therapeutic value it is coming largely into favour, and is replacing salvarsan and neo-salvarsan groups, especially in cases of intolerance. Sulfarsenol is easily administered, produces little or no local reaction and appears to be of equal therapeutic value.

These substitutes have been very largely employed clinically and the reports are eminently satisfactory.

Another preparation introduced by Danysz is **Luargol,** which is a compound of arseno-benzol with bromine, silver and antimony. It is an orange yellow powder insoluble in water, but soluble in caustic soda and is generally given in progressive doses of 0.15 to 0.35 grm. making a total of 1.2 to 1.5 grm. in six or seven injections. The clinical results as reported have been very good, but owing to one disadvantage, viz., thrombosis of vein at the site of injection, *Luargol* has been replaced by **Di-Sodo-Luargol,** which is soluble in distilled water.

Salvarsan and other arylarsonates combine with metals and form non-ionisable compounds with copper, silver, gold, mercury, etc. Of these **silver salvarsan** has of late become very popular, especially in cases of neurosyphilis.

These preparations are put up in hermetically sealed glass tubes in strengths of 0.45, 0.6 and 0.9 grms.

Dose.— For women .. 0.45 to 0.6 grm.
For men .. 0.6 to 0.9 grm.
For children .. 0.15 to 0.3 grm.

Methods of Injection.—(1) *Intramuscularly,* into the gluteal muscles.

(2) *Subcutaneously,* into the tissues adjoining bases of the shoulder-blades.

(3) *Intravenously.*—In this method salvarsan alone is given greatly diluted, 200 to 250 c.c. of diluent being employed, all others in only 10 c.c. of water.

(4) *Intravenously followed by intramuscular injection.* In cases in which one wants to prolong or intensify its action.

N.B.—All solutions must be freshly prepared.

Preparation of solutions with Arsenobenzol.—*Intramuscular.*—Place the required salvarsan in a small porcelain dish and rub it with 9 to 10 drops of sodium hydrate solution 15 p.c. by weight, then add (carefully rubbing all the time with a glass rod) drop by drop the required amount of *fresh distilled water*, about 5 to 10 c.c. Neutralise the solution by the addition of sodium hydrate or dilute hydrochloric acid.

After an intramuscular injection rest in bed for 3 or 4 days should be enjoined, as after-pain frequently follows the injection. This pain may be relieved by a sitz-bath.

Intravenous.—Place 30 to 40 c.c. physiological salt solution in a 300 c.c. stoppered bottle, add to this 0.6 grm. of salvarsan. Dissolve it by thorough shaking, add 23 drops of 15 p.c. sodium hydrate solution. A precipitate forms which quickly re-dissolves. Dilute the remaining clear yellow solution to 300 c.c. with normal saline solution.

Each 50 c.c. is equal to 0.1 grm. Therefore 150 c.c. form the average dose for women and 200 c.c. for men.

Pharmacology of Arsenobenzol

The introduction of salvarsan as a remedy for syphilis is the direct result of the chemotherapeutic studies of Ehrlich, who suggested a parasiticidal action of the drug. Certain side chains of the drug possess a selective affinity for certain side chains of the protoplasm of the spirochæte, and the drug kills the germs at a concentration harmless to the tissues of the host. This theory however is open to doubt. These organic compounds undergo certain changes in the body tissues when they exert an action either on the parasites or on the host. Thus the pentavalent arsenic compounds are inactive in that form, but become active only when they are changed into the trivalent form.

Given intravenously in increasing doses salvarsan causes dilatation of the heart, a rise of pulmonary pressure and a slow fall of systemic pressure. The heart is depressed, depending upon the concentration and reaction. Acid solutions are specially toxic to the heart.

Absorption and elimination.—The absorption is very slow even when given intravenously. Very little is absorbed by the rectum. It is broken down in the body and is excreted by the urine and fæces in the form of ionised arsenic. Excretion is very slow especially after intramuscular injection, and the maximum quantity eliminated in 24 hours after an intravenous injection of salvarsan is about 10 mg. *i.e.* about 3 p.c. of arsenic contained in 0.9 gm. The excretion is said to be hastened by the use of potassium iodide. It has also been found in the cerebro-spinal fluid an hour after

an intravenous injection, but this has not been confirmed by other observers.

Toxic symptoms and other side effects.—In about half to fifteen per cent. of cases severe toxic symptoms appear even within a few minutes. They are annoying and alarming, but rarely dangerous. The symptoms resemble anaphylactic shock, and may either disappear soon or may be followed by febrile reactions accompanied by burning ethereal taste, flushing of the face, headache, nausea, vomiting and diarrhœa of varying severity. Skin eruptions are an usual accompaniment, and may be urticarial, scarlatinal or erythematous. All these symptoms may appear independently or be preceded by anaphylactic shock. Occasionally severe and fatal reactions appear a few days after administration, affecting either the cerebrum or the liver. The cerebral symptoms appear usually after large doses or when ordinary doses are given too quickly. The symptoms are headache, vomiting, muscular twitchings, epileptiform convulsions, suppression of urine, dilatation of the pupil, coma and death.

Uses

The great advantage of these preparations is their remarkably rapid effect on **syphilitic lesions,** whether primary, secondary or tertiary. In the British army their routine use in syphilis has led to an enormous reduction in inefficiency from this disease ; but the results obtained by their use alone will not compare with the results obtained when they are used in conjunction with mercury, for nothing can usurp the place of mercury in the treatment of syphilis.

In cerebro-spinal syphilis, salvarsan does not produce any improvement as it is unable to reach the parasites. The use of salvarsanised serum however is attended with better results.

Recent reports of the use of salvarsan in **pernicious anæmia** have been most favourable, and justify extended trials. In such cases smaller doses (0.2 to 0.3 grm.) should be used. It has also been used in **malaria, yaws, relapsing fever, plague, leprosy, framboesia** and various other diseases, with varying results. It is possible that it is being used not wisely and without due thought and care, and it is probable that more careful selection of cases will be essential in the future.

Caution.—Nearly all the deaths may fairly be attributed to faulty technique and gross disregard to well-known contra-indications. But a few must be ascribed to the fact that a small proportion of patients are susceptible to salvarsan.

The after-effects are a slight rise in the temperature, headache and sickness, a sense of cardiac oppression, and pains in the limbs. The intramuscular injections should be given slowly and cautiously deep into the muscle, and the solution should be of the body temperature. Care should

be taken to avoid puncturing a blood-vessel, or transfixing a nerve.

Contra-indications.—1. The injection should never be given on a full stomach, or when the blood pressure is high. 2. It should not be given to persons suffering from chronic renal disease (of non-syphilitic origin), diabetes, or chronic myocardial degeneration, or to cases exhibiting evidences of recent endocarditis. 3. Owing to the congestive action of this drug it should not be used in cases with signs of active pulmonary tuberculosis, fetid bronchiectasis, or serious lung disease. 4. Patients whose vessels are atheromatous or have suffered from cerebral hæmorrhage are also bad subjects for salvarsan. 5. Persons showing special idiosyncrasy to arsenic. 6. Persons suffering from non-syphilitic retinal diseases or affections of the optic nerve. 7. Advanced cerebral mischief, and cachexia.

Method of administration.—The usual method is the intravenous route. It is practically painless, and there is seldom objectionable local effects at the point of injection ; if any should arise it may be ascribed to faulty technique. Moreover the time spent in bed is greatly reduced by this method. Whatever method is used strictest asepsis must be maintained. These injections should be followed by mercurial treatment, and usually injections of calomel cream are given. When intensive treatment is required a series of six intravenous injections, once a week, constitutes a course. But usually three injections are given at fortnightly intervals. The highest dose of salvarsan for a healthy adult man of average weight is 0.5 gm. intravenously, and 0.4 gm. for a woman. For a child ten pounds in weight the first dose should not exceed 0.01 gm. The maximum dose for a healthy adult Indian is somewhat lower, preferably 0.4 gm. of salvarsan for a man and 0.3 gm. for a woman. The dose of neo-salvarsan is greater than salvarsan in the proportion of 3 to 2, *i.e.*, 0.6 gm. of neo-salvarsan equals 0.4 gm. of salvarsan. The dose should always be varied with the strength and condition of the patient. It has been found that smaller doses frequently repeated, give as good results as full doses, and are less dangerous to the patient.

Injection of Salvarsanised Serum.—Since very little arsenic passes into the central nervous system, intravenous use of salvarsan is not very useful in cerebro-spinal syphilis. It has therefore been suggested that in these cases salvarsanised serum may be injected directly into the spinal canal. The results have been rather hopeful specially in the treatment of tabes. The following are the different methods :—

1. *Swift-Ellis Method.*—The patient is given an ordinary dose of salvarsan or neo-salvarsan intravenously, and after an hour 40 c.c. of blood are withdrawn from a vein, which is allowed to clot and left for 24 hours on ice. 12 to 15 c.c. of serum are then drawn off and centrifugalised. This serum

contains about 0.01 mg. of salvarsan per c.c. It is heated to 56°C. for half an hour. This may be diluted with normal saline to make 30 c.c., and injected by lumbar puncture, an equal volume of cerebro-spinal fluid being first withdrawn. The injections are safe and may be repeated after two weeks.

2. Injections of watery solutions of salvarsan and neo-salvarsan have also been advocated, but they cause severe irritation of the cord and should not be attempted on man.

ANTIMONIUM. Antimony. Sb. (*Not official*)

ANTIMONII OXIDUM

Antimonious Oxide. Sb_2O_3

Source.—Prepared by pouring solution of antimonious chloride into water, $SbCl_3+H_2O=SbOCl+2HCl$, and decomposing the precipitate antimony oxychloride with sodium carbonate, $2SbOCl+Na_2CO_3=Sb_2O_3+2NaCl+CO_2$.

Characters.—A greyish-white powder. *Solubility.*—Readily in HCl, insoluble in water. *Impurities.*—Higher oxides.

B.P. Dose.—1 to 2 grs. or 6 to 12 cgrms., ⅛ to ¼ gr. for a child 1 year old.

Enters into.—The preparation of Antimonium Tart. and the

OFFICIAL PREPARATION

1. **Pulvis Antimonialis.**—A substitute for *James' Powder.*—1 in 3. **B.P. Dose.—3 to 6 grs. or 2 to 4 dgrms. ; ⅛ to ¼ gr. for a child 1 year old.**

ANTIMONIUM SULPHURATUM

Sulphurated Antimony

Source.—A mixture containing antimony sulphides and oxides, Sb_2S_5, Sb_2O_5, Sb_2S_3, Sb_4O_6, and sulphur, prepared by boiling antimonious sulphide with sublimed sulphur and solution of caustic soda and adding diluted sulphuric acid and water.

Characters.—An orange-red powder, readily dissolved by hot hydrochloric acid with evolution of hydrogen sulphide and separation of sulphur. *Solubility.*—Insoluble in water.

B.P. Dose.—1 to 2 grs. or 6 to 12 cgrms.

Enters into.—Pil. Hydrarg. Subchlorid. Co.

ANTIMONIUM TARTARATUM

Tartarated Antimony. $[K(SbO)C_4H_4O_6]_2,H_2O$

Syn. B.P.—Potassio-tartrate of antimony. *Tartar Emetic.*

Source.—Prepared by setting aside a mixture of antimonious oxide and acid potassium tartrate, made into a paste with a little water, until combination has taken place, and then purifying by crystallisation from water. Contains not less than 99 p.c. of antimonium potassio-tartrate.

Characters.—Colourless, transparent crystals with triangular facets. Taste sweet, metallic. *Solubility.*—1 in 17 of cold, 1 in 3 of boiling water. The solution is acid. *Impurity.*—Acid tartrate of potassium.

Incompatibles.—Alkalies, lead salts, gallic and tannic acids, and most astringent substances.

B.P. Dose.—$\frac{1}{25}$ **to** $\frac{1}{4}$ **gr. or 2.5 to 8 mgrms. ; emetic,** $\frac{1}{4}$ **to 1 gr. or 3 to 6 cgrms. ; U.S.P.**—Expectorant, **0.005 gm. or** $\frac{1}{12}$ **gr.**

Official Preparation

1. Vinum Antimoniale.—2 grs. to 1 oz. or 0.1 p.c. **B.P. Dose.—10 to 30 ms. or 6 to 18 decimils ; 2 to 4 drs. or 8 to 16 mils.** as an emetic. For a child 1 year old, 3 ms. as an expectorant, and 15 ms. as an emetic.

Non-official Preparations

Many organic compounds of antimony have been prepared on the same lines as of arsenic. The aliphatic compounds are however unstable and have not been tried therapeutically. The aromatic compounds have attained considerable reputation owing to the success attained by the corresponding arsenical preparations. The following are the commonly used preparations :—

1. Stybenyl.—Sodium acetyl-p-amine-phenyl stybiate.—A brownish powder soluble 1 in 10 of water. Can be given intramuscularly. Results have not been encouraging.

2. Stybamine.—Sodium-p-amine-phenyl stybiate.—An unstable compound. Can be given intramuscularly.

3. Urea Stybamine.—Given good results in the treatment of kala-azar with injections of 0.15 to 0.3 gm. in 2 p.c. solution twice a week intravenously.

4. Antimonii et Sodii Tartras.—Soluble 1 in 1½ of water. Used largely in the treatment of *trypanosomiasis* and *leishmaniasis* in preference to potassium salt.

Pharmacology

Externally.—Salts of antimony cause a characteristic local inflammation, at first papular, then vesicular and lastly pustular, simulating smallpox. This is due to the formation of insoluble irritant precipitates at the orifices of sweat-glands by the acid solution (perspiration). Hence they are **irritants** and **pustulants.**

Internally. **Gastro-intestinal tract.**—Locally antimony is an irritant to the stomach, the degree of irritation depending upon the dose. In small doses it produces a sense of warmth and soreness in the stomach, and in larger doses loss of appetite, nausea and increased secretion of gastro-intestinal mucus. In still larger doses, 2 to 3 grs., it **induces vomiting,** due to direct irritant action on the stomach. It was thought that the vomiting might be due to stimulation of the vomiting centre, but this view has of late been entirely discarded. Antimony salts dissociate in the stomach and intestine and increase their peristaltic movements. But the antimony ion is more slowly absorbed. In toxic doses it induces **gastro-enteritis,** with symptoms resembling those of arsenical poisoning.

Heart and circulation.—From the beginning, even in small doses, antimony reduces the **force and frequency of the cardiac**

beat, which tends to become intermittent, and in large doses the heart becomes **profoundly depressed** with acceleration of the pulse-rate. The **blood-pressure falls** considerably (1) partly from the depressed condition of the heart, (2) partly from the relaxed state of the arterioles caused by the depression of some portion of the vaso-motor system, and (3) partly reflexly from the stomach (nausea). Hence, antimony is a **powerful cardiac and circulatory depressant.** Antimony probably circulates in the blood in combination with proteins. It increases the number of leucocytes and is said to diminish the red blood-cells.

Lungs and respiration.—Respiration is very much **depressed** after a brief stimulation. Inspiration becomes short, expiration prolonged, and finally respiratory movements irregular. Antimony increases the bronchial secretions, and acts as an **expectorant.**

Temperature is not much affected in health, but is reduced in fevers, owing chiefly to (1) the depressed condition of the circulation, (2) dilatation of peripheral vessels, and (3) diaphoresis.

Liver.—Tartar emetic, particularly antimonium sulphuratum, directly increases the **secretion of bile.** It tends also to increase the formation of urea and carbonic acid, and depresses the glycogenic function. If continued long, it causes **fatty degeneration.**

Skin.—It is a **powerful diaphoretic,** due chiefly to (*a*) the depressed condition of the circulation, and possibly to some extent (*b*) reflexly from the alimentary canal.

Nervous system.—Tartar emetic is a **powerful sedative** to the nervous system, especially the sensory and motor tracts of the cord, which are affected directly and not through the blood. The cerebrum is also depressed though not so profoundly, causing a feeling of languor, inaptitude for mental exertion, lowness of spirits and sleepiness.

Metabolism.—Its effects on metabolism are pretty much the same as those of phosphorus and arsenic (which see). In minute doses it has a slight **alterative** action, but in continued doses it clings to the tissues tenaciously for some months, producing (*a*) a fatty degeneration of the organs, especially the liver, (*b*) an increased formation of nitrogenous products, and (*c*) deficient oxidation in the tissues. According to Ringer, antimony is a protoplasmic poison and paralyses the functions of nitrogenous tissues in the same way as arsenic, aconite and hydrocyanic acid.

Micro-organisms.—Like arsenic, antimony in dilutions of 1 in 200,000 kills **trypanosomes,** and the trivalent antimony, whether in organic or inorganic combinations, is more toxic than the pentavalent form. Antimony therefore has a specific action on trypanosome in much the same way as quinine has

on the malarial parasite. In fact Cushny has shown that in dilutions of 1 in 500,000 it has a destructive action on trypanosomes in the blood.

Elimination.—Absorption of antimony is slow, the salts are excreted by the kidneys, bile, skin, mucous membranes of the bronchi and gastro-intestinal tract and mammary glands. A portion is stored up in the liver. A considerable amount is excreted by the intestine, a large portion is also thrown out by the kidneys.

Toleration.—Large doses given several times a day sometimes do not induce vomiting, thereby producing tolerance of the drug.

Acute toxic action is very much the same as that of arsenic. Pain and discomfort in the region of the stomach, headache, general weakness, profuse diarrhœa and jaundice are some of the symptoms. Albumen appears in the urine and the pulse becomes slow and weak. The *post-mortem* appearances are not so marked as in arsenical poisoning.

Antidotes.—Emetics or stomach-pump if vomiting is not free. *Tannin is the chief antidote* in any shape. Strong tea, coffee, gallic acid, astringent infusions, and demulcent drinks should be freely given. Stimulants, strychnine and digitalin subcutaneously are also necessary. *Chronic toxic action* is rare nowadays. For butter of antimony the antidotes are the same as those for mineral acids.

The action of tartar emetic resembles in many respects that of aconite, and the student will no doubt find assistance by studying the following table :—

Tartar emetic	Aconite
1. An irritant and pustulant to the skin and mucous membrane.	A sensory depressant and anæsthetic to the same.
2. An emetic, and purgative in large doses.	A gastro-intestinal irritant in toxic doses.
3. A powerful cardiac, circulatory and respiratory depressant.	The same.
4. Lowers blood-pressure.	The same.
5. An expectorant.	*Nil.*
6. A powerful depressant to the cord and to a less extent to the brain. A muscular relaxant.	A powerful depressant to the sensory nerve-endings. Only large doses cause muscular weakness.
7. A powerful diaphoretic.	Not so powerful as a diaphoretic.
8. An antipyretic.	The same.
9. Causes fatty degeneration and is deposited in the tissues.	*Nil.*

THERAPEUTICS

Externally.—As a *counter-irritant*, tartarated antimony ointment 5 p.c. is used in cases of **kala-azar** of children who cannot be given intravenous injections. Appilcation of 1 to 2 p.c. tartar emetic ointment has given good results in the treatment of **oriental sores.**

Internally. **Gastro-intestinal tract.**—As an *emetic*, tartar emetic is not suitable in cases of **poisoning** on account of its tardy action and the general prostration it induces, but is of great service in those cases of acute inflammatory affections of the respiratory tract, such as **croup** and **bronchitis** where both emesis and vascular depression are needed. **Intermittent fevers,** rebellious to quinine, yield when it is given after an antimonial emetic.

Circulation and respiration.—As an *antiphlogistic*, tartarated antimony in $\frac{1}{60}$ gr. doses may be given like aconite in a variety of acute inflammatory diseases at the outset, such as **tonsillitis, laryngitis, acute bronchitis, pneumonia, pleurisy, pericarditis, peritonitis, ovaritis,** etc. In **acute bronchial affections** of children, antimony still holds a high place when given alone or in combination with ipecacuanha. Half to one teaspoonful of wine as an emetic, followed by 3 to 5 drops every one or two hours, keeps up expectoration and wards off bronchial spasms.

Fevers.—Tartarated antimony at once cuts short an attack of **catarrhal fever.** As a *diaphoretic* it may sometimes be given to reduce the pyrexia in *sthenic* subjects. Pulv. antimonialis co. is a mild diaphoretic, and may yet occasionally be prescribed in **catarrhal fever and broncho-pneumonia** with good results.

Micro-organisms.—The use of tartar emetic is now quite general in the treatment of several tropical diseases, such as **leishmaniasis, trypanosomiasis, yaws** and **bilharziasis.** It has also been recommended in the treatment of **malaria,** but our experience has been that it is practically useless unless the doses are toxic to the patient. It has been used in the treatment of **filarial infection,** but the results have been very disappointing. In the treatment of these diseases it is given as intravenous injections in 2 p.c. solution. It is customary to begin with 0.5 c.c. and then to increase the dose by the same amount with each injection till the maximum of 4 or 5 c.c. is given. For children and debilitated patients the initial dose should be 0.25 c.c. Children tolerate relatively larger dose than adults. These injections are given twice a week or on alternate days for several months, depending on the severity of the case.

Intravenous injections are *contra-indicated* when there is any pulmonary or gastro-intestinal complications are present. Several cases of deaths from broncho-pneumonia have been

observed by us when these precautions have not been followed. It should not also be given to patients with feeble pulse and low blood-pressure.

Nervous and muscular systems.—Tartarated antimony may be used also to allay the excitement in **mania** and to induce sleep in **acute alcoholism.** Before the introduction of general anæsthetics, it was largely employed as a **relaxant of muscles,** in **dislocations** and **hernia.** It is occasionally given to relax the **rigidity** of the os during parturition.

Toxic symptoms associated with intravenous injections.—As a rule no untoward symptoms are noticed in the majority of cases provided the treatment is commenced with small doses and gradually worked up to the maximum dose. A certain number of patients however show an intolerance to the drug, and untoward symptoms may appear even after very moderate doses. These symptoms may be classified as follows :—(*a*) Gastro-intestinal symptoms. Severe fits of coughing and retching immediately after an injection is very common. These are less likely to occur if the injections are given on an empty stomach. Nausea and vomiting and sometimes acute diarrhœa may follow an injection. (*b*) A slight rise of temperature with or without rigor. (*c*) Cyanosis, rapid and irregular pulse. (*d*) Nervous symptoms. General depression when the treatment has been continued long, persistent headache and hemicrania. Rarely loss of consciousness and incontinence of urine and fæces. (*e*) Pain on the shoulders and the big joints. (*f*) Papular eruptions.

Appearance of any of these symptoms demands either reduction of the dose or stoppage of treatment.

Prescribing hints.—The use of antimony in the treatment of kala-azar is almost universal and the student should know its different methods of administration. In cases of children, or where its use is otherwise contraindicated, tartar emetic ointment 5 p.c. or metallic antimony 5 to 10 p.c. in lanoline may be rubbed on the skin. Only small doses can be given by the mouth, and therefore in the treatment of protozoal diseases where bigger concentration is required this method is of no use. Intramuscular injections are very irritating and painful, producing severe inflammation. Although several preparations are now available which are claimed to have the advantage of not producing any local effect, the intravenous route is the only reliable method and should always be adopted. Some patients are intolerent to even small doses of antimony.

ACIDUM CHROMICUM

Chromic Anhydride. CrO_3

Syn.—Chromium Trioxide, U.S.P.

Source.—Produced by the interaction of sulphuric acid and potassium bichromate.

Characters.—Crimson, acicular, deliquescent crystals. *Solubility.*—Freely in water. Decomposed by alcohol.

Official Preparation

1. **Liquor Acidi Chromici.**—1 in 4.

Pharmacology

Externally.—It is a powerful **oxidising agent,** destroying the lower organisms, and is therefore a **deodorant** and **disinfectant.** It coagulates albumin and oxidises organic substances, and therefore acts as a **caustic.**

Therapeutics

Externally.—Liquor acidi chromici is used for destroying **warts.** It should be applied with a pointed glass rod, the adjacent parts being protected by a plaster or ointment, and a piece of wet lint kept ready to absorb any superfluous acid. A weak lotion (1 in 40 or more) is useful for **ulcerated gums** and **foul sores ;** A 3 per cent. solution checks perspiration of the feet.

Chromic acid solution does not burn or stain linen, and is a delicate test for albumin in the urine.

Prescribing hints.—It should not be mixed with glycerin or alcohol as the mixture is likely to explode (*see* p. 110).

POTASSII BICHROMAS

Potassium Bichromate. K_2CrO_4,CrO_3

Syn. B.P.—Potassium Dichromate, Red Chromate of Potassium.

Source.—Obtained by roasting chrome ironstone with lime in the presence of air, and by treating the resulting chromate with a potassium salt, and subsequently with an acid.

Characters.—Large, orange-red, transparent, triclinic crystals *Solubility.*—1 in 10 of water.

Enters into.—The preparation of Chromic Acid.

B.P. Dose.—$\frac{1}{10}$ to $\frac{1}{5}$ **gr.** or **6 to 12 mgrms.** in capsule or pill with kaolin.

Actions and Uses

Potassium bichromate is rarely used in medicine, but extensively in arts. In large doses, it causes severe **gastro-enteritis** with collapse. Those who handle this salt, suffer from **eczema.** Fraser recommended it in **dyspepsia** and **gastric ulcer.** It is best given in pill form on an empty stomach.

Toxic action.—It is a powerful irritant poison.

Antidotes.—**Emetics or pump. Albuminous and demulcent drinks, magnesium carbonate, chalk, etc.**

URANII NITRAS, U.S.P.

(Not official)

Characters.—Large lemon-yellow slightly efflorescent prismatic crystals Has an astringent styptic taste. Soluble in half its weight of water. Possesses radio-active properties.

Dose. *U.S.P.*—0.01 gm. or ⅙ gr. It is very corrosive and must be given with caution.

Pharmacology and Therapeutics

It is an antiseptic but is too costly to be used for that purpose. May be used as an astringent wash for **indolent ulcers** in strengths of 2 grs. to the ounce of water, and an injection of 5 grs. to the oz. is useful in **gonorrhœa.** Internally it is given in **diabetes** and **phthisis.**

PHOSPHORUS

Phosphorus. P

Source.—A solid non-metallic element obtained from calcium phosphate.

Characters.—A semi-transparent, wax-like solid, emitting white vapours and is luminous in the dark; ignites in the air. *Solubility.*—Insoluble in water; 1 in 25 of chloroform, 1 in 350 of absolute alcohol, 1 in 80 of olive oil and of ether; 2 in 1 of carbon disulphide, 1 in 60 of oil of turpentine. Also in melted fats

B.P. Dose.—$\frac{1}{100}$ to $\frac{1}{25}$ gr. or **0.6 to 2.5 mgrms.; U.S.P.—0.0005 gm. or** $\frac{1}{120}$ **gr.** in pill or solution.

Enters into.—The preparation of Calcii Hypophosph., Acid Phosph. Concent. and the

Official Preparations

1. **Oleum Phosphoratum.**—1 p.c. A clear straw-coloured oil. For its unpleasant taste, it is rarely prescribed. **B.P. Dose.—1 to 5 ms. or 6 to 30 centimils.**

2. **Pilula Phosphori.**—1 p.c. phosphorus. It is half the strength of the corresponding pill B.P. 1898. **B.P. Dose.—1 to 4 grs. or 6 to 25 cgrms.**

Non-official Preparations

1. **Elixir Phosphori.** *Syn.—Syrupus Phosphori.*—Tr. Phosph. Co. 1, Glycerin 4; mix and agitate. Palatable and well borne by the stomach. *Dose.*—15 to 60 ms. or 1 to 4 mils. in water. Contains $\frac{1}{150}$ gr. phosphorus in 1 dr.

2. **Tr. Phosphori Comp., B.P.C.**—Contains 1 of phosphorus in 500. Dissolve Phosphorus 1 in chloroform 85 within a stoppered bottle on a water-bath, and then add absolute alcohol to 500, shake well. *Dose.*—3 to 12 ms. or 2 to 7 decimils. Preserve from light.

CALCII HYPOPHOSPHIS

Calcium Hypophosphite. $Ca(PH_2O_2)_2$

Source.—Obtained by the interaction of phosphorus, calcium hydroxide, and water. $3Ca(HO)_2+8P+6H_2O=3Ca(PH_2O_2)_2+2PH_3$.

Characters.—A white crystalline, pearly salt. Taste bitter, nauseous. *Solubility.*—1 in 8 of water, insoluble in alcohol (90 p.c.).

B.P. Dose.—3 to 10 grs. or **2 to 6 dgrms. ; U.S.P.—0.5 gm. or 8 grs.**

SODII HYPOPHOSPHIS

Sodium Hypophosphite. $NaPH_2O_2$

Source.—Obtained by the interaction of sodium carbonate and calcium hypophosphite. $Na_2CO_3 + Ca(PH_2O_2)_2 = 2NaPH_2O_2 + CaCO_3$. Contains not less than 97 p.c. of pure sodium hypophosphite.

Characters.—A white granular, deliquescent salt. Taste bitter, nauseous. *Solubility.*—1 in 1 of water, 1 in 30 of alcohol (90 p.c.).

B.P. Dose.—3 to 10 grs. or **2 to 6 dgrms. ; U.S.P.—1 gm. or 15 grs.**

NON-OFFICIAL PREPARATIONS

1. **Syr. Calcii Hypophosphitis, B.P.C.**—1 gr. in 1 dr. Calcium Hypophosph. 1.75, Distilled Water 45, dissolve and filter. Add and dissolve sugar 80, with the aid of gentle heat. After cooling, add Hypophosphorous Acid 0.25 and Distilled Water *q.s.* to 1 pint. *Dose.*—1 to 4 drs. or 4 to 16 mils.

2. **Calcii Glycerophosphas, U.S.P.**—A calcium salt of glycerophosphoric acid. *Dose. U.S.P.*—0.25 gm. or 4 grs.

The following preparations of the glycerophosphates are largely used :

Ferri Glycerophosphas.—*Dose.*—1 to 5 grs. or ½ to 3 dgrms.

Sodii Glycerophosphas, U.S.P.—*Dose.*—0.25 gm. or 4 grs.

3. **Syrupus Glycerophosphatum Compositus, B.P.C.** *Dose.*—1 to 2 drs. or 4 to 8 mils.

PHARMACOLOGY

Phosphorus has a specially interesting physiological action, but its therapeutic value is unfortunately limited. As a poison it is important.

Externally.—Undiluted phosphorus is a strong local **irritant** and **caustic.**

Blood.—It is absorbed into the blood partly unchanged, and partly as an oxidised product, phosphorus or phosphoric acid. It was formerly believed to cause destruction of the red blood-cells but later observations have shown that it has no such effect even in severe poisoning. In therapeutic doses it increases the number of corpuscles. The coagulability of the blood is diminished due either to the destruction of fibrinogen or fibrin ferment, or to the production of peptone bodies due to the destruction of proteins. It is directly poisonous to the heart. Fatty degeneration of the heart muscle is seen in the later stages of poisoning.

Stomach and liver.—In very minute doses, it is said to sharpen the appetite, and in moderate doses it increases the development of the **connective tissue** of the stomach and liver, and induces a sort of chronic inflammation of the organs ; thus, atrophy of the gastric follicles and cirrhosis of the liver

are the results. The **glycogenic function** of the liver too is greatly reduced, and fatty degeneration ensues. In toxic doses it is a **gastro-intestinal irritant,** producing vomiting and purging, the vomited matters having a garlic odour. These symptoms do not follow *immediately after administration, but may be delayed for hours or days.*

Bones.—When continued long in such minute doses as not to affect the stomach or liver, it has a specific action on the bone. There is an increased osseous deposit, and the cancellous tissue becomes converted into compact bone. These changes are not due to the excess of phosphates produced in the blood, but to the stimulation of the cell growth by the drug itself.

Nervous system.—It is said to act as a **tonic** and **restorative** to the nervous system, supplying it with nutrition, but it is difficult to understand how it can do this, when it arrests oxidation, except on the supposition that it does so by stimulating cell growth, as in the case of bones. It is popularly supposed to excite the reproductive centres in the spinal cord, and is therefore regarded by many as an **aphrodisiac,** but the best authorities have now entirely discarded it for this purpose.

Metabolism.—In large doses, it distinctly increases the nitrogenous products, such as urea, leucin, tyrosin, etc., raises temperature, reduces absorption of oxygen and excretion of carbonic acid, and leads to **fatty degeneration** of the glandular, muscular and epithelial protoplasm throughout the body. The urea, etc., being soluble, are excreted by the kidneys, whose action they increase, but the insoluble products, such as fats and oils, are deposited in the various organs.

Absorption and elimination.—Absorption is slow and occurs from the intestine, and to some extent by the lungs when inhaled. The systemic effects are therefore delayed several days. It is excreted as hypophosphorous acid but its fate is very imperfectly known.

Acute toxic action.—Acute poisoning may occur from swallowing rat-paste or lucifer match-heads. Beside gastro-enteritis already described, there is considerable prostration, and occasionally collapse and death. Generally these symptoms come on in a mild form, and the patient does well for a few days. Then, after an interval, jaundice is noticed, with a tender enlarged liver. The jaundice soon deepens; vomiting, which may be luminous, and purging of dark-coloured blood set in; temperature first rises and then falls; the pulse becomes weak and rapid; the skin cold and clammy; and the urine scanty, high-coloured, and albuminous. Muscular twitchings, convulsions or coma supervene, terminating in death. **Fatty degeneration of the liver,** with general ecchymoses and hæmorrhages, are the common P.M. appearances.

Antidotes.—Stomach-pump, copper sulphate is the appropriate emetic. It should be given in 3 gr. doses every 5 minutes till vomiting takes place, and then 1 gr. every quarter of an hour as an antidote. The

stomach should be washed out with a 0.2 p.c. solution of potassium permanganate, which converts phosphorus into phosphoric acid. If rejected, give it with morphine solution (10 ms.). Ozonized oil of turpentine 30 ms. every half hour. This acts by converting the phosphorus into hypophosphoric acid. The French turpentine is the best. *New* turpentine is *worse than useless*. Mag. Sulph. ½ oz. as a purgative, and demulcent drinks may also be given. Avoid fats, butter and oils which dissolve phosphorus.

Chronic toxic action.—Chronic poisoning is rare, *and occur only in those workmen who are exposed to the fumes* of phosphorus. Gastro-enteritis, fatty degeneration, **necrosis of the jaw**, general tuberculosis are the prominent symptoms. Phosphorus fumes attack the bone through carious teeth or spongy gums, but this effect is not produced by its internal use.

THERAPEUTICS

Internally.—The use of phosphorus is limited and probably mostly inert.

As a nervine tonic, the hypophosphites and the glycerophosphates have been given in **nervous exhaustion** during convalescence from acute illness, **over-taxation of the brain** from prolonged strain and overwork, but as they pass unchanged through the system and can be almost entirely recovered from the urine, they can furnish no phosphorus to the nerve tissue. They are used largely in wasting diseases like **phthisis,** and in **chronic bronchitis,** but with doubtful results. Phosphorus is occasionally recommended in functional impotence and in many other nervous disorders, and neurasthenia, etc.

As a restorative or a stimulant to the cell growth, it has been given in affections dependent on malnutrition, such as **anæmia, leucocythæmia,** with occasional success. Dr. Kassowitz obtained very good results in the **rickets** of children, the dose being $\frac{1}{120}$ to $\frac{1}{60}$ gr. *per diem* for a child weighing 12 lbs. But Whitla apprehends danger of the bones hardening in their bent condition. It is no doubt useful in **ununited fractures,** *especially during pregnancy*, and in **osteomalacia.**

Prescribing hints.—All phosphorus preparations should be given with caution. It is safe to commence with $\frac{1}{60}$ gr. dose, but in sexual debility large doses such as $\frac{1}{30}$ to $\frac{1}{20}$ gr. are necessary at times. The B.P. oil is best administered with cod-liver oil (30 to 40 ms. in 6 ozs.) in 1 dr. doses. Gelatin capsules or perles containing oil are elegant. Elixir phosphori is the best preparation. Phosphorus is to be given after meals. The hypophosphites and the glycerophosphates are generally used in the form of syrup. The compound syrup of glycerophosphates, Parrish's food and the syrup hypophosphitum co. are the preparations generally selected.

GROUP IV

Chlorine, Bromine, Iodine, Iodoform

CHLORUM

Chlorine. Cl. (*Not official*)

This gas is usually obtained from calx chlorinata and liquor sodæ chlorinatæ. Acidum nitro-hydrochloricum dilutum contains some free chlorine.

CALX CHLORINATA

Chlorinated Lime. $CaCl_2$, $CaCl_2O_2$

Syn.—Bleaching powder, Chloride of lime.

Source.—Obtained by exposing slaked lime to chlorine gas until absorption ceases. Should contain not less than 30 p.c. of chlorine. $2CaH_2O_2 + 2Cl_2 = CaCl_2O_2$, $CaCl_2 + 2H_2O$.

Characters.—A dull white powder with a characteristic smell. Becomes moist and gradually decomposes on exposure to air. *Solubility.*—Partly in water.

Dispensing hints.—It should be preserved in well stoppered bottles.

Enters into.—The preparation of chloroform and the

Official Preparation

1. **Liquor Calcis Chlorinatæ.**—1 in 10. Yields when fresh 3 p.c. of Cl. Preserve it in a stoppered bottle in a cool and dark place.

Non-official Preparations

1. **Liquor Acidi Hypochlorosi Co.** *Syn.—Eusol.*—Contains approximately 0.27 p.c. hypochlorous acid with small amounts of calcium biborate and calcium chloride. To 1 litre of water add 12.5 grms. bleaching powder, shake vigorously, add 12.5 grms. boric acid powder and shake again, allow to stand for some hours, then filter off. Said to be most potent, non-toxic, non-irritating and inexpensive *germicide*. Extensively used, in surgical practice, has no harmful effects on the tissues. Used as a lotion, compress, or as a bath.

Note.—Keep in stoppered bottles away from light. Deteriorates in hot weather after one week.

2. **Pulvis Calcis Chlorinatæ et Acidi Borici.** *Syn.—Eupad.*—Mix intimately equal weight of finely ground bleaching powder (dry) and powdered boric acid. Contains 15 p.c. available chlorine, or 11 p.c. (approximately) of hypochlorous acid. Evolves hypochlorous acid. Can be used as a dry dressing. The gas evolved acts more powerfully than Eusol, especially when moistened between layers of gauze or lint and covered with wool and bandaged.

3. **Dakin's Hypochlorite Solution.**—Obtainable in two strengths "weaker" and "stronger" solution. The weaker preparation contains 0.5 to 0.6 p.c. of sodium hypochlorite which is equivalent to 0.48 to 0.57 p.c. available chlorine. The stronger solution is approximately seven times this strength. It is prepared as follows :—Dissolve 140 grms. of dry sodium

carbonate (or 400 grms. of crystallised salt) in 10 liters of tap water, add 200 grms. of chlorinated lime. Shake and after an hour the clear liquid is syphoned off and filtered through cotton wool. Finally add 40 grms. of boric acid. Should not be kept longer than one week. A non-irritating *antiseptic* for treatment of wounds. They resemble liq. sodæ chlorinatæ of the B.P. which is five times stronger than the weaker solution.

4. **Chloramine-T.** *Syn.—Chlorazene, p.-Toluene Sodium Sulphochloramide.*—A powerful *antiseptic* and *bactericide*. Soluble 1 in 2 of boiling water, 1 in 7 of glycerin, 1 in 12 of alcohol. Should not be mixed with other antiseptics. For treatment of wounds and in surgical practice, as antiseptic mouth-wash, vaginal douche, and urethral injection. Usual strength used is 2 to 4 p.c. 1 in 250,000 with a little citric acid sterilises water.

LIQUOR SODÆ CHLORINATÆ

Solution of Chlorinated Soda. NaCl,NaClO

Syn.—Labarraque's disinfecting fluid.

Source and Characters.—A colourless alkaline liquid with an astringent taste and odour of chlorine, obtained by mixing a solution of sodium carbonate with one of chlorinated lime. $CaCl_2O_2CaCl_2+2Na_2CO_3=(NaCl.\ NaClO)_2+2CaCO_3$.

Dispensing hints.—Preserve it in a stoppered bottle in a cool and dark place.

B.P. Dose.—10 to 20 ms. or 6 to 12 decimils.

NON-OFFICIAL PREPARATION OF CHLORINE

1. **Liquor Chlori** (Burney Yeo).—Put powdered potassium chlorate 30 grs. into a 12-oz. bottle and pour over it strong hydrochloric acid 1 dr., cork, shake, and allow gas to generate, then add water by degrees shaking after each addition. Into this solution dissolve 24 to 36 grs. of quinine and 1 oz. of syrup of orange peel. *Dose.*—1 oz. every 2, 3, or 4 hours in *typhoid fever.*

PHARMACOLOGY

Externally.—Chlorine has a great affinity for hydrogen, and consequently decomposes chemical and organic compounds which contain it, such as ammonia, sulphuretted hydrogen, and many organic matters. It also destroys putrefactive and septic germs. Hence it is a powerful **disinfectant** and **deodorant.** Applied to the skin for a long time, as in the case of workmen in a manufactory of bleaching powder, it causes itching, redness and inflammation, leading even to vesication or sloughing. Inhaled in a concentrated form it is a powerful irritant to the respiratory passages and may cause death from spasm of the glottis or inflammation of the air-passages.

Both chlorinated lime and chlorinated soda are powerful **disinfectants** and **deodorisers,** because they give off hypochlorous acid—an active oxidising agent. Being unstable, the acid is soon decomposed and liberates chlorine and oxygen. The former greedily attacks hydrogen, and the latter the

oxidisable constituents of many chemical and organic substances with which it may come in contact. On this account liq. calcis chlorinatæ is used in testing for **indicanuria.**

Internally.—It exerts the same local influence on the parts with which it comes in contact, until decomposed into chlorides in the stomach, when it loses its virtues as an uncombined element.

THERAPEUTICS

Externally.—As a *disinfectant* and *deodoriser*, chlorinated lime is often poured into drains, privies, urinals, bed-pans, etc. Moistened with water it may be put in saucers in different parts of a sick-room to disinfect the air. If the room requires a speedy disinfection, chlorine gas may be quickly generated by pouring sulphuric acid on salt and black oxide of manganese ; the room being closed up for 24 hours. The chlorine thus liberated attacks the hydrogen of the ammonia and sulphuretted hydrogen present in the atmosphere of the room.

Chloride of lime is now largely used for sterilising drinking water, one drachm is dissolved in a pint of water, and a teaspoonful of this will purify two gallons without imparting any taste to the water.

Eusol, Chloramine-T, and Dakin's solution are largely used as non-irritating and inexpensive antiseptics for wounds and ulcers, and for washing cavities with foul discharges, etc. These have replaced chlorine water and solution of chlorinated lime. All these compounds contain active chlorine which exists in loose combination, and give off chlorine more slowly than the official solutions. These are not strongly irritants and have the advantage of not precipitating proteins.

As a *parasiticide* any of the solutions may be found useful in **ringworm** and **scabies.**

Internally.—In **malignant sore throat, diphtheria, mercurial salivation,** and **sloughing stomatitis,** either of the solutions may be used with advantage as a gargle (½ to 1 dr. to 1 oz.). A solution of chlorine is recommended in septic diseases, such as **typhoid fever** and **septicæmia,** but the results are not encouraging. Burney Yeo's chlorine mixture has not proved successful in our hands, though it relieves flatulence. The great drawback to its use is its extremely nauseous taste.

BROMUM

Bromine. Br. (*Not official*)

Source and Characters.—A liquid non-metallic element obtained from sea-water and saline springs. From it are prepared—

POTASSII BROMIDUM

Potassium Bromide. KBr

Source.—Obtained by the interaction of ferrous bromide with potassium carbonate. Contains not less than 98 p.c. of pure potassium bromide.

Characters.—In colourless cubical crystals: taste pungent, saline. *Solubility.*—1 in 2 of water, 1 in 200 of alcohol (90 p.c.). *Impurities.*—Lead, iron, copper, arsenium, aluminium, zinc, calcium, magnesium, sodium, ammonium, bromates, iodates, cyanides, etc.

Incompatibles.—Solutions containing free chlorine or free acids, spirit of nitrous ether if acid, mercury, silver salts, and strychnine.

B.P. Dose.—5 to 30 grs. or 3 to 20 dgrms. ; U.S.P.—1 gm. or 15 grs.

Enters into.—The preparation of Acid. Hydrobrom. Dil.

SODII BROMIDUM

Sodium Bromide. NaBr

Source.—Prepared in the same manner as potassium bromide, sodium carbonate being used in place of potassium. Contains not less than 99 p.c. of pure sodium bromide.

Characters.—In small, white, cubic crystals, or a white granular powder, somewhat deliquescent, inodorous; taste saline. *Solubility.*—1 in 1.5 of water, 1 in 16 of alcohol (90 p.c.). *Impurities.*—The same as of potassium bromide.

Incompatibles.—The same as of potassium bromide.

B.P. Dose.—5 to 30 grs. or 3 to 20 dgrms. ; U.S.P.—1 gm. or 15 grs.

AMMONII BROMIDUM

Ammonium Bromide. NH_4Br

Source.—Formed by neutralising hydrobromic acid with solution of ammonia, $HBr + NH_4HO = NH_4Br + H_2O$. Contains not less than 98 p.c. of pure ammonium bromide.

Characters.—In small, colourless crystals; taste pungent, saline. *Solubility.*—1 in 1½ of water, 1 in 13 of alcohol (90 p.c.). *Impurities.*—Bromates, iodides, nitrates, lead, iron.

B.P. Dose.—5 to 30 grs. or 3 to 20 dgrms. ; U.S.P.—1 gm. or 15 grs.

STRONTII BROMIDUM

Strontium Bromide. $SrBr_2$, $6H_2O$

Source.—By neutralising dilute hydrobromic acid with strontium carbonate. Contains not less than 97 p.c. of pure strontium bromide.

Characters.—White acicular deliquescent crystals. Taste saline, slightly bitter. Soluble in less than 1 part of water and in alcohol.

B.P. Dose.—5 to 30 grs. or 3 to 20 dgrms. ; U.S.P.—1 gm. or 15 grs.

NON-OFFICIAL PREPARATIONS AND DERIVATIVES

1. **Bromidia.** *Syn.—Liq. Bromo-Chloral Comp., B.P.C.*—1 dr. contains 15 grs. of each of Chloral Hydrate and Pot. Bromide. Chloral Hydrate 27.50, Ext. Cannab. Ind. 0.23, Tr. Aurant. 12.50, Ext. Hyoscyam. 0.23, Glycerin 18.75, pot. Bromide 27.50, add water to 100. *Dose.*—½ to 2 drs or 2 to 8 mils.

2. **Bromoform, U.S.P.**—A colourless, volatile, sweet liquid, with an agreeable odour. Soluble in chloroform, ether, and slightly in water. Most efficacious in *whooping cough*, diminishing the number, duration, severity, and vomiting. *Dose, U.S.P.*—0.2 mil or 3 ms.

Pharmacology of the Bromides

Externally.—Bromides have no action on the unbroken skin, but on the denuded surface a concentrated solution acts as an **irritant.** The fumes of bromine are so irritating to the respiratory tract that they cannot be inhaled.

Internally. **Alimentary canal.**—Either in concentrated solution applied to the throat or in repeated large doses given by the mouth, bromides **diminish** the **sensibility** and the **reflex excitability** of the fauces. Tickling the pharynx then no longer tends to excite vomiting even though the tactile sensation may remain. The bromides are readily absorbed by the gastro-intestinal mucous membrane. Large doses in concentrated solutions produce nausea, vomiting and gastralgia by their local salt action.

Heart and circulation.—Some believe that all bromides are changed into the sodium salt in the blood. But it is certain that they circulate as sodium bromide, and pass through the different organs as such. In therapeutic doses there is no essential effect on the heart and circulation, but in cardiac neurosis the effect of the bromides is to steady and quiet the heart's action through its general sedative effect. It is only in enormous and toxic doses that the potassium ion has any depressing effect on the heart muscle.

Respiration is only slightly depressed, probably through their influence on the circulation. The coughing reflex is diminished.

Nervous system.—The chief action of bromides is on the entire **nervous system,** which is **moderately depressed** and which depression can be maintained for a long period without any effect on the vital centres on the medulla. In their progressive action on this system, they do not follow the " Law of Dissolution " (*see* p. 151), but the highly-developed functions and the lower and the spinal ones are all affected at the same time.

Cerebrum.—All bromides **lessen the functional activity of the brain.** The sensibility, excitability and emotional activity are all diminished, thereby inducing a state most favourable for sleep. Hence they are **hypnotics** (*see* hypnotics). It causes sleep by rendering the brain less sensitive to external influences. They also depress the **cortical motor area.**

Medulla and cord.—The great vital centres are more or less depressed. There is considerable **impairment** of the **reflex excitability** induced partly by the paralysed condition of the peripheral sensory nerves but chiefly by the diminished excitability of the nerve-centres.

In brief, bromides depress (1) the cortical motor cells, (2) the medullary and spinal centres, (3) reflex excitability in connection with all the sentient surfaces of the body, (4) the activity of the sensory mechanism, and (5) that of the peripheral nerves. The effect of bromides is the direct antithesis of strychnine.

Muscles.—The bromides not only **impair the activity** of the muscles by their action on the motor-cells and reflex centres, but by their direct influence on the muscles themselves. They may be paralysed to such an extent that no convulsions can be produced by poisoning with strychnine. Therefore they are powerful **antispasmodics.**

Genitals.—Bromides decidedly lessen virility and if continued long the sexual passion due either to its action on the brain, or diminished reflex activity. Hence they are **anaphrodisiacs.**

Elimination.—Inspite of the fact that elimination of bromide by the kidneys begins soon after administration, the process is slow, and traces have been found 20 days after cessation of administration. Owing to this fact certain saturation of the organism results. During a long course of bromide treatment the blood always contains bromides and the chlorides are correspondingly diminished. Bromides also partially replace chlorides in other tissues, accumulating in the largest amounts in those organs which normally are richest in chlorine. For instance, hydrobromic acid appears in gastric juice. It is of practical importance to note that the accumulation of bromides in the body is influenced by the amount of sodium chloride taken. Bromides are also eliminated, by the intestinal and bronchial mucous membrane, skin, saliva and milk. Many think that they depress the sensibility of the fauces during their excretion through its mucous membrane.

Acute toxic action.—Acute poisoning is rare. But if ½ to 1 oz. is swallowed, weakness, frontal headache, reduction of pulse-rate, irregular pulse, insensibility, aphasia, amnesia are the chief symptoms. Recovery takes place as a rule unless œdema of the lungs supervenes.

Chronic toxic action or "Bromism."—A group of symptoms following a prolonged use of bromides is known by the name of "bromism." They are an eruption resembling acne which may lead to boils, chiefly on the face and back, mental dulness, anæmia, general prostration, muscular weakness, imperfect articulation, staggering gait, drowsiness, and inclination to sleep, lowering of cutaneous sensibility, abolition of reflex action of the pharynx, conjunctivitis, slight increase of bronchial secretion and impairment of sexual powers. The mental faculties may be so much depressed in bad cases, that melancholia, dementia, or other mental disorders may follow.

Antidotes.—The mere stoppage of bromides is enough in the early stage, but by administering an extra quantity of common salt (sodium chloride) with food, the ill-effects of the drug may be counteracted.

Physiological antagonists.—Strychnine and atropine.

Therapeutics of Bromides

Internally.—Bromides are chiefly used therapeutically as **sedatives** in hypersensitive state of the nervous system. They are also used as **hypnotics** to promote sleep, but are not of value when sleeplessness is due to painful conditions. Bromides may therapeutically be used :

1. As a *hypnotic* they are very efficacious in **sleeplessness** caused by worry, overwork or mental strain. In **delirium tremens, mania, acute inflammatory and febrile diseases, cerebral congestion, night screaming** of children, **nightmare** of children and adults, bromides may be used with the greatest benefit either to induce sleep or to allay irritability.

2. *To allay slight pain* which is keenly felt on account of the hypersensitiveness of the nervous system.

3. *To lessen excitability* bromides are very effective, **irritability** of temper, **nervous excitability** of women either during the latter months of pregnancy or the change of life, **hysteria, hypochondriasis,** etc.

4. *To prevent convulsions.* As a muscular or spinal depressant bromides are used in **infantile convulsions, epilepsy, puerperal eclampsia, hysteria, chorea, tetanus** and **strychnine poisoning.** In epilepsy their efficacy is more marked in *grand mal*, producing little or no effect in *petit mal.* In these conditions it must be remembered (*a*) that large doses are required if any physiological results are to be obtained, and (*b*) that children bear bromides well.

5. *To lessen sexual excitability* as in **chordee** and **nymphomania.**

6. As a *sedative* in all *spasmodic conditions*, such as **pertussis, asthma, hiccough, laringismus stridulus, etc.**

7. As a *cardiac sedative* in **nervous arrhythmias.**

8. To check **reflex or central vomiting,** as sea sickness, etc.

The salts most commonly used are potassium or sodium bromides, and as above-mentioned it is in large and toxic doses that the potassium ion has any special depressing effect.

Potassium bromide is useful in lessening the disagreeable effects of quinine, salicin and salicylates.

Prescribing hints.—Bromides may be administered by the mouth or rectum. By the mouth in the form of lozenge, tablet or mixture. Their taste is fairly well disguised by the liquid extract of liquorice, milk or beer. For an enema they may be dissolved in gruel or mucilage. Their efficacy is greatly enhanced if potassium, sodium and ammonium bromides are given in combination, and the patient is restricted to vegetable food and salt free diet. Strontium bromide is probably the most inoffensive of all the bromide salts. As it improves the appetite and assists assimilation and nutrition, it may be used in gastric affections and dyspepsia. To prevent acneform eruptions they may be combined with small doses of arsenic. The hypnotic effect of the bromides may be greatly increased if they are given with chloral hydrate, morphine

or hyoscyamus. In some cases of *insomnia* bromidia may be used with great advantage. Anæmic persons cannot bear a protracted course of bromide treatment. Children even very young ones, bear bromides well. In *whooping cough* bromoform is sometimes more beneficial than ammonium bromide. Bromides should not be prescribed with strychnine or other alkaloids in a mixture, as this will throw down alkaloidal precipitates, especially if the solution is concentrated.

IODUM

Iodine. I

Source.—A solid non-metallic element obtained from the ashes of seaweeds and sponges and from native iodides and iodates.

Characters.—Rhombic prisms or octahedrons of a peculiar odour, dark colour, metallic lustre, yielding violet vapour on heating. *Solubility.*—Very slightly in water, more in alcohol (90 p.c.), freely in ether, or solution of potassium iodide and in carbon disulphide. *Impurities.*—Water, iron, iodine cyanide.

Incompatibles.—Mineral acids, metallic salts, vegetable alkaloids, oil of turpentine, and ammonia.

Enters into.—The preparation of Arsenic, Iron, Lead, Mercury, Potassium, Sulphur, and Sodium Iodides. Of these, Potassium and Sodium Iodides only will be described here.

Dose, U.S.P.—0.005 gm. or $\frac{1}{12}$ gr.

Official Preparations

1. **Tinctura Iodi Fortis.** *Syn.—Linimentum Iodi, B.P.*' 85, *Liq. Iodi Fortis, B.P.*' 98.—$\frac{1}{10}$ gr. in 1 m. About 4 times the strength of Tr. Iodi mitis.

2. **Tinctura Iodi Mitis.**—*Tr. Iodi, B.P.* 1898.—1 in 40. $\frac{1}{4}\frac{1}{0}$ gr. in 1 m. **B.P. Dose.—2 to 5 ms. or 12 to 30 centimils. ; U.S.P.—0·1 mil. or 1½ ms.**

3. **Unguentum Iodi.**—1 in 25.

Non-official Preparations

1. **Liquor Iodi Co. U.S.P.** *Syn.—Lugol's Solution.*—Iodine 5 ; pot. iodide 10 ; water *q.s.* to 100. *Dose.*— 0.2 mil. or 3 ms.

2. **Iodized Phenol.**—Carbolic Acid and Iodine, equal parts.

3. **Tr. Iodi Decolorata, B.P.C.**—Iodine 2.5, Rectified Spirit 27.5 ; dissolve with a gentle heat, and when cold, add strong solution of ammonia, 6.25 ; keep the mixture in a warm place until decolorised, after which dilute it with rectified spirit to 100.

4. **Iodinol** or **Iodipin.**—A yellow, oily liquid compound of iodine and *sesame* or *teel oil.* More easily assimilable and efficacious than Pot. Iodide. *Dose.*—1 to 4 drs. daily, subcutaneously or by inunction.

5. **Pigmentum Mandl, T. H.**—Iodine 6 grs., Pot. iodide 20 grs., oil of peppermint 5 ms., glycerin to 1 oz.

PHARMACOLOGY

Externally.—The action of iodine is identical with that of chlorine, but not so energetic. It is a powerful **antiseptic, disinfectant, deodorant** and **antiparasitic,** decomposing organic compounds and killing germs and parasites. Locally, its action is **irritant, rubefacient** and **vesicant,** according to the strength and length of the application. It stains the skin yellowish-brown and deadens the cuticle, which peels off. Iodine dilates local blood-vessels and causes exudation of leucocytes, and thus stimulates absorbent vessels. It is a point of practical importance that widespread inflammation of an erysipelatous character may be set up by painting the skin with iodine, especially in children and rheumatic subjects. It may also be absorbed into the circulation when it undergoes the change described under the head of iodoform, and may, in a similar manner, lead to irritation of any internal organ which has an acid reaction.

Internally.—In the stomach and intestines it is slowly converted into iodide or iodate of sodium, but much may be left free to cause vomiting, purging and colic. In minute doses it occasionally stops vomiting. Inhalation of iodine produces **irritation** of the respiratory passages, cough, sneezing, frontal and thoracic pain and dyspnœa.

Remote effects.—For a description of these the student is referred to the pharmacological action of iodoform and the iodides. Nothing further need be said here on these points.

THERAPEUTICS

Externally.—The tincture, ointment or liquor is often used to stimulate **foul, indolent** or **lupoid ulcers,** and as a counter-irritant in **subacute** and **chronic inflammations** of joints, synovial membranes, lymphatic glands, pleura, pericardium, lungs, liver, spleen, uterus, ovary, periosteum, peritoneum, etc. Tr. iodi mitis has been successfully injected into **abscesses, sinuses, cysts, hydroceles, bronchoceles, joint cavities, empyema** and **spina bifida.** Tr. iodi fort. being very strong cannot be painted more than twice or at the utmost thrice over the same spot. If the application causes much pain and irritation, the iodine can be washed off with alcohol, brandy whisky or eau-de-cologne, or better still with a solution of potassium iodide or liq. potassæ. The weak tincture or the strong one may be painted over the chest to help the absorption of **pleuritic fluid.** Blistering with the strong tincture around or near a threatening **abscess, bubo** or **carbuncle,** lessens the inflammation. Iodine may also be painted over and around the circumjacent skin, to prevent the spread of **erysipelas** and **carbuncle.** Its chief external use, however, is for the **sterilisation of the skin** before operations of all kinds. Iodized phenol is a valuable local application in **endometritis.** Vapor iodi is an efficacious inhalation in **hoarseness, diphtheria**

and **phthisis.** To prevent bronchial irritation it is inhaled with chloroform and steam. Iodine lotion (iodine 2 to 4 grs., pot. iodide 2 grs., water 1 oz.) removes **opacity of the cornea** when it is of recent origin and does not involve the cornea to any depth.

Internally.—Free iodine is rarely used. The weak tincture painted over the gums and teeth **dissolves tartar,** heals ulcers, and stimulates the **growth** of **gums,** when they have ulcerated and receded. Iodine gargle (2 to 4 drs. in water 8 ozs.) checks **mercurial salivation,** and heals **syphilitic** and **non-syphilitic sores** of the mouth and throat. Pigmentum Mandl is a capital application for **chronic granular pharyngitis.** Tr. iodi mitis 1 or 2 drops in 1 oz. of water at times checks vomiting, when given every quarter hour. Iodine is recommended in **scrofula, malarial fever, gout,** and other septic fevers, but the writer has used tincture of iodine in chronic malarial fevers without appreciable benefit. Sometimes iodine does good in **syphilis** and **scrofula,** where its salts fail.

The use of **nascent iodine** has been advocated for the treatment of **pulmonary phthisis.** This is done by giving 20 to 30 grs. of potassium iodide with 10 to 20 grs. of pot. bicarb. in a draught of water in the morning at 7 a.m. followed at intervals either by chlorine solution made from pot. chloras and hydrochloric acid, or hydrogen peroxide, or inhalation of ozone.

Caution.—As iodine is a gastro-intestinal irritant, it should be freely diluted and administered after food. In the stomach it is converted into **iodide of starch,** which is less irritant. Trousseau gives the tincture in sugared water or in sherry.

POTASSII IODIDUM

Potassium Iodide. KI

Source.—(1) Dissolve iodine in a solution of potassium hydroxide and evaporate to dryness; $6KHO+3I=5KI+KIO_3+3H_2O$. (2) Mix the residue with charcoal and heat, thereby to remove the oxygen of iodate as carbonic oxide; $2KIO_3+6C=2KI+6CO$. (3) Dissolve and purify. Contains not less than 99 p.c. of pure potassium iodide.

Characters.—Colourless, opaque, cubic crystals with a feebly alkaline reaction. *Solubility.*—Less than 1 part of water, 1 in 12 of alcohol (90 p.c.). *Impurities.*—Iodates, nitrates, bromides, cyanides, etc.

Incompatibles.—Bismuth subnitrate, sp. ætheris nitrosi, liquorice, liq. strychnine, alkaloidal salts, and substances containing starch.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms., U.S.P.—0.3 gm. or 5 grs.

Enters into.—Tr. Iodi Fort., Tr. Iodi Mitis, Ung. Iodi, and the

Official Preparations

1. **Linimentum Potassii Iodidi cum Sapone.**—1 in 10 by wt. A creamy unirritating substance. Does not stain the skin.

2. **Unguentum Potassii Iodidi.**—1 in 10. White; acting in the same way as the above.

SODII IODIDUM

Sodium Iodide. NaI

Source.—Prepared from iodine and sodium hydroxide by a process similar to that adopted in making potassium iodide ; the salt being crystallised at a temperature not less than 20°C. Contains not less than 99 p.c. of pure sodium iodide.

Characters.—A dry white crystalline deliquescent powder having a saline and somewhat bitter taste. *Solubility.*—Less than 1 part of water, 1 in 3 of alcohol (90 p.c.). *Impurities.*—The same as of potassium iodide.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—0.3 gm. or 5 grs.

ACIDUM HYDRIODICUM DILUTUM

Diluted Hydriodic Acid

Source and Characters.—A colourless liquid containing 10 p.c. by weight of hydrogen iodide HI, and 1 p.c. by weight of hydrogen hypophosphite. Obtained by the action of hydrogen sulphide on a solution of iodine with the addition of hydrogen hyposulphite.

Incompatibles.—Alkalies and their carbonates, metallic oxide, salts of silver and lead.

B.P. Dose. 5 to 10 ms. or 3 to 6 decimils. ; U.S.P.— 0.5 mills or 8 ms.

Official Preparation

1. Syrupus Acidi Hydriodici.—1 in 10. B.P. Dose.— ½ to 1 dr. or 2 to 4 mils. ; U.S.P.—4 mils. or 1 dr.

Non-official Preparation

1. **Ammonii Iodidum, U.S.P.**—In minute colourless cubical crystals, or as white granular powder. Odourless, with a sharp saline taste. Very hygroscopic. Becomes yellow or brownish when exposed to air and light. *Dose. U.S.P.*—0.3 gm. or 5 gr.

Pharmacology of Iodides and Hydriodic Acid

Externally.—Potassium and sodium iodides are freely absorbed, being decomposed by the sweat.

Internally.—The action of the salts of iodine is identical with that of iodine, except that they are less irritant to the gastro-intestinal canal, and are therefore used in preference to iodine. Of these, potassium iodide is the most largely employed.

In minute doses it improves appetite and body weight of healthy individuals. It is quickly absorbed and is converted into sodium iodide ; this again is slowly decomposed by small quantities of nascent oxygen (set free by living protoplasm) acting upon the iodide in an acidulated solution, the acid being provided either by carbonic acid in the blood, or the acid secretions of different organs. In large doses it produces a group of symptoms known as "**iodism.**" Besides the characteristic action of iodine, it has a certain definite action of its own. It increases the secretion of bronchial glands

during its elimination through the respiratory mucous membrane, producing a flow of thin mucus, and liquefying tenacious secretions; hence it is an **expectorant.** It is also an indirect **antispasmodic.** In large doses it causes **diuresis,** but how far this diuretic action is due to the large doses of alkali, or to the iodine, is not known.

Large doses of the salt (10 grs.) **lessen** the secretion of **milk,** produce **atrophy** of **mammæ** and **testicles,** and destroy **sexual power.** Potassium iodide, or at least the iodide, disengages certain metallic poisons, such as mercury and lead, from their albuminous compounds, forms soluble salts, and removes them from the tissues.

As the spirochæta of syphilis is not killed by the application of iodide of potassium to a syphilitic lesion, iodide does not act as a parasiticide. The specific effects in the tertiary stage are exerted not on the parasite but upon the tissues in which the parasite lives and which have reacted to its presence by the formation of tumours. These lowly organised tumours disslove under the action of iodides, while the parasite remains unaffected, but is now more readily accessible to the parasitic drugs—mercury and arsenic (Cushny). It has been suggested that iodides help the production of proteolitic ferments.

Iodine is contained in the form of thyroxin in the thyroid gland. The administration of iodine or iodides increases its formation and therefore affect metabolism.

Elimination.—Iodides ar rapidly eliminated mainly by the urine, but partly also by the saliva, gastric juice, sweat, milk, and other secretions and body fluids and effusions. Seventy five per cent. of the dose appears in the urine within twenty-four hours. The remainder may remain in organic combination in the body. In escaping through the skin it produces **cutaneous eruptions,** vesicular, bullous or hæmorrhagic starting from the pappilary layer and not from the sweat glands as was originally supposed. This is due to the liberation of nascent iodine as already described.

Iodism.—Some individuals are very susceptible to its influence, even ¼ to 1 gr. producing symptoms of iodism; while others can bear much larger quantities (1 to 4 drs. daily). The characteristic symptoms of iodism are due to irritation of the skin taking the from of various rashes, and of coryza, *i.e.*, running of the eyes and nose, sneezing, œdema around the eyes, frontal headache, brassy taste in the mouth, loss of appetite, with irritation of the fauces and trachea. These grow intense if the iodides are pushed, leading to swollen gums, furred tongue, salivation and in some cases, vomiting, diarrhœa, bronchitis and cutaneous eruptions. Often large doses are better borne than small ones: they should be given freely diluted. In some cases one big dose at night is better borne than three smaller ones during the day.

Antidotes.—Carbonate of ammonia, sp. ammon. aromat., or bicarbonate of potassium controls iodism. Fowler's solution prevents skin eruptions.

THERAPEUTICS OF IODIDES

Externally.—The liniment and ointment of potassium iodide are used for the same purposes as the preparations of iodine, with this advantage, that they neither stain nor irritate the skin, but they are decidedly weaker.

Internally.—Iodides are employed in the same class of diseases, where iodine is indicated either internally or externally; but the following deserve a special notice:—

1. **Stomach and liver.**—Potassium iodide given after food, in minute doses say ½ gr. with aromatic spirit of ammonia or ipecacuanha wine, is of great service in **atonic dyspepsia.** It is said to be useful in **cirrhosis** of the **liver** in its early stage.

2. **Respiratory passages.**—Pot. iodide 10 grs. given at bedtime cuts short an attack of acute **coryza** at the outset, whilst chronic colds are relieved by small doses. In acute **febrile catarrh,** it is serviceable when given with antimonial wine. It relieves **asthma** (15 to 20 grs.) whether dependent on cold or not. It liquefies the phlegm and helps expectoration and thus is useful in the early stages of bronchitis, bronchopneumonia and pneumonia.

3. **Heart and blood-vessels.**—It is useful for absorbing the effusion in **pericarditis,** and the deposits over the **cardiac valves.** Iodides are extremely valuable in all conditions of heart and the vessels, which may be ascribed to be due to tertiary manifestation of syphilis. It is also extremely useful for relieving the pain of aneurism, but this is not due to reduction of blood-pressure, as recent experimental works by Price and others have clearly proved that even in large doses they have no effect whatsoever on blood-pressure. Beneficial effects have been obtained in **angina,** by giving it in the interval between the attacks. Potassium iodide is also a very valuable remedy in **arterio-sclerosis.** Stockman has recently suggested that the value of this drug is due possibly to its acting upon the thyroid gland and stimulating it to produce a larger amount of thyro-iodin.

4. **Brain.**—Many authorities recommend the use of potassium iodide in **hydrocephalus,** but it only acts as a palliative. In **meningitis** with exudations, and other cerebral lesions of syphilis, a combination of iodide with bromide is more efficient than any other remedy known, but in order to have the full benefit the iodide must be used in large doses, say 1 or ½ dr.

5. **Skin.**—Many syphilitic cutaneous diseases, such as **psoriasis** and **erythema,** are sometimes cured by full doses of iodides.

6. **Scrofula.**—The iodides, especially syrupus ferri iodidi either alone or with cold-liver oil, have a remarkable effect in **tuberculosis** when the glands are affected; but they have little effect on the tubercles of the lungs.

7. **Syphilis.**—What mercury is in the primary and secondary stages, iodides are in the tertiary. Under its use **periostitis, nodes, gummata,** syphilitic **deposits** in the **brain** and other organs disappear with remarkable rapidity. Success depends upon boldly pushing the drug in doses of 20 to 40 grs. or 1 dr. 3 times a day. In secondary syphilis even, it sometimes does great good when combined with corrosive sublimate. It cures barrenness of women due to syphilis. In congenital syphilis, the iodides are also efficacious, but the system becomes less tolerant after the poison is destroyed. In primary syphilis they have no effect. Iodides are of no value in the treatment of syphilis, but are of enormous value in the **manifestations of untreated syphilis.** Pains resembling rheumatism and increasing at night, due to syphilis, are removed by them.

8. **Metallic poisons.**—Potassium iodide eliminates lead and mercury from the system, magnesium sulphate should always be given in these cases in combination with the iodide, otherwise the metallic salt may be reabsorbed from the bowels. During elimination, mercury may cause salivation. Argyria is also treated successfully with iodides. Some authorities recommend this salt in mercurial salivation, but there is a chance of salivation being increased by it as it is a sialagogue itself.

The action of sodium iodide is similar to that of potassium iodide.

Prescribing hints.—Potassium iodide is generally used in preference to other salts. It is best administered freely diluted in water or milk, preferably an hour after food. Individual susceptibility varies. While some patients suffer from iodism within a few hours after a relatively small dose, others bear quite large doses. Sometimes the symptoms produced by small doses disappear when the dose is increased. Ammonium carbonate or potassium bicarbonate also checks the symptoms of iodism. Hydriodic acid or the syrup is used when the alkaline iodides are not tolerated. Iodides are incompatible with alkaloidal salts, and should not be prescribed with liquor strychnine, which will throw down alkaloidal precipitate. It should not be used with calomel or hydrogen peroxide. Iodides precipitate heavy metals and are incompatible with mineral acids and oxidising agents. When prescribed with ferric salts iodine is liberated, so also when combined with spiritus etheris nitrosi if acid. Combined with subnitrate of bismuth the mixture turns yellow from free iodine and from formation of an iodide of bismuth.

IODOFORMUM

Iodoform. Tri-iodomethane. CHI_3

Source.—Prepared by the action of iodine on ethylic alcohol in the presence of solution of potassium carbonate.

$$C_2H_6O+4I_2+3K_2CO_3=CHI_3+KCHO_2+5KI+2H_2O+3CO_2.$$

Characters.—Shining, lemon-yellow, small, hexagonal crystals, unctuous to the touch, with a persistent and disagreeable odour and taste. Volatilises slowly and contains iodine 96.7 p.c. *Solubility.*—Slightly in water, 1 in 8 of ether, 1 in 12 of chloroform, 1 in 100 of alcohol (90 p.c.), 1 in 100 of glycerin, 1 in 10 of collodion, 1 in 14 of oil of eucalyptus, 1 in 30 of olive oil, and also in fixed and volatile oils. Sparingly in benzene. *Impurities.*—Soluble yellow colouring matters, iodides, picric acid.

Incompatibles.—Calomel, silver and other nitrates, pot. chlorate, and nitrates.

B.P. Dose.—½ to 3 grs. or 3 to 20 cgrms. ; **U.S.P.**—0.25 gm. or 4 grs.

Official Preparations

1. **Suppositoria Iodoformi.**—3 grs. or 0.2 grm. in each.
2. **Unguentum Iodoformi.**—1 in 10.

Non-official Preparations

1. **Collodium c. Iodoformo.**—Iodoform 1, Collodion Flexile 12. As a pigment in *venereal sores* and *glandular swellings.*

2. **Emulsio Iodoformi, U.C.H.**—Iodoform 10, Glycerin 70, Water 20. For injection into *sinuses* and *abscess cavities.*

3. **Iodoform Varnish.** *Syn.*—*Whitehead's Paint.*—Contains Iodoform 10 p.c. in Tr. Benz. Co., of which ether is substituted for alcohol.

Substitutes for Iodoform

1. **Thymolis Iodidum. U.S.P.** *Syn.*—*Aristol.*—Prepared by mixing solution of iodine in potassium iodide with thymol solution. Contains 43 p.c. of iodine. A reddish-brown powder insoluble in water and glycerin, but soluble in collodion, ether, and oils. Useful in *ulcerative lupus, tinea, eczema, psoriasis,* when applied as an ointment 10 p.c. or dusted, or in collodion.

2. **Iodol.** *Syn.*—*Tetra-Iodo-Pyrrol.*—A brownish-white powder without disagreeable smell and toxic action, insoluble in water, but soluble in 1 in 145 of glycerin, alcohol, chloroform, and ether. Externally it acts like iodoform, and internally like potassium iodide in 1 to 3 grs. in pill or capsule.

3. **Iodo-Salicylic Acid** and **Di-Iodo-Salicylic Acid.**—Are compounds of iodine and salicylic acid and having the combined action of both. *Antipyretic, analgesic,* and *antirheumatic.* Succeeded where salicylates failed. The dose of the latter 20 grs. and upwards.

4. **Loseophan.** *Syn.*—*Meta-Tri-Iodo-Cresol.*—A white or yellowish white odourless powder containing iodine 80 p.c. As an antiparasitic.

5. **Nosophen.** *Syn.*—*Tetra-iodophenolphthalein.*—A cream-coloured almost odourless powder containing 60 p.c. of iodine. Combines with bases. A good intestinal antiseptic. *Dose.*—3 to 8 grs. The sodium salt of Nosophen is a blue powder known as **Antinosin** ; and the bismuth salt is a reddish-brown powder known as **Eudoxin.**

6. **Iothion.**—A pale yellow syrupy liquid. Contains 80 p.c. iodine, used as 10 p.c. ointment.

7. **Sajodin.**—An organic compound with calcium 4.1 p.c. and iodine 25 p.c. *Dose.*—5 to 15 grs.

PHARMACOLOGY

Externally.—Iodoform when locally applied is a **deodorant, antiseptic** and **disinfectant.** This action is due to the decomposition of the iodoform and the liberation of nascent iodine by many agents, such as living cells, ptomaines, light, air, etc.; but before this decomposition can take place the iodoform must first be dissolved in the fats of the tissues. None of the agents above mentioned have any effect upon undissolved iodoform. This decomposition, as one would expect, does not take place very rapidly. It must not therefore be supposed that when iodoform is applied to a wound iodine is set free so abundantly as to cause local irritation; on the contrary iodoform is a **local anæsthetic.**

Internally.—The precise action of iodoform within the body is not well understood. To a certain extent it acts like an iodide. In the stomach it acts as a **sedative** and **depreasses** the **heart.** In large doses it produces toxic symptoms. It is eliminated by the **breath** as iodine, and by the **urine** as iodides and iodates.

Toxic action.—Acute poisoning is rare now. Chronic poisoning may take place either from repeated doses, or from absorption from a raw surface. The symptoms are malaise, vertigo, dilatation of the pupil, loss of appetite, gastro-intestinal disturbance, quick, feeble pulse, fever (temperature sometimes rising to 104°F.), delirium, mania, or melancholia, erythema and perhaps eczema, convulsions, collapse and at times death. Fatty degeneration of the liver and muscles, hæmaturia, and albuminuria sometimes occur. These symptoms may come on suddenly, or may develop gradually, lasting for weeks. Moorhof says that poisoning never occurs if iodoform is used alone, and without other antiseptics. The statement is however incorrect. Some persons are peculiarly susceptible to iodoform, and toxic symptoms have occurred after the slightest dusting of the powder upon a small wound.

Treatment of Iodoform poisoning.—If iodoform is dissolved in the fats and ptomaines present in a wound, iodine, is set free. Its vapour then passes into the body-fluids and is resolved by the *alkaline* serum into five molecules of iodates and one of iodide. In those tissues having an *acid* reaction iodine is again set free and *acts on the tissue on which it is liberated.* The **cerebral cortex,** the **mucous membrane of the stomach,** and the **sweat glands,** all have an *acid* reaction. Hence the cerebral, gastric, and cutaneous symptoms in iodoform poisoning. By giving 10 grs. of sodium bicarbonate every hour, we can alleviate the symptoms and lessen the ill-effects of the drug. Stimulants, diaphoretics, and sponging the skin with warm water are also recommended.

THERAPEUTICS

Externally.—Iodoform is employed as a local antiseptic, but the strong characteristic smell is the chief drawback to its use. However, it can be disguised by coumarin (50 p.c.) or 0.1 of geranium (1 in 25). It is extensively employed in surgery in various forms such as powder, collodion, ointment,

emulsion, bougie, gauze, wool, etc., in **wounds, sloughing sores, lupus, rodent, syphilitic** and **scrofulous ulcers, chancres, bedsores, cancers, ozæna, abscess cavities, sinuses, fistulæ, gonorrhœa, granular lids,** etc. The ointment removes **itch.** Collodion iodoform subdues **mumps, buboes** and **chronic glandular enlargements.** The suppository is used to relieve painful conditions of the bladder and rectum and the ointment gives great relief in **pruritus ani.** It may be insufflated for otorrhœa and frequently proves extremely beneficial.

Internally.—It is rarely used internally. As a spray, pastil, or insufflation, it is used in syphilitic sores of the mouth, tubercular pharyngitis, and laryngitis. It has been unsuccessfully used in **gastric ulcers** and **phthisis,** and Burney Yeo recommends ½ gr. dissolved in cod-liver oil three times a day in **tubercular peritonitis** of children.

Caution.—The weak and the aged are liable to poisoning. Children bear it well.

Prescribing hints.—Iodoform is rarely used for internal administration. In a mixture or lotion, suspend it with mucilage of acacia. When in pill it is massed with glucose, or one-fourth its weight of pulv. tragacanth. co. Its disagreeable odour is covered by eucalyptus and geranium (5 ms. to 2 dr.) oils, balsam of Peru, musk, and coumarin prepared from Tonka beans.

GROUP V

DRUGS USED TO KILL PARASITES

Sulphur, Ichthyol, Hydrogen Peroxide, Borax, Boric Acid, Sulphurous Acid

SULPHUR SUBLIMATUM

Sublimed Sulphur

Syn. B.P.—*Flowers of Sulphur.* **Syn. I.V.**—*Gandak,* Beng.

Source.—Obtained from native sulphur or sulphides.

Characters.—A greenish-yellow gritty powder, without taste or smell unless heated, when it evolves fumes of sulphurous anhydride. *Impurities.*—Sulphide of arsenic, sulphurous and sulphuric acids. *Solubility.*—Insoluble in water or alcohol: slightly soluble in oils and fats; completely soluble in carbon disulphide.

Enters into.—Pulv. Glycyrrhiz. Co.

B.P. Dose.—20 to 60 grs. or 12 to 40 dgrms. ; U.S.P.—4 gm. or 1 dr.

Official Preparation

1. Unguentum Sulphuris.—1 in 10. Made with adeps benzoata.

Non-official Preparations

1. Confectio Guaiaci Composita, L.H. *Syn.—Chelsea Pensioner.*—Guaiacum 2, sublimed sulphur 4, mustard 4, nitrate of potash 2, rhubarb 1, honey or treacle to 16. *Dose.*—1 to 2 drs. or 4 to 8 grms.

2. **Unguentum Sulphuris Co., B.P.C.** *Syn.—Wilkinson's Ointment.*—Soft soap 30, sublimed sulphur 15, precipitated chalk 10, tar 15, lard 30.

SULPHUR PRÆCIPITATUM

Precipitated Sulphur

Syn. B.P.—*Milk of Sulphur.*

Source.—By the action of hydrochloric acid upon a solution prepared by boiling together sulphur and lime in water.

Characters.—A smooth, not gritty powder of a greyish-yellow colour.

Impurity.—Calcium sulphate due to sulphuric acid being used instead of hydrochloric acid, which is more expensive.

B.P. Dose.—20 to 60 grs. or 12 to 40 dgrms. ; U.S.P.—4 gm. or 1 dr.

Official Preparations

1. **Confectio Sulphuris.**—45 p.c. **B.P. Dose.—60 to 120 grs. or 4 to 8 grms.**

2. **Trochiscus Sulphuris.** *Syn.—Garrod's Lozenges.*—Precipitated sulphur 5 grs. (0,3 grm.), acid potassium tartrate 1 gr. (0.06 grm.), in each lozenge.

Pharmacology

Externally.—When applied to the whole skin, pure sulphur has no effect, but if it be mixed with any greasy substance, some of it is converted into sulphuretted hydrogen which acts as a mild irritant, causing dilatation of the vessels, and, in delicate skins, sometimes even a severe dermatitis. It is a **parasiticide,** and rapidly causes the death of the **itch-insect.** Sulphur acts as a keratoplastic or reducing agent upon the epidermis and withdraws oxygen from the tissues, thereby favouring cornification of epithelial cells. When it is brought into contact with living protoplasm, sulphurous and sulphuric acids are formed : it is therefore a violent irritant to raw surfaces. It destroys fungi and low forms of vegetable life. This action is made use of in protecting the vines from the fungus which causes the **vine disease** in Italy.

Internally. **Gastro-intestinal tract.**—Being insoluble in the fluids of the mouth, sulphur has no taste, neither does it undergo any change in the stomach. When however it reaches the small intestine, it comes in contact with the alkaline bile, and a small portion, being converted into an alkaline sulphide, is absorbed as such, but the greater portion passes unchanged through the bowels and is excreted with the fæces. The amount absorbed depends on the preparation used, and Buchheim has shown that as much as 46 p.c. of the finely divided precipitated sulphur can be detected in the urine, but only 15 p.c. of sublimed sulphur is eliminated in this way. In the intestine, sulphur acts as a **mild laxative,** causing soft motions without any colic due to sulphides, which act as mild stimulants

to peristalsis. Some sulphuretted hydrogen is generated in the bowels which also stimulates peristalsis, but this gas forms the chief objection to its use, as the smell is very offensive.

Remote effects.—It is absorbed into the blood as sulphides and sulphuretted hydrogen which is a powerful poison, first reducing and then decomposing hæmoglobin giving rise to marked cyanosis with coma and muscular weakness. It thus **causes internal asphyxia.** It also acts as a **paralyser of the nervous and muscular systems.** *Sulphur is never used internally in sufficiently large doses to produce these remote effects*, but it is probable that many of the obscure nervous symptoms that accompany certain forms of dyspepsia and constipation, are due to the development of sulphuretted hydrogen in the bowel and its subsequent absorption into the blood.

Excretion.—Sulphur is excreted chiefly as sulphates by the urine, and as sulphuretted hydrogen by the lungs, skin, and milk. It gives an offensive smell to the breath, and blackens silver ornaments that are worn next the skin.

Therapeutics

Externally.—Sulphur is chiefly used in the treatment of **scabies** or itch. The patient should be instructed to scrub the skin well with soap and water at bedtime, then rub in the ointment and sleep in flannel garments. He may wash off the ointment when he rises in the morning. In this way, itch can be cured in a few days. When the cure is complete the patient must be warned to change his linen, and have it thoroughly disinfected to destroy any eggs of the parasite that may remain in it. On account of the irritation caused by sulphur and its disagreeable smell, some physicians substitute storax for it in the treatment of this disease.

If scabies be **complicated by eczema and impetigo,** the best preparation to use is the Unguentum Sulphuris Co., B.P.C., the various constituents of which act as follows :—(1) the chalk mechanically breaks up the dead skin and opens up the burrows of the parasite, (2) the tar cures the eczema, and (3) the alkali in the soap checks the weeping from the raw surface. This ointment, accompanied by the use of the warm bath, is applied twice daily, and cures in three days.

For the cure of **acne,** a lotion, consisting of sulphur 1 dr., glycerin 1 oz. in 10 ozs. of rose water, should be substituted for the ointment which is a very unsightly application to the face. Some of the severe forms of acne, however, will only yield to the Unguentum Sulphuris Hypochloritis. As an insufflation or dusting-powder, sulphur is said to be of value in **diphtheria,** and great relief is often obtained in **rheumatism and sciatica** by rubbing the affected limbs with sulphur and then applying flannel bandages.

Internally.—Sulphur is largely used as a laxative in **hæmorrhoids** and **fissure of the anus,** in which case it not only acts

as a purgative, but it also has a direct soothing effect on the hæmorrhoidal vessels. Equal parts of the confections of senna and sulphur is a favourite prescription. Too long use of this drug leads to dyspepsia and catarrh of the bowels. It is given in **plumbism** to prevent reabsorption of lead from the intestines. In the form of "Chelsea Pensioner" it is a favourite remedy for **chronic rheumatism and gout.** It is beneficial in many chronic skin diseases, as **psoriasis, impetigo, eczema,** and **acne,** and it acts as a sedative to the nervous system in **many troubles of the menopause.**

Prescribing hints.—The confection, even when freshly prepared, is a very nauseous compound, and, when it is old, it sets into a hard mass like plaster. The lozenge is the most elegant method of administration to better-class patients, and if for any reason the use of sugar is inadvisable, the pastils may be substituted. To children sulphur is best given in the form of the compound liquorice powder, or it may be suspended in milk, honey or marmalade.

CALX SULPHURATA

Sulphurated Lime

Syn.—Crude Calcium Sulphide U.S.P., Canton's Phosphorus.

Source.—A mixture containing not less than 50 p.c. of calcium sulphide and calcium sulphate. May be prepared by heating a mixture of native calcium sulphate with carbon.

Characters.—A greyish-white powder with a smell of hydrogen sulphide.

B.P. Dose.—¼ **to 1 gr. or 16 to 60 mgrms. ; U.S.P.**—**0.06 gm. or 1 gr.**

Non-official Preparation

1. **Lotio Calcii Sulphurati, U.C.H.**—Slaked lime 4, Sublimed Sulphur 4, Distilled Water 35. Boil, evaporate and filter to 20. May cure itch in half an hour when applied after a warm bath. It resembles **Vleminckx' Solution.**

Pharmacology and Therapeutics

Internally.—Its chief property is to hasten the maturation, and to prevent the formation of **boils,** but its value is doubtful. It has also been found useful in carbuncles, acne, suppurating glands in the neck, periostitis and alveolar abscess.

Prescribing hints.—It is best given in pills. The pills can be obtained ready-made containing each $\frac{1}{12}$, $\frac{1}{10}$, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, and 1 gr.

POTASSA SULPHURATA

Sulphurated Potash

Syn. B.P.—*Liver of Sulphur.*

Source.—By heating together sublimed sulphur 50 grms. and carbonate of potash 100 grms.

Characters.—Solid, dull-green fragments, liver-brown when freshly broken, reaction alkaline, taste acrid.

Composition.—It is a mixture of salts, chiefly potassium sulphides.

Dose.—2 to 10 grs. or 12 to 60 cgrms.

Pharmacology of the Alkaline Sulphides

Externally.—All are **irritants** and **parasiticides.** Strong solutions of the soluble potassium salt excite active inflammation of the skin ; weak solutions stimulate it, causing dilatation **of the cutaneous vessels** and **diaphoresis.**

Internally.—The alkaline sulphides possess the same action as sulphuretted hydrogen, to which they owe their virtues. They **decompose the blood,** producing asphyxia, and they **paralyse the nervous and muscular systems.** Large doses give rise to **narcotic symptoms and convulsions.** They are partly decomposed by the acids in the stomach, giving rise to disagreeable eructations of sulphuretted hydrogen. In small doses they merely cause a sensation of warmth in the epigastrium and determine **gentle relaxation of the bowels,** but large doses set up **gastro-enteritis.** All the sulphides possess the power of **arresting and preventing suppuration** : they also have a **tonic effect on mucous membranes.** The constant inhalation of air impregnated with sulphuretted hydrogen **causes anæmia** and much functional depression.

Therapeutics of the Alkaline Sulphides

Externally.—Unguentum Potassæ Sulphuratæ B.P.C. (1 in 80 with hard and soft paraffin) may be used as a substitute for sulphur ointment in the treatment of **scabies,** but a better preparation is the Lotio Calcii Sulphurati, or **Vleminckx' solution,** which according to Bourguignon will cure the disease in half an hour. Solutio Calcii Oxysulphurati (Vleminckx' solution) according to the Austrian Pharmacopœia has the following composition :—

One of calcium oxide slaked with 1 of water and mixed with 2 of washed sulphur ; of the foregoing mixture 2.5 is boiled with 20 of water until it is so reduced as to yield 10 by weight when strained.

In the form of a bath (4 ozs. to 30 gallons of water) sulphurated potash is used in **chronic psoriasis, chronic rheumatic arthritis,** and **myalgia, chronic nervous diseases** and as a **diaphoretic in albuminuria.** These baths are also said to promote the elimination of the poison from the system in **plumbism** and **hydrargyrism,** whilst the combination of sulphide baths with the internal administration of mercury constitutes the celebrated "**Aix**" **treatment for syphilis,** as practised at Aix-la-Chapelle. Instead of using artificially prepared baths, it is best wherever possible to resort to the natural mineral springs which contain alkaline sulphides. The best known are :—*Harrogate* in England, *Strathpeffer* in Scot-

land, and *Bareges* and *Aix-la-Chapelle* in France : whilst in India the sulphur springs at *Bhaji* near Simla have a great local reputation. An excellent imitation of the Bareges waters may be made by combining sodium sulphide, sodium carbonate and sodium chloride in the proportion of 20 grs. of each to every gallon of water.

Internally.—The natural sulphurous waters are especially useful in **follicular pharyngitis** and are much resorted to by public singers in Europe. They also increase both the secretion of bile and the amount of solids in it, on which account they are highly esteemed in the treatment of all **hepatic disorders.** The two sulphides are useful in **boils, carbuncles,** and **scrofulous glands.** Calx sulphurata is the better preparation, but potassa sulphurata may also be used for this purpose. The latter drug has also been **given in chronic bronchitis, croup,** and **whooping-cough,** and *as a rectal injection* for the destruction of thread worms

Prescribing hints.—Sulphide baths must always be given in porcelain or wooden vessels, as the salt attacks and discolours metals. Remember that these baths have the offensive smell of rotten eggs, and that you must therefore be careful how you prescribe them for delicate or fanciful patients.

ICHTHYOL

(Not official)

Syn.—*Ammonium Ichthyol Sulphonate.*

Source.—Prepared from a bituminous quarts found in the Tyrol, consisting of fish and animal remains. It is first treated with sulphuric acid and then neutralised with ammonia.

Characters.—A viscous, brownish, almost black substance, with a disagreeable tarry odour. Contains a considerable amount of sulphur (15 p.c.).

Solubility.—Soluble in water, oils, fat, glycerin, and vaseline.

Dose.—15 to 30 grs. or 1 to 2 grms.

NON-OFFICIAL PREPARATIONS

1. **Ichthyol Collodion.**—1 in 7. For *eczema* and *erysipelas.*

2. **Suppositoriæ Ichthyol.**—3 grs. in each. *Add 1 gr. of besewax to give firmness to the oil of theobroma.*

3. **Unguentum Ichthyol.**—20 to 50 p.c., with lanoline, or olive oil and lard.

4. **Pasta Ichthyol. B.P.C.**—Starch 40, water 20, ichthyol 40, strong solution of albumin 1. To be painted on the skin. Quickly dries and is easily washed off. Recommended by Unna for *acne rosacea.*

5. **Ichthalbin.**—A combination of ichthyol and albumin. A tasteless odourless brown powder. In *eczema* and *nervous intestinal affections,* and during *convalescence from fevers. Dose.*—1 to 15 grs.

6. **Ichthargan.** *Syn.—Silver ichthyolate.*—Amorphous powder, light brown, 30 p.c. silver. *Antiseptic,* 0.02 to 2 p.c. in *gonorrhœa.*

PHARMACOLOGY AND THERAPEUTICS OF ICHTHYOL

Ichthyol was introduced by Unna in 1882 as a remedy for chronic skin diseases : since then it has been found to possess the following virtues : (1) it is an **antiseptic,** and kills most disease germs, (2) it is a **local anæsthetic,** (3) it **contracts the small vessels,** (4) it **promotes the absorption of exudations,** (5) it **increases the body weight and improves the general health,** (6) it **saturates the system with sulphur,** thus possessing all the good properties of that drug. It is free from toxic properties, and ten times the ordinary dose may be taken without ill effects. It is valuable in all diseases where there is **capillary engorgement.**

A 3 p.c. injection is valuable in **gonorrhœa,** and a 30 p.c. solution is recommended for **prurigo senilis.** Externally the 30 p.c. ointment is employed for **wounds** and **burns of the first and second degree,** when it relieves pain at once and slight burns heal rapidly. A 50 p.c. ointment gives excellent results in **erysipelas,** and the collodion may be used for the same purpose. The ointment, in varying strengths, is also useful in **eczema, acne, psoriasis, herpes, erythema, boils, carbuncles, ringworm** and **favus.**

As a suppository, in combination with conium, it will be found a very soothing application in **hæmorrhoids** and **fissure of the anus.** Ichthalbin is insoluble in the stomach and only splits up in the duodenum. It is intended for internal use only. Four parts are equivalent to three of ichthyol.

Prescribing hints.—The odour of ichthyol may be disguised with oil of citronella, which is itself used in Ceylon for rheumatism.

LIQUOR HYDROGENII PEROXIDI

Solution of Hydrogen Peroxide. H_2O_2

Source.—Prepared by the interaction of water, barium peroxide, and a dilute mineral acid, at a temperature below 10°C. Should yield ten times its volume of oxygen.

Characters.—A colourless, odourless liquid with a slightly acid taste. Renders saliva frothy. It readily decomposes on coming in contact with metallic oxide or heat. *Impurities.*—Barium, mineral matter, and less oxygen.

B.P. Dose.—½ to 2 drs. or 2 to 8 mils. ; U.S.P.—4 mils. or 1 dr.

NON-OFFICIAL PREPARATIONS

1. **Oxygen, U.S.P.**—A colourless, odourless and tasteless gas. Compressed oxygen gas is obtainable in cylinders containing 12 to 20 cubic feet. Before inhalation, a rubber tube with an inhaler may be attached, the gas coming out in a gentle stream. Dr. G. Stoker has been very successful in the treatment of *indolent ulcers* by exposing them to the vapour of oxygen gas, which has the power of killing off putrefactive bacilli and stimulating the growth of benign microbes. **Oxygen inhalation** is of great

use in *pneumonia*, relieving *dyspnœa* and reducing pyrexia. It is successfully employed in *cardiac and respiratory failure, Bright's disease, angina, asthma, phthisis*, etc.

2. **Pyrozone.**—Is an American specialty containing hydrogen peroxide of several strengths. A 3 p.c. solution is used internally as an antiseptic, and a 25 p.c. solution in ether as a caustic.

3. **Alphozone.** $(COOH.CH_2CH_2.CO)_2O_2$.—A finely crystalline white powder, produced by the synthesis of Succinic Acid and Hydrogen Peroxide. Reaction acid. Taste slightly acid and bitter, leaving a metallic after-taste. Solubility 1 in 60 of water, solution being accompanied by hydrolysis and the production of nascent hydrogen peroxide. A·1 p.c. solution is easily tolerated in the mouth. Useful as a non-toxic germicide. *Dose.*—2 grs. (12 cgrms.) in solution.

4. **Magnesii Peroxidum.**—A white tasteless powder. More stable than H_2O_2. It is the chief active principle of **Magnesium Perhydrol**, which is useful in gastric and intestinal fermentation and indigestion. *Dose.*—15 to 60 grs. or 1 to 4 grm.

Pharmacology

Being a powerful oxidising agent, it destroys organised ferments, but has no effect on enzymes. A few drops of a 1½ p.c. solution destroy hydrophobic virus. It causes effervescence when in contact with pus, thus killing bacteria. Hence it is a powerful **antiseptic** and **disinfectant.** Peroxide solutions differ from most other disinfectants in the short duration of their action, which passes off as soon as all the oxygen is liberated. It bleaches hair and cleanses the skin.

Therapeutics

Externally.—Hydrogen peroxide is largely used in general and dental surgery, also many cosmetics owe their efficacy to its presence. A solution (1 in 8) may be used with benefit in **sores, foul suppurating wounds, chancres** and **fetid discharges from the ear.**

Internally.—It is much employed as a gargle, or mouth wash, as in **diphtheria,** or **pyorrhœa alveolaris,** or for deeply furred tongue, and as a surgical cleanser in pus conditions. In pus cavities the oxygen is freed with great rapidity, and the pus corpuscles are said to be disintegrated.

ACIDUM BORICUM

Boric Acid. H_3BO_3

Syn. B.P.—Boracic Acid, Hydrogen Borate.

Source.—Obtained by the interaction of sulphuric acid and borax. Contains not less than 99.5 p.c. of orthoboric acid.

Characters.—White pearly lamellar crystals, unctuous to touch, odourless. Taste slightly acid and bitter. *Solubility.*—1 in 25 of cold water, 1 in 3 of boiling water, 1 in 4 of glycerin, 1 in 30 of alcohol (90 p.c.).

which burns with a green flame. The *greasy feel* of powdered boric acid is to be noted for its identification.

Incompatible.—Sodium salicylate in powder.

B.P. Dose.—5 to 15 grs. or 3 to 10 dgrms. ; U.S.P.—0.5 gm. or 8 grs.

Official Preparations

1. **Glycerinum Acidi Borici.**—6 in 20 by weight. A substitute for Boro-glyceride.

2. **Unguentum Acidi Borici.**—1 in 10.

Non-official Preparations

1. **Boro-glyceride.**—A tough deliquescent mass, soluble in water and alcohol, obtained by heating glycerin 92 parts with 62 of boric acid. A patented preparation. Powerfully antiseptic.

2. **Pigmentum Acidi Borici.** *Syn.—Solutio Saturans.*—Boric Acid 1, Ether 3, Alcohol (90 p.c.) 6. Mix. Used in *ringworm*, etc.

BORAX PURIFICATUS

Purified Borax. $Na_2B_4O_7,10H_2O$

Syn. B.P.—Biborate of Sodium. Sodii Boras, U.S.P. **Syn. I.V.**—*Shohaga*, Beng., Hind.

Source.—Obtained from native borax, or by boiling native calcium borate with solution of sodium carbonate. (Impure borax is largely imported from Nepal). Contains not less than 98.9 p.c. of sodium pyroborate.

Characters.—Transparent, colourless, odourless, efflorescent crystals, with a weak alkaline reaction. Taste saline, alkaline. *Solubility.*—1 in 25 of cold water, 1 in 1 of glycerin, insoluble in alcohol (90 p.c.). It gives a yellow colour to the flame.

Incompatibles.—Mineral acids, most metallic salts, mucilage of acacia, also alkaloidal salts, *e.g.* cocaine hydrochloride.

B.P. Dose.—5 to 15 grs. or 3 to 10 dgrms. ; U.S.P.—0.75 gm. or 12 grs.

Official Preparations

1. **Glycerinum Boracis.**—1 in 7.

2. **Mel Boracis.**—1 in 10.

Non-official Preparations

1. **Trochisci Boracis, T.H.**—Each contains 3 grs. of borax. Used in thrush.

2. **Tr. Myrrh. et Boracis.**—Myrrh 1, Eau de Cologne 16, Borax 1, Water 3, Syrup 3.

Pharmacology of Boric Acid and Borax

Externally.—Both boric acid and borax are non-irritating and mild **antiseptics.** In 2½ p.c. solution almost all forms of bacilli stop growing, but they are not destroyed. They kill micro-organisms, but their action is entirely local. Some skins, however, are very sensitive to the action of boric acid, which is apt to produce a troublesome herpes in such cases.

Internally. **Gastro-intestinal tract.**—Taken by the mouth in large doses they cause gastro-intestinal irritation, evidenced by vomiting and purging. Both borax and boric acid are rapidly absorbed by the bowel, and do not affect the intestinal putrefaction.

Urinary tract.—Boric aicd is rapidly excreted in the urine, causing increase in the elimination of both water and urea. Borax like any other alkaline preparation renders the urine alkaline. They are good **genito-urinary antiseptics** and differ from other more active drugs in retaining their disinfectant action when the urine is alkaline. The administration of a few doses often has a marvellous effect in rendering a foul alkaline urine perfectly clean and sweet. Repeated small doses have induced albuminuria especially in persons predisposed to it. Maximum daily dose should not exceed 1 dr.

Nervous system.—Both produce a sedative action on the nervous system.

Generative organs.—Borax promotes menstrual flow and uterine contractions, it is therefore an **emmenagogue** and **ecbolic.**

Therapeutics of Boric Acid and Borax

Externally.—Boric acid is used as a food preservative, but recently attention has been drawn to specific effects giving rise to poisoning symptoms on account of such use. These symptoms are loss of appetite, mild gastro-enteritis, muscular weakness and prostration. The prolonged use, either internally or externally, has led to falling of the hair, eczema and psoriasis. Œdema and swelling of the skin may appear, and a gray line on the gums, similar to that seen in lead poisoning, is stated to occur along with irritation of the mouth. Also bulbous cutaneous lesions or a dermatitis. Renal disease seems to increase the susceptibility to poisoning. Being a non-irritant, it is largely employed in surgical dressings. The ointment is applied to **wounds, ulcers** and **burns.** As its action is entirely local its use is of no value in deep suppurating cavities. It is used as an eye-wash in **ophthalmia,** and as an injection in **leucorrhœa, gonorrhœa, ozæna** (10 grs. to 1 oz.), and **otorrhœa.** In **cystitis,** the irrigation of boric acid (1 in 100) is a capital local application. Thompson's fluid (borax 1 oz., glycerin 2 ozs., and water 2 ozs.) in ½ to 4 ozs. of warm water is also very serviceable in **cystitis. Pityriasis** of the body and scalp, **eczema** of the ear and scalp, and **cracked nipples** are benefited by boric acid applications. Borax (1 dr. to water 4 ozs.) removes **prurigo** of the labia and anus. The wearing of socks soaked in a warm saturated solution of borax removes the smell of **fetid perspiration of the feet.**

Internally.—Borax is used as a gargle in **mercurial salivation** and **aphthous sores** of the mouth. Borax tablets slowly dissolved in the mouth reduce **hoarseness.** Borated tincture

of myrrh is a valuable local paint for **ulcerated gums.** Glycerin boracis 1 dr., tr. myrrh. 10 ms. and water to 1 oz., make a good all-round mouth-wash. Mel boracis is a soothing and antiseptic application to inflamed mucous membrane and is specially useful in **thrush.** Borax is an excellent remedy for **fermentative dyspepsia,** and for disinfecting foul urine. To clear putrid ammoniacal urine, boric acid is superior to borax, three or four 15-gr. doses rendering it quite clear. Borax is sometimes employed to increase the labour pains, or to expel the placenta. Owing to its sedative action on the nervous system it is largely used with bromides in epilepsy.

Prescribing hints.—The taste is disguised by the syrup of orange peel. The powder may be given in cachets or solution. Borax being alkaline should not be combined with cocaine or other alkaloids. Combined with acetate of lead or sulphate of zinc insoluble borates are precipitated. Being alkaline it liberates chloroform when prescribed with chloral hydrate.

ACIDUM SULPHUROSUM

Sulphurous Acid. H_2SO_3

Source.—An aqueous solution containing 6.4 p.c. of hydrogen sulphite, H_2SO_3, corresponding to 5 p.c. by weight of SO_2. The sulphur dioxide may be prepared by heating sulphuric acid with charcoal or sulphur.

Characters.—A colourless liquid with a pungent sulphurous odour. Sp. gr. 1.025. *Impurities.*—Sulphuric acid, mineral matters.

B.P. Dose.—½ **to 1 dr. or 2 to 4 mils.**

Pharmacology and Therapeutics

Externally.—Sulphurous acid is a powerful **deoxidising agent, a disinfectant, a deodorant** and an **antiseptic.** Sulphurous acid gas is chiefly used for disinfecting infected rooms. Disinfection is best carried on by carefully closing all doors and windows, crevices being pasted over with paper and sulphur being burnt in the room for at least six hours. Use 2 lbs. of sulphur for every 1000 c. ft. of air space. Also remember to wet the floor, as dry fumes of SO_2 are useless for disinfecting purposes. Metallic substances left in the room should be greased, and coloured fabrics removed, as the gas has bleaching properties. Infected clothes may also be disinfected by sulphur fumes. A lotion (2 drs. to 1 oz.) is said to be efficacious in **ringworm, foul ulcers,** and **chloasma.** Sulphur fumigation quickly removes **scabies,** if it is resorted to after a hot-water bath with friction.

Internally.—As a spray it is of use in **gangrenous stomatitis** and **diphtheritic ulcers.** On the stomach and intestine it produces the same disinfecting and antiseptic effects as on the skin, and is absorbed as a sulphate. It is sometimes given with benefit in **pyrosis** and **fermentative dyspepsia** due to sarcinæ. Sulphites and hyposulphites may be used for the same purposes as the acid.

GROUP VI: WATER

AQUA DESTILLATA

Distilled Water. H_2O

Source.—Prepared by distillation from good natural potable water.

Characters.—Colourless, tasteless, odourless. Should be free from metals, chlorides, nitrates, nitrites, or sulphates.

Used in pharmacy and making up preparations.

Pharmacology of Water

Externally.—The actions of water in different forms and of different temperatures have been fully described under the heads of baths, fomentations, poultices, etc. (*see* pp. 62-66, and 69).

Hot water is a local **hæmostatic.**

Internally. **Alimentary canal.**—Water is an essential article of food. It allays thirst reflexly as well as by diluting the plasma after absorption. When drunk in moderation and at definite hours, it increases the secretion of saliva, bile, and gastro-intestinal and pancreatic juices. Large quantities derange digestion and cause diarrhœa. Warm water acts as an **emetic,** and hot water a **gastric sedative.**

Blood and circulation.—Water is quickly absorbed into the blood. A sudden influx of water into the circulation, if the body has suffered a great loss of the same, may cause death from rapid destruction of corpuscles by osmosis.

Kidneys.—Copious drinking flushes the kidneys and bladder and carries with it effete products circulating in the blood, such as excess of urea, phosphoric and sulphuric acids and sodium chloride, but lessens the amount of uric acids. Thus water is a natural **diuretic.**

Skin.—In hot weather, a glass of water is sufficient to bring on perspiration with many persons, but in cold, warm drinks do this with the aid of external warmth. Water is therefore a powerful **diaphoretic.**

Metabolism.—Water plays an important part in tissue metamorphosis. Taken under certain precautions, it facilitates construction and destruction of tissues, and thus acts as a true **metabolic stimulant.** Hence is the improvement of patients under the water-treatment.

Therapeutics of Water

Externally.—Besides its uses already adverted to in pages 62-66, water, in the form of ice, or constantly changed through a Leiter's coil, is useful in subduing many acute inflammatory diseases, such as **meningitis, cerebritis, synovitis, sprains,** etc. It contracts not only the superficial blood-vessels, but also those of the organs by reflex action. On the same principle,

a local application of ice to the surface arrests internal hæmorrhages, such as **epistaxis, hæmoptysis, hæmatemesis,** etc. A sudden partial application of cold to the abdomen, by flapping a wet towel over it, excites contraction of the parturient womb, and is therefore employed in **uterine inertia** and **post-partum hæmorrhage.** A smart sprinkling of cold water on the face restores consciousness in **hysteria, fainting** and **narcotic** and **chloroform poisoning.** The same plan may be adopted in reviving still-born infants. Iced water subcutaneously injected over the diaphragm checks **hiccough,** and within paralysed muscles improves their nutrition. Iced poultices applied to the chest are used in the treatment of pneumonia. Hot water injected into the womb arrests **post-partum hæmorrhage.**

Internally.—The sucking of ice allays thirst, vomiting and hiccough. A small glass of cold water slowly sipped controls the craving for **drinks** by stimulating the circulation. In the same manner, hot water before meals soothes the irritable conditions of the stomach in **gastritis, gastrodynia** and **gastric ulcers.** A glass of cold water taken immediately on rising from bed helps the bowels to act. The swallowing of ice arrests **hæmatemesis.** Copious draughts of water help to wash out minute deposits of **urinary gravel.** If it is a uric acid calculus, drinking of distilled water diminishes the tendency to deposition. Large draughts of water given between meals may arrest the formation of **gall-stones** by liquefying the bile. As an *emetic*, warm water should not be given in quantities sufficient to over-distend the stomach, as this may paralyse its muscular fibres and thereby impede rather than promote vomiting. Half to one pint at a time is enough for the purpose.

GROUP VII: ACIDS

Acid Acetic, Tartaric, Sulphuric, Hydrobromic, Nitric, Hydrochloric, Nitro-hydrochloric, Phosphoric, Picric, Lactic, Hydrocyanicum Dil., Chromic (*see* p. 271), **Sulphurous** (*see* p. 303), **Boric** (*see* p. 300), **Hydriodic** (*see* p. 287).

ACIDUM ACETICUM

Acetic Acid. $CH_3.COOH$

Source.—Prepared by the destructive distillation of wood. 33 p.c. by weight of hydrogen acetate, and 67 p.c. by weight of water.

Characters.—A clear, colourless acid liquid with a pungent odour. Sp. gr. 1.044. *Impurities.*—Copper, lead, arsenic, and sulphuric, nitric, hydrochloric, and formic acids.

Enters into.—Oxymel Scillæ, Liq. Ammon. Acetat., Acet. Scillæ, **Acet. Urgineæ,** many Acetates, and the

Official Preparations

1. **Acidum Aceticum Dilutum.**—1 in 8 or 5 p.c. of hydrogen acetate. Sp. gr. 1.007. **B.P. Dose.—½ to 1 dr. or 2 to 4 mils. ; U.S.P.—2 mils or 30 ms.** *Enters into.*—Liqr. Morph. Acet.

2. **Oxymel.**—1 in 7. **B.P. Dose.—½ to 2 drs. or 2 to 8 mils.**

Non-official Preparation

1. **Acidum Trichloraceticum, U.S.P.**—In deliquescent crystals. A 1 per cent. solution is a powerful stimulant for granulating surfaces, and is also a very useful application for the phagedænic ulcerations of the cheek which are so common in the terminal stages of Leishmaniasis.

ACIDUM ACETICUM GLACIALE

Glacial Acetic Acid

Source and Characters.—A concentrated, colourless liquid, with a very pungent odour, containing 98.9 p.c. of hydrogen acetate. Sp. gr. 1.058. *Solubility.*—Freely in water and absolute alcohol. *Impurities.*—The same as those of acetic acid.

Enters into.—Acet. Canth. and Lin. Terebinth. Acet.

Non-official Preparation

1. **Acetum.**—*Vinegar.*—Contains 5.41 p.c. of hydrogen acetate. An acid liquid obtained by the acetous fermentation of malt and unmalted grains. *Dose.*—1 to 8 drs. Country vinegar (*sirka*) is made from the saccharine juice of plants.

Pharmacology and Therapeutics

The action of acetic acid resembles more or less that of the mineral acids.

Externally.—Glacial acetic acid is a **caustic** and is therefore used in destroying **corns** and **warts.** It speedily **vesicates,** and may be used in those cases where cantharidin cannot be employed, but it causes much pain, and if not cautiously applied, may produce a nasty sore.

Acetic acid destroys **tinea,** and is an effective application for ring-worm. Vinegar or diluted acetic acid is an **external refrigerant,** and may be used as a **cooling lotion** in **cerebral congestion, sprains** and **bruises** ; and sponging with vinegar will **reduce pyrexia** and **check excessive sweating.** Vinegar is sometimes used topically to check **epistaxis,** etc.

Internally.—Diluted acetic acid **allays thirst** by increasing the salivary secretion, and may be used as a **gargle** (15 ms. to 1 oz.) in cases where dryness of the mouth is a troublesome symptom.

After prolonged use, it diminishes the number of red blood-corpuscles, and therefore its employment in **obesity** is contra-indicated. As an internal refrigerant, it may be given in **fevers, cholera, diabetes, Bright's disease,** etc.

Acetic acid is excreted in the urine as a carbonate. Given in large doses it passes out unchanged.

Antidotes.—The same as those for the mineral acids. No stomach pump.

ACIDUM CITRICUM

Citric Acid. $H_3C_6H_5O_7$, H_2O

Source.—Prepared from the juice of the fruit of various species of *Citrus*. Contains not less than 99.5 p.c. of hydrogen citrate.

Characters.—Colourless, trimetric prisms; taste acid. Soluble in 0.5 part of water, less so in alcohol (90 p.c.), and slightly soluble in ether. *Impurities.*—Copper, lead, iron, calcium, sulphuric and tartaric acids.

Incompatibles.—Alkaline carbonates, potassium tartrate, and acetates.

Enters into.—Succus Limonis (35 grs. in 1 oz.), Syr. Limonis, effervescent preparations, and Liq. Ammon. Citratis. All these contain free citric acid.

20 grs. of Citric Acid in 1 oz. of water } will neutralise { 30 grs. of Pot. Bicarb. / 24 grs. of Sod. Bicarb. / 17 grs. of Ammon. Carb. / 13 grs. of Mag. Carb.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—0.5 gm. or 8 grs.

ACIDUM TARTARICUM

Tartaric Acid. $H_2C_4H_4O_6$

Source.—Prepared from acid potassium tartrate. Contains not less than 99 p.c. of hydrogen tartrate.

Characters.—Colourless, monoclinic prisms; taste acid. *Solubility.*—Less than one part of water and in three parts of alcohol (90 p.c.). *Impurities.*—Iron, lead, copper, calcium, tartrate of potassium, oxalic acid, arsenium, etc.

Incompatibles.—Salts of calcium, potassium, lead, mercury, alkaline carbonates and vegetable astringents.

Enters into.—Effervescent preparations and Pil. Quin. Sulph.

Dispensing hints.—Both citric and tartaric acids should be weighed in a dry glass pan, and preserved in a tightly stoppered bottle, otherwise they will deliquesce.

20 grs. of Tartaric Acid in 1 oz. of water } will neutralise { 27 grs. of Potas. Bicarb. / 22 grs. of Sodium Bicarb. / 15 grs. of Ammon. Carb.

B.P. Dose.—5 to 20 grs. or 3 to 12 dgrms. ; U.S.P.—0.5 gm. or 8 grs.

SUCCUS LIMONIS

Lemon Juice. N. O. *Rutaceæ*

Syn. I.V.—*Nebbu-ras*, Beng. *Nembuka arak*, Hind.

Habitat.—West Indies, Southern Europe, India.

Source.—Freshly expressed juice of the ripe fruit of *Citrus medica*, var. *β limonum*.

Characters.—Slightly turbid, yellowish liquid. Taste sharply acid. Sp. gr. 1.030 to 1.040. 1 fl. oz. contains 20 to 40 grs. or on an average 35 grs. of citric acid.

Composition.—Citric acid free and combined, malic acid, phosphoric acid, etc.

100 mils of the juice are neutralised by 11.4 grms. of $KHCO_3$, 9.5 grms. of $NaHCO_3$, and 16.5 grms. of Na_2CO_3.

Dose.—1 to 2 oz., or 30 to 60 mils.

Enters into.—The preparation of Citric Acid and the

Official Preparation

1. **Syrupus Limonis.**—1 in 2. **B.P. Dose.**—½ to 1 dr. or 2 to 4 mils.

Pharmacology of Citric Acid, Tartaric Acid and Lemon Juice

Externally.—They have no action on the unbroken skin but cause irritation and pain when applied to an abraded surface.

Internally. **Mouth.**—Like all acids, they stimulate the salivary secretion and thereby allay thirst.

Stomach.—Free acids unite with bases to form neutral salts. When given in an effervescing form, the liberated **carbonic acid gas** acts as a **gastric sedative.**

Blood.—The neutral salts formed in the stomach are **deoxidised** in the blood after absorption. For instance, potassium citrate becomes decomposed into potassium carbonate, carbonic acid and water, thus $2(C_3H_4.OH(COOK)_3)+O_{18}$ (from blood) $=3(K_2CO_3)+9CO_2+5H_2O$, thereby **increasing** the **alkalinity** of the plasma. If these acids are given in large doses, a portion remains unoxidised and thus diminishes the alkalinity and as a consequence thereof, somewhat checks metabolic exchanges between the blood and the tissues.

Urine.—They are excreted as carbonates, except in large doses, when they escape partly unchanged. Hence, in medicinal doses they increase the **alkalinity of the urine.**

Therapeutics of Citric Acid, Tartaric Acid and Lemon Juice

Internally.—As a refrigerant drink, *e.g.* lemonade, they are given to allay thirst in **fevers.** The sucking of a lemon is refreshing in dryness of the mouth. Carbonic acid—the product of an effervescing mixture—checks **nausea** and **vomiting.** Citrates and tartrates are useful in promoting the absorption of **uric acid** deposits. Lemon juice is rich in *antiscorbutic vitamin* or water-soluble C, and is therefore a specific for **scurvy** and **scurvy rickets.** Citric and tartaric acids are chiefly used for their remote effects, and for making effervescing draughts and preparations. In thrombosis the fresh lime juice is largely used, and by some authorities is preferred to the artificial citrates.

Prescribing hints.—For causing the absorption of small uric acid calculi, order 40 to 60 grs. of citrate of potash to be dissolved in 4 ozs. of water and taken every 4 hours. If more than this is given, an insoluble biurate may form on the surface of the stone.

With some patients it is best to give the full dose in a tumbler of water at bedtime, so as to counteract the excessive acidity of the urine passed during the night.

ACIDUM HYDROBROMICUM DILUTUM

Diluted Hydrobromic Acid. HBr

Source.—An aqueous solution containing 10 p.c. by weight of hydrogen bromide, obtained by the interaction of bromine and sulphurous acid, and subsequent distillation.

Characters.—A colourless, inodorous liquid; taste and reaction acid; sp. gr. 1.077. *Impurities.*—Arsenic, barium, chlorides, phosphates, sulphates, or sulphites.

Dispensing hints.—Should be kept in the dark. Commercial acid becomes coloured by keeping.

B.P. Dose.—15 to 60 ms. or 1 to 4 mils. (60 ms. = 10 grs. of potassium bromide). **U.S.P.—1 mil or 15 ms.**

Pharmacology and Therapeutics

Internally.—Diluted hydrobromic acid has the same action as that of the bromides, but is weaker. It is chiefly used in combination with quinine to prevent cinchonism, and sometimes, with morphine to prevent its after-effects. It neither gives rise to **acne** nor is it so depressant as bromides. The writer often combines it with quinine, when he administers large doses.

Prescribing hints.—Large doses (2 to 4 drs.) may be given freely diluted or with syrup and water. 2 ms. of the dilute acid should be prescribed for each grain of quinine ordered.

ACIDUM HYDROCHLORICUM

Hydrochloric Acid. HCl

Syn.—Muriatic acid, Spirit of salt.

Source.—Obtained by dissolving in water the gas produced by the interaction of sulphuric acid and sodium chloride, containing 31·79 p.c. of hydrogen chloride by weight.

Characters.—A *colourless*, strongly acid liquid emitting white fumes; sp. gr. 1.160. *Impurities.*—Sulphurous and sulphuric acids, arsenic, copper, lead, iron, aluminium, bromides, free chlorine.

Incompatibles.—Lead, silver, and mercurous salts, tartar emetic, alkalies and their carbonates.

Enters into.—The preparation of Acid. Nitro-hydrochloricum dil., Apomorph. Hydrochlor., Cocaine Hydrochlor., Glyc. Pepsini, Liq. Arsen. Hydrochlor., Ext. Cinchon. Liq., and the

Official Preparation

1. **Acidum Hydrochloricum Dilutum.**—Contains 10 p.c. by weight of hydrogen chloride. **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils; U.S.P.—1 mil or 15 ms.**

Enters into.—The preparation of Inj. Apomorph. Hyp., Liq. Morph Hydrochlor. and Liq. Adrenalini Hydroch.

PHARMACOLOGY AND THERAPEUTICS

Internally.—Being the normal acid of the gastric juice, it is given *after meals* in all cases of **fermentative dyspepsia** which is due to the absence of the antiseptic action of the normal acid of the gastric juice, and other conditions due to a deficiency in the secretion of hydrochloric acid. In small doses given before meals, it helps to convert pepsinogen into active pepsin. It is also employed to **reduce the alkalinity** of urine in phosphatic **deposits,** and to **stimulate the hepatic action.** Given towards the end of gastric digestion in 15 to 30 ms. doses it increases the pancreatic secretion and helps intestinal digestion.

ACIDUM NITRICUM

Nitric Acid. HNO_3

Source.—Prepared by the interatcion of sulphuric acid and sodium nitrate ; containing 70 p.c. by weight of hydrogen nitrate.

Characters.—A clear, colourless acid liquid emitting corrosive fumes ; sp. gr. 1.42. *Impurities.*—Lead, copper, iron, arsenic, chlorides, bromates, iodates, sulphates.

Incompatibles.—Alkalies, alcohol, carbonates, oxides, sulphates, lead acetate, ferrous sulphate.

Enters into.—The preparation of Acid. Phosph. Con., Argent. Nitras, Liq. Hydrarg. Nit. Acid., Spt. Æther. Nitrosi, Ung. Hydrarg. Nit., Pyroxylin, and the

OFFICIAL PREPARATIONS

1. **Acidum Nitricum Dilutum.**—10 p.c. by weight of hydrogen nitrate ; three-fifths the strength of the corresponding preparation of B.P. 1898. **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils.**

2. **Acidum Nitro-hydrochloricum Dilutum.**—1 and 1 in 8 (1 dr. contains 6 ms. of nitric and 8 ms. of hydrochloric acid). **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils ; U.S.P.—1 mil. or 15 ms.**

PHARMACOLOGY AND THERAPEUTICS

Externally.—Strong nitric acid is often employed to destroy **chancre, warts, hæmorrhoids, phagedænic sores** and the poison of venomous snakes and rabid dogs. Nitro-hydrochloric acid baths (*see* p. 65) are useful in **chronic hepatic congestion.**

Internally.—Both the diluted nitric and nitro-hydrochloric acids are **sialagogues, gastric tonics** and **hepatic stimulants,** and are largely employed in **dyspepsia, torpidity of the liver** and **catarrhal jaundice.** They are sometimes given in **infantile diarrhœa** on account of their **feeble astringent** property, and in **chronic bronchitis** when the secretion is profuse.

ACIDUM PHOSPHORICUM CONCENTRATUM

Concentrated Phosphoric Acid. H_3PO_4

Source.—Obtained by the oxidation of phosphorus, containing 66.3 p.c. by weight of hydrogen orthophosphate.

Characters.—A colourless, *syrupy* liquid; taste and reaction acid; sp. gr. 1.5 *Impurities.*—Lead, copper, arsenic, sulphuric, nitric, hydrochloric, phosphorus, pyro and metaphosphoric acids, silica.

Incompatibles.—Sodium carbonate, calcium salts.

Enters into.—The preparation of Syr. Calcis Lactophosph., Syr. Ferri Phosph., Syr. Ferri Phosph. c. Quin. et Strych., Acid. Sodium Phosphate. and the

Official Preparation

1. **Acidum Phosphoricum Dilutum.**—10 p.c. by weight of hydrogen ortho-phosphate. **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils. ; U.S.P.—2 mils. or 30 ms.**

Pharmacology and Therapeutics

Internally.—The diluted acid is a **refrigerant and gastric tonic.** It does not derange the digestion. It makes an agreeable drink in **diabetes** and **febrile diseases.** By some it is considered serviceable in cases of **hypo-phosphaturia.** It is a mistake to ascribe the therapeutic virtues of free phosphorus to the acid.

ACIDUM SULPHURICUM

Sulphuric Acid. H_2SO_4

Source.—Obtained by the combustion of sulphur or pyrites and the oxidation and hydration of the resulting sulphur dioxide by means of nitrous and aqueous vapours. Contains not less than 95 p.c. by weight of hydrogen sulphate.

Characters.—A *colourless*, corrosive, *oily*, acid liquid, evolving heat when water is added. Sp. gr. 1.841. *Impurities.*—Lead, copper, iron, arsenic, selenium, ammonium, carbonaceous matters, and other acids.

Incompatibles.—Alkalies and their carbonates, calcium, and lead salts.

Enters into.—The preparation of many mineral acids, ethers, sulphates inf. rosæ acidum, pyroxylin, and the

Official Preparations

1. **Acidum Sulphuricum Aromaticum.** *Syn.—Elixir of Vitriol.*—Sp. gr. 0.917 to 0.923. **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils. ; U.S.P.—1 mil or 15 ms.**

2. **Acidum Sulphuricum Dilutum.**—1 in 10. Sp. gr. 1.069. In making this preparation, remember that the acid must be added to the water; not the water to the acid. **B.P. Dose.—5 to 20 ms. or 3 to 12 decimils. ; U.S.P.—1 mil or 15 ms.**

Pharmacology and Therapeutics

Externally.—Concentrated sulphuric acid has a strong affinity for water, charring and desiccating the parts with which it comes in contact. It is therefore a most powerful **caustic.**

Internally.—The concentrated form is a violent irritant and caustic. Freely diluted, it may be given to **allay thirst** in

cholera and **hæmorrhage.** Being a powerful **gastro-intestinal astringent,** it is successfully employed in **diarrhœa, cholera** and **gastro-intestinal hæmorrhage.** It is eliminated by the kidneys and bowels in the form of a sulphate. It prevents the absorption of lead, and for that reason lemonade made with sulphuric acid is largely used by workers in lead as a prophylactic against plumbism.

In combination with zinc sulphate, it checks the night-sweats of **phthisis.**

General Pharmacology of Hydrochloric, Nitric, Phosphoric and Sulphuric Acids

Externally.—All are **irritants** and **corrosives** in a concentrated form. Diluted solutions are local **astringents** and **styptics.** Still more diluted, they are **external refrigerants** and **anhydrotics.** All mineral acids are **disinfectants.**

Internally. **Gastro-intestinal tract.**—They stimulate the secretion of the alkaline **saliva** and thus **allay thirst.** In the stomach they neutralise free alkali and form neutral salts, which are probably absorbed as such. Given before food, they are believed to retard the flow of the acid secretion—gastric juice, but this is doubtful; and towards the end of gastric digestion they promote the alkaline secretions of the liver, pancreas and intestinal glands. Nitric and nitro-hydrochloric acids act also as powerful **hepatic stimulants** and **cholagogues.** Diluted acids, especially sulphuric, have an **astringent** action on the intestines.

Blood.—They circulate in the blood as neutral or acid salts, and render the *blood less alkaline* and increase the H-ion concentration of the blood.

Kidneys.—They do not increase the **free acidity of urine** to any appreciable extent. Nitric acid is partly converted into ammonia and tends to increase the alkalinity of urine.

Acute toxic action.—All these acids are **irritant poisons.** If swallowed in a concentrated form, intense burning pains extending from the mouth to the stomach, excoriation, and formation of grey or yellowish eschars in the mouth, severe abdominal pain and tenderness, vomiting of coffee-coloured matters containing dark clots of blood and shreds of mucus, constipation, or if bowels are open, stools dark from the admixture of blood, are the prominent symptoms. Dyspnœa, due to laryngeal swelling either from irritant fumes or from the introduction of some of the acid, is not infrequent. Collapse with cold perspiration soon sets in and the patient dies.

Antidotes.—*No pump.* Alkalies, such as soda, lime water, soap water, magnesia in a moderately diluted solution at once. Demulcents as egg albumen, bland oils, linseed tea, etc. Morphine subcutaneously to relieve pain; ether, brandy, etc., as stimulants.

Chronic toxic action.—General emaciation, languor, catarrhal inflammation of the gastro-intestinal canal, anorexia, and anæmia are the chief symptoms.

ACIDUM PICRICUM

Picric Acid. $C_6H_2(NO_2)_3OH$

Syn. B.P.—Carbazotic acid. Trinitrophenol, U.S.P.

Source.—Obtained by the action of nitric acid and sulphuric acid on phenol, and contains not less than 99 p.c. of tri-nitro-phenol.

Characters.—Bright yellow crystalline powder. Inodorous, taste very bitter. *Solubility.*—In 90 parts of water and in 10 parts of alcohol (90 p.c.).

Dose, U.S.P.—0.03 gm. or ½ gr.

Non-official Preparations

1. **Ammonii Picras.**—In yellow scales. Soluble in water. Useful in *ague* and *malarial fevers*. *Dose.*—⅛ to ½ gr. or 8 to 30 mgrms.

2. **Ung. Acidi Picrici, B.P.C.**—Picric acid 2, soft paraffin 98.

Pharmacology and Therapeutics

Picric acid is an irritant to the skin and mucous membranes. In large doses it causes vomiting and often anuria and strangury. After absorption it colours the skin and mucous surfaces yellow, simulating jaundice due to the staining of the epithelium by the acid. The saturated solution is used as a hardening agent in microscopical work. When heated with glucose it is reduced to picramic acid, and this test is utilised in the detection and estimation of glucose in urine (Johnson's test); with citric acid it forms the well-known Esbach's test for albumin in urine. It is an **antiseptic** and four times more active than phenol. Its chief therapeutic use is in cases of **burns** and **scalds.** The wounds heal under the superficial scab formed. Lint or cotton-wool soaked in 1 p.c. solution of the acid is generally used for the purpose. A 5 p.c. solution in alcohol is recommended for **hyperidrosis** of the feet. The ointment may be used in **eczema, pruritus,** etc.

ACIDUM LACTICUM

Lactic Acid. Hydrogen Lactate. $HC_3H_5O_3$

Source.—May be obtained from the fermentation of lactose, containing not less than 75 p.c. of hydrogen lactate, and not less than 10 p.c. of lactide.

Characters.—A colourless, syrupy liquid, hygroscopic, inodorous, sp. gr. 1.21. *Solubility.*—Freely in water, alcohol, and ether. *Impurities.*—Mineral and other acids, sugar, lead, etc.

Enters into.—The preparations of Benzamine and Calcium lactate.

B.P. Dose.—15 to 30 ms. or 1 to 2 mils .; U.S.P.—2 mils or 30 ms.

Official Preparation

1. **Syrupus Calcii Lactophosphatis.—B.P. Dose.—½ to 1 dr. or 2 to 4 mils. ; U.S.P.—10 mils or 2½ dr.**

Pharmacology and Therapeutics

Externally.—The concentrated acid is **corrosive** and is used alone or in the form of a paste with kaolin to destroy **lupus.**

Internally.—A 10 to 50 p.c. solution in glycerine has been successfully applied to **pharyngeal tubercles** after scraping. As a pigment or spray it is occasionally used to dissolve **false diphtheritic membranes.** On the stomach, it acts like hydrochloric acid, and is often given as a **gastric adjuvant** in **dyspepsia.** It allays thirst in **diabetes** and other diseases. Sour butter-milk may be used as a substitute for the same purpose. It is said to be useful in the **diarrhœa of phthisis** and of **enteric fever,** and in the **green diarrhœa of infants.** It enters the blood as a lactate, and is eliminated in the urine as a carbonate or carbonic acid in solution.

Soured milk at one time was very popular in the treatment of diseases of the **large bowel, colitis, chronic dysentery,** etc., and also in the **summer diarrhœa** of infants. To be free from danger it is absolutely necessary that certain precautions be taken in the preparation of this soured milk. The milk used must first be sterilised to get rid of all contaminating and undesirable organisms. To this sterilised milk some reliable preparation of lactic acid bacilli must be added, *e.g.* trilactin tablets or liquid trilactin, fermen lactyl, etc.; the vessel containing the milk is then covered and allowed to stand in a warm place, or a thermos flask may be used, or an apparatus consisting of lamp and vessel obtainable from any chemist. After being thus incubated for from six to ten hours the milk is ready for use. From one to three pints may be taken daily. Cream, sugar, etc., may be added if desired, before taking, to render the preparation more palatable.

ACIDUM HYDROCYANICUM DILUTUM

See Local Anæsthetics

GROUP VIII: CARBON

CARBO LIGNI

Wood Charcoal (Carbon)

Source and Characters.—A black powder, free from gritiness, prepared by exposing wood to a red heat without access of air.

Dose, U.S.P.—1 gm. or 15 grs.

PHARMACOLOGY

Externally.—Dry charcoal absorbs and condenses gases within its pores, especially oxygen, which it parts with to oxidise organic or other substances either liquid or gaseous, Hence it is a **disinfectant** and **deodoriser.** In the same way it oxidises colouring matters and is therefore a **decoloriser.** It has no action on living organisms.

Internally.—In the stomach and intestine it is said to absorb and oxidise gases and irritating fluids, and thus acts as