

PHYSIOLOGICAL ACTION.

Phenol is antiseptic and disinfectant, somewhat antipyretic, also a local anesthetic, and a depressant of the cardiac, respiratory, cerebral and spinal functions. In strong aqueous solutions it is destructive to low forms of life, rapidly destroying all organized ferments, both animal and vegetable. On unorganized ferments (enzymes), such as pepsin and ptyalin, it does not act so readily, but in large doses it destroys their activity, and it is an efficient parasiticide against certain vegetable parasites which infest the skin. The foregoing is true of the liquefied phenol and its aqueous and glycerin solutions, but not of its solutions in oils, which have no antizymotic properties.

Applied to the skin in weak or moderately strong solutions, it produces local anesthesia with a sensation of numbness, which lasts for several hours. Applied in concentrated form, it is irritant and superficially escharotic, with burning pain of brief duration, and produces at the point of application a white spot, changing to red if the acid is soon removed. It does not vesicate, but if the application be prolonged, a white eschar or slough results, from coagulation of the albumin of the tissue, and this is bordered by a red zone of inflammation. Even a 3 per cent. aqueous solution, kept on a part for several days, has produced dry gangrene of the tissues (Czerny). This is especially true of the fingers and toes, probably because the action of the drug on their blood-vessels arrests the circulation therein completely. A solution not stronger than 5 per cent. applied for 24 hours, caused gangrene of a finger necessitating amputation (Harrington).

Taken internally, the concentrated Phenol has the same effect on the mucous membranes as on the skin, producing white, superficial eschars, after burning pain of short duration, in the mouth, gullet and stomach. To the latter viscus it is a powerful irritant, and causes a violent gastritis. In medicinal doses, when acted upon by the gastric secretions, it is converted into a phenol-sulphonate, and is so diluted by the contents of the stomach that it loses its antizymotic power, and is of no value as an internal antiseptic remedy. In the blood it probably circulates as an alkaline phenolate, in medicinal doses having no effect upon the circulation or respiration. Its antipyretic power is incapable of being utilized, requiring a dosage which would be dangerous.

A toxic dose paralyzes the vaso-motor centre in the medulla before markedly affecting the heart. The blood-pressure and body-temperature fall; the respiration, at first accelerated by stimulation of the vagi, is quickly depressed and ultimately paralyzed; cardiac inhibition is stimulated, the heart being first slowed and then depressed. The anterior cornua of the spinal cord are first stimulated, producing convulsions; and subsequently depressed, causing suspension of reflexes, impaired motility and sensibility, and finally paralysis of both motion and sensation. The cerebrum is profoundly depressed, producing stupor deepening into coma, with contracted pupils. Death occurs, in most cases, by paralysis of respiration; in a few, by paralysis of the heart.

Phenol is readily absorbed and rapidly diffused; many fatal cases having resulted from its external use in undiluted form. A single vaginal injection of a moderately weak solution has produced very severe constitutional results. It is partly oxidized in the blood, and partly eliminated by the lungs and kidneys. It imparts to the urine a peculiar smoky or olive-green color, which is not due to blood, and may be seen after moderate doses, or even as a result of its absorption from dressings. When ingested in a large dose, phenol itself may appear in the urine; but the smoky color is due to the presence of its intermediate oxidation products, viz., pyrocatechin (only in alkaline urine), and hydrochinone, also salts of phenol-sulphonic acid and glycuronic acid. In poisoning thereby the sulphates are absent from the urine.

A case of poisoning by Phenol shows white, corrugated eschars in the mouth and fauces, if the drug has been swallowed in concentrated form. These eschars are also found on the mucous lining of the esophagus and stomach, at the autopsy. The patient complains of an intense, burning sensation along the same tract, immediately after the ingestion of the poison, and soon passes into a state of collapse; the skin is cold and clammy, the pupils contracted, respiration becomes more and more feeble and shallow; the urine, if not entirely suppressed, is of a dark-green color; reflexes are then abolished, stupor and coma supervene, and finally the breathing ceases. The blood, after death, is dark in color, and coagulates imperfectly; and fatty degeneration of the liver and kidneys may be found. When poisoning occurs by absorption, an early symptom is the peculiar, smoky color of the urine. There may be pain in the lumbar region, indicating renal irritation, and slight restlessness or cerebral disturbance; after which comes the impairment of respiration and stupor.

A toxic dose of Phenol, taken internally, is one of the most rapidly acting poisons known, sometimes equalling Prussic Acid in this respect. The symptoms develop almost immediately and death may occur in a very few minutes; but usually the patient lives from one to ten hours; rarely over two days. In some cases, a great amendment has occurred, with restoration of consciousness, but after some hours sudden and fatal collapse has supervened. The minimum fatal dose is not determined, but $\frac{z}{ss}$ has frequently caused death; and doses as small as $\frac{m}{vj}$ have given rise to dangerous symptoms. Cases of suicidal and accidental poisoning by this drug are very frequent, by reason of the facility with which it may be obtained for use as a disinfectant.

THERAPEUTICS.

Phenol owes much of its prominence to its having been the principal agent at first used in the antiseptic method of treating wounds; but its employment in that connection has become much restricted, and many of the most prominent surgeons have abandoned it altogether in favor of other germicides. Recent investigations have proved beyond doubt that this agent has a reputation as a disinfectant far above that which it deserves; that in the ordinary solutions

it is almost useless as a germicide though actively antiseptic; and that very many hours of exposure to very strong solutions are required to kill pathogenic germs. In the estimation of many, however, it still retains high favor as a surgical antiseptic lotion; and it is in general use as a disinfectant for surgical instruments, hospital apparatus, soiled linen, etc. The carbolic spray, formerly so commonly used during operations, has been entirely discarded. For disinfectant purposes about drains, privies, on floors, walls, etc., Cresol is to be preferred, having very high power as a disinfectant.

As a local application, Phenol has extensive and varied uses. Unna calls it the opium of the skin, as it relieves pruritus of almost any form, if applied in 5 per cent. aqueous solution over the itching surface; and a lotion, composed of gr. xx to ʒss each of water and glycerin, makes a very efficient application for the itching of jaundice. The glycerite, diluted, effectively destroys the fungus of tinea tonsurans or tinea versicolor, and may be applied as a stimulant to indolent ulcers, or to patches of aphthous stomatitis. Its liability to cause gangrene, when applied continuously to a finger or toe (see page 378), should be remembered when using it on those members. A one per cent. solution in water and glycerin makes an excellent analgesic and cleansing gargle for the painful sore throat of tonsillitis, pharyngitis, and diphtheria. Cotton soaked in strong phenol and applied to the cavity of a decayed tooth will stop the pain, but care must be taken, by covering it with dry cotton, to prevent its reaching the gum, or sloughing may result. For burns and scalds a good application is phenolized sweet oil of 3 per cent. phenol strength, and the strong phenol has been applied by a brush over burned surfaces with excellent results in many cases. In this form it is less dangerous than in solution, as it forms a protective combination with the exuded blood-serum, and prevents its own absorption. In granular conjunctivitis a 5 per cent. solution has been efficiently applied once a week in the angles of the upturned eyelid, and acute conjunctivitis is greatly relieved by holding the open eye in the spray of a steam atomizer, the cup of which contains a 5 per cent. solution. This measure may also be used for acute coryza with beneficial results; or a mixture of phenol and tincture of iodine may be dropped on to a sponge in a wide-mouthed bottle and volatilized for inhalation by being wrapped in a cloth wrung out of hot water, or by being held in the hand. In phthisis and other chronic pulmonary diseases, Phenol has been much employed as a spray by inhalation, and certainly does good therein by relieving cough and irritation of the throat. In these affections, Creosote is preferred both for internal and local use. For local anesthesia in minor surgical operations, such as that for ingrowing toe-nail or opening a felon, the part may be soaked for ten minutes in a 30 per cent. solution, or the pure phenol may be brushed over the line of incision.

As a parenchymatous injection, which should be not over ʒss of a 2 per cent. solution, Phenol has been employed with much success in combating deep-seated inflammations. The skin being first anesthetized by the local appli-

cation of phenol, a hypodermic needle is introduced obliquely, to the centre of the inflamed tissue, but should not be connected with the syringe if any blood escapes through it, lest the injection be introduced into a vein. This method has been successfully used in glandular swellings, 5 to 10 minims of the solution for each gland being sufficient in phlegmons of every grade and character, erysipelas, poisoned wounds, inflamed bursæ, hydrocele, chronic synovitis, buboes, and relapsing tonsillitis. It may be injected into the sac for the radical cure of hydrocele, and two minims have proved equally efficient for this purpose as the 30 to 90 minims formerly employed. Internal hemorrhoids have been cured by Phenol, one or two minims injected into each tumor once a week, in 10 per cent. solution; but this measure may prove dangerous, and has never received general professional approval. Anthrax has been successfully combated by the local injection of the pure phenol, and in 3 per cent. solution it has been used subcutaneously in acute articular rheumatism and neuralgia with benefit in many cases. Tetanus has been successfully treated by subcutaneous injections of Phenol in $\frac{1}{2}$ to 2 per cent. solutions, Bacelli and Ascoli reporting 73 cases thus treated with only two deaths. The quantity administered daily was usually from 5 to 15 grains, but was as high as 60 to 80 grains in some cured cases, and a total administration of 500 grains in one, the organism proving very tolerant of the remedy in this disease. Under the trade-name *Aseptolin*, (see page 377), a solution was put forth some years ago containing 2½ per cent. of phenol, and a minute quantity of a pilocarpine salt, for hypodermic use in curable cases of tuberculosis, malaria, and other diseases due to germ infection. There is nothing original in this treatment, it being a repetition of the phenic acid injection of Declat combined with the pilocarpine treatment of phthisis announced several years ago as the "discovery" of Dr. Waldstein. It has gone through the usual puffing methods of trade promotion, and the few independent reports upon its use show no evidence of any special merit for it in these diseases.

Internally, Phenol is not much employed. It has been given to relieve flatulence and dyspepsia, and is often an efficient remedy against vomiting. It has proven of considerable temporary benefit in diabetes of hepatic origin; and has been used against intermittents, typhoid fever and various zymotic diseases; but is probably of no efficacy in constitutional affections. A mixture containing phenol and spirit of chloroform was used as an internal remedy for typhoid fever in India with satisfactory results, Dr. Quill of the Indian army reporting no deaths among those so treated during an entire year, in a country where this disease has usually a high mortality record. Phenol is highly praised by Dessau as a remedy for catarrhal affections of the respiratory tract in children, and has been used with benefit in pertussis, locally as spray, also internally and hypodermically.

The Phenol-sulphonates of Sodium, Potassium, etc., have been employed internally in the septic diseases, as the exanthemata, diphtheria, and puerperal

fever, with the object of obtaining the antiseptic action of phenol without the dangers attending its use in efficient doses. They may be used locally with good results in aphthæ, tonsillitis, otorrhea, gonorrhœa, and for inflamed mucous membranes generally.

A Cresol preparation named Creolin has been highly praised by von Esmarch and others as the ideal antiseptic for external use, but it has given rise to serious symptoms when excessively employed. As a vaginal wash in puerperal cases the 2 per cent. solution has given general satisfaction, and weaker ones are recommended by Parvin as a vesical wash in female cystitis. Solutions of 1 in 1000 are employed locally in otorrhea, rhinitis, blepharitis, keratitis, and nasal ulcers. Internally it has been used in doses of $\text{m} \cdot \text{ij}$ – v for gastric fermentation, typhoid fever and dysentery, and in the chronic form of the latter disease a $\frac{1}{2}$ to 1 per cent. solution as an injection into the colon has proved very beneficial.

PHOSPHORUS. This element, its Acids and their salts, the Phosphates and Phosphites, are properly studied together, as the chief aim of their medicinal use is to supply phosphorus to the organism.

Phosphorus, P,—is a non-metallic element obtained from bones, and occurs as a translucent, nearly colorless solid, of waxy lustre, and the consistence of beeswax, insoluble in water, to which, however, it imparts its characteristic odor and taste. It is soluble in 50 parts of any fatty oil, in 80 of absolute ether, 350 of absolute alcohol, and freely in chloroform and in carbon disulphide. It has a disagreeable odor and taste, melts at 111° F., and in the air it emits white fumes which are luminous in the dark. On longer exposure to the air it ignites, and should be kept under water in a cool place, protected from light. It usually contains Arsenic and sometimes Sulphur, the limits of which are fixed by the official tests. Dose, gr. $\frac{1}{150}$ – $\frac{1}{50}$ [av. gr. $\frac{1}{28}$.]

Acidum Phosphoricum, Phosphoric Acid,—is a liquid composed of 85 per cent. of Orthophosphoric Acid, H_3PO_4 , and 15 per cent. of water, and is obtained by oxidizing phosphorus with nitric acid. It is strongly acid, odorless, colorless, and miscible in all proportions with water or alcohol.

Acidum Phosphoricum Dilutum, Diluted Phosphoric Acid,—has of Phosphoric Acid 10 parts in 75 of Distilled Water, and contains 10 per cent. of Orthophosphoric Acid. Dose, $\text{m} \cdot \text{v}$ – xlv [av. $\text{m} \cdot \text{xxx}$.]

Acidum Hypophosphorosum, Hypophosphorous Acid,—is a liquid composed of 30 per cent., by weight, of absolute Hypophosphorous Acid, H_3PO_2 , and 70 per cent. of water.

Acidum Hypophosphorosum Dilutum, Diluted Hypophosphorous Acid,—a liquid composed of 10 per cent. of the absolute acid and 90 per cent. of water. Used in the preparation of Syrupus Hypophosphitum. Dose, $\text{m} \cdot \text{v}$ – x [av. $\text{m} \cdot \text{vij}$.]

Preparations of Phosphorus.

Pilulæ Phosphori, Pills of Phosphorus,—each contains gr. $\frac{1}{100}$ of Phosphorus, dissolved in Chloroform, mixed with Althæa and Acacia in Glycerin and Water, and coated by shaking with a solution of Balsam of Tolu in Ether. Dose, j – ij [av. j .]

Tinctura Phosphori, Thompson's, (Unofficial),—Phosphorus gr. j , Absolute Alcohol v . Glycerin v ss, Alcohol v ij, Spt. Menthæ Piperitæ $\text{m} \cdot \text{xl}$. Of this v j contains gr. $\frac{1}{4}$ of Phosphorus. Dose, v ss– v jss.

Tinctura Phosphori, Bellevue Hospital, (Unofficial),—Phosphorus gr. xxxij, Absolute Alcohol, v xlvi, Essence of Vanilla v j, Oil of Orange v iiij, Alcohol q.s. ad v xlviij. Of this v j contains gr. $\frac{1}{2}$ of Phosphorus. Dose, v ss– j .

Phosphites and their Preparations.

Calcii Hypophosphis, Calcium Hypophosphite, $\text{Ca}(\text{PH}_2\text{O}_2)_2$,—colorless prisms, or thin, pearly scales, of nauseous taste, soluble in 6.8 of water, insoluble in alcohol. Is an ingredient of the Syrupus Hypophosphitum. Dose, gr. v – v [av. gr. vijss.]

Ferri Hypophosphis, Ferric Hypophosphite, $\text{Fe}(\text{H}_2\text{PO}_2)_3$,—a white or grayish-white powder, odorless and tasteless, slightly soluble in water. A ferruginous tonic. Dose, gr. j – v [av. gr. ijij.]

Mangani Hypophosphis, Manganese Hypophosphite,—a pink, crystalline powder, soluble in water, almost insoluble in alcohol. Dose, gr. j – v [av. gr. ijij.]

Potassii Hypophosphis, Potassium Hypophosphite, KH_2PO_2 ,—white masses, or a white granular powder, deliquescent, odorless, of saline taste and neutral reaction. Soluble in 0.6 of water and in 7.3 of alcohol at 59° F. Dose, gr. v – x [av. gr. vijss.]

Sodii Hypophosphis, Sodium Hypophosphite, $\text{NaPH}_2\text{O}_2 + \text{H}_2\text{O}$,—small plates, or a white, granular powder, deliquescent, odorless, of sweetish, saline taste, and neutral reaction. Soluble in 1 of water and in 30 of alcohol at 59° F. Dose, gr. v – xxx [av. gr. xv.]

Syrupus Hypophosphitum, Syrup of Hypophosphites,—has of Calcium Hypophosphite $\frac{4}{3}$, of Potassium and Sodium Hypophosphites $\frac{1}{2}$ each, per cent. Dose, v j– v ss [av. v ijij.]

Phosphates and their Preparations.

Calcii Phosphas Præcipitatus, Precipitated Calcium Phosphate, $\text{Ca}_3(\text{PO}_4)_2$,—a light, white, amorphous powder, insoluble in water or in alcohol. Dose, gr. ij – xxx [av. gr. xv.]

Syrupus Calcii Lactophosphatis, Syrup of Calcium Lactophosphate,—has of Calcium Carbonate $2\frac{1}{2}$, Lactic Acid 6, Phosphoric Acid 3.6, per cent. Dose, v j– iv [av. v ijij.]

Sodii Phosphas, Sodium Phosphate, $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$,—large, colorless, monoclinic prisms, efflorescent, of saline taste and alkaline reaction; soluble in 6 of water, in $1\frac{1}{2}$ of boiling water, insoluble in alcohol. Its solubility in water is much increased by the addition of citric acid. Dose, gr. xx – v ij [av. gr. xxx.]

Crocq's Solution, for hypodermic use, contains Sodium Phosphate 1, Alcohol 5, Glycerin 20, Distilled Water 25; the dose of which is $\text{m} \cdot \text{xlvi}$ subcutaneously with aseptic precautions, once daily or on alternate days. Lutton uses a solution of the crystallized Sodium Phosphate and Sodium Sulphate. These solutions are used as substitutes for the animal extracts.

Sodii Phosphas Exsiccatus, Exsiccated Sodium Phosphate,—is the crystallized phosphate allowed to effloresce, and then gradually heated to 212° F. until the salt ceases to lose weight. Dose, gr. x – xx [av. gr. xv.]

Sodii Phosphas Effervescens, Effervescent Sodium Phosphate,—has of the exsiccated salt 20, Sodium Bicarbonate $47\frac{1}{2}$, Tartaric Acid $25\frac{1}{2}$, Citric Acid $16\frac{1}{2}$. Dose, v j– ijij [av. v ijij.]

Liquor Sodii Phosphatis Compositus, Compound Solution of Sodium Phosphate,—has of the Phosphate 100, Sodium Nitrate 4, Citric Acid 13, Water to 100. Dose, v j– ijij [av. v ijij.]

Sodii Pyrophosphas, Sodium Pyrophosphate, $\text{Na}_4\text{P}_2\text{O}_7 + 10\text{H}_2\text{O}$,—colorless, monoclinic prisms, of saline taste and alkaline reaction; soluble in 12 of water, insoluble in alcohol. Dose, gr. x – xlvi [av. gr. xxx.]

Elixir Ferri, Quininae et Strychninae Phosphatum, Elixir of Iron, Quinine and Strychnine Phosphates,—has in each dose of v j the $\frac{1}{4}$ of a grain of Strychnine. Dose, v ss– ij [av. v jij.]

Glyceritum Ferri, Quininae et Strychninae Phosphatum, Glycerite of the Phosphates of Iron, Quinine and Strychnine,—has of Strychnine gr. $\frac{1}{80}$ in each dose of $\text{m} \cdot \text{xlvi}$. Dose, $\text{m} \cdot \text{xx}$ – xx [av. $\text{m} \cdot \text{xlvi}$.]

Syrupus Ferri, Quininae et Strychninae Phosphatum, Syrup of the Phosphates of Iron, Quinine and Strychnine,—has of Strychnine gr. $\frac{1}{80}$ in each dose of v j, and is prepared by mixing the Glycerite 25 with Syrup to 100. Dose, v ss– ij [av. v jij.]

Ferri Phosphas Solubilis, Soluble Ferric Phosphate, and Ferri Pyrophosphas Solubilis,—are described under FERRUM, page 277.

Syrupus Phosphatum Compositus, *Compound Syrup of Phosphates*, Parrish's Chemical Food, (Unofficial),—has in each ℥, of Ferric Phosphate gr. i℥ss, Calcium Phosphate gr. j. Dose, ℥j-ij.

Melachol (Unofficial),—is a proprietary preparation, advertised to contain in each fʒ eighty-five grains of Sodium Phosphate with Citric Acid and Sodium Nitrate. Dose, ℥ss-℥j, in water.

Glycero-phosphates (Unofficial),—have been used, especially in France. Glycerophosphoric Acid is prepared by mixing Phosphoric Acid 1 part, with Glycerin 1½, and gradually heating to 374° F. When pure, it is a yellow, odorless liquid, of syrupy consistence and acid taste, soluble in water and in alcohol. Dose, ℥j-v, three times daily. The salts in general use are—the Glycero-phosphate of Calcium, dose, gr. ij-v; of Iron, dose, gr. j-ij; of Lithium, dose, gr. iij-xv; and of Sodium (in 50 per cent. solution), dose, gr. ij-iv in sodium chloride solution by hypodermic injection.

Incompatibles.

Incompatible with *Phosphorus* are all oxidizers. With *Phosphoric Acid* and the *Phosphates* are: the Chlorides of Barium, Calcium and Magnesium in ammoniacal solutions; Lead Acetate, Silver Nitrate, Soluble Iron Phosphate and Pyrophosphate. With *Pyrophosphates* are: Albumin, Ferric Chloride, Gelatin, Lead Acetate, Silver Nitrate. With *Sodium Phosphate* are: Acetamide, Alkaloids, Antipyrine, Chloral Hydrate, Lead Acetate, Phenol, Pyrocatechin, Pyrogallol, Resorcinol, Salicylic Acid, Sodium Salicylate, also those under Phosphoric Acid above. With *Dilute Hypophosphorous Acid* and the *Hypophosphites* are: Arsenic salts, Bromine and Bromates, Chlorine and Chlorates, Chromates, Cupric salts, Ferric salts, Iodine and Iodates, Nitric Acid, Permanganates, Sulphuric Acid, Sulphurous Acid.

PHYSIOLOGICAL ACTION.

Phosphorus in small doses stimulates the brain and circulation, the functions of the stomach and the genital organs, and the growth of bones. It aids digestion by irritating the end-organs of the gastric nerves, but produces eructations of hydrogen phosphide. Its fumes cause necrosis of the upper or lower maxillæ especially in those whose teeth are decayed, but this may be prevented by the inhalation of the fumes from old acid turpentine. In poisonous doses it is a powerful irritant of the gastro-intestinal tract, causing vomiting and purging with great depression of the vital forces. Reaching the blood as phosphorus, it is partly oxidized at the expense of the oxygen of the red corpuscles, causes acute hemorrhages by producing fatty degeneration of the arterial walls; also rapid steatosis of the stomach, liver and heart, accompanied by deep jaundice; then delirium, convulsions, coma and death, the latter usually from gradual failure of the respiration and circulation. Acute yellow atrophy of the liver resembles phosphorus poisoning so much that it is very difficult to distinguish between them. The effect of Phosphorus on metabolism is to increase the nitrogenous products, to diminish the excretion of carbon dioxide, to reduce the glycogen of the liver to almost nothing, and to raise the temperature. While generally increasing metabolism it so influences that process as to arrest it at the stage of the conversion of proteids into urea and oil, instead of allowing it to proceed to the final oxidation of oil into carbon dioxide and water, and hence it induces fatty degeneration of epithelial, glandular and muscular protoplasm throughout the body.

Phosphoric Acid is a weak mineral acid, being much less corrosive and irritant than the others (see page 72), but in large and concentrated dose it may cause gastro-enteritis. It contains no free phosphorus and does not produce the effects of that substance, but is believed to increase the amount of phos-

phates in the red blood corpuscles. In the dilute form it is a gastric tonic and a refrigerant.

Calcium Phosphate is an essential ingredient of all the tissues and fluids of the body, and forms more than 50 per cent. of the bones. Lactic and hydrochloric acids dissolve it in small quantities. It increases the alkalinity of the blood as well as its power of holding carbon dioxide, and diminishes the excretion of urea.

Sodium Phosphate acts on the blood and on the excretion of urea similarly to the calcium salt. It increases secretion generally, especially that of the bile, being an excellent cholagogue and thereby aiding in the digestion of fats. In half-ounce doses it is laxative. It is a normal constituent of the blood, is the principal agent maintaining the acidity of the urine, and possesses the property of increasing the capacity of any fluid to hold carbon dioxide in solution.

The Hypophosphites are generally tonic in action, and are supposed to constitute a safer form in which to administer phosphorus than in the unoxidized state. They are probably converted into phosphates in the stomach.

THERAPEUTICS.

Phosphorus is chiefly used to promote the nutrition of osseous and nervous tissue. It is useful in chronic nervous exhaustion when the nerve centres are implicated, also in osteomalacia, rachitis and progressive locomotor ataxia. In threatened cerebral softening it affects the nerve centres as no other drug does, and in paraplegia of myelitic origin from excessive venery it is often efficient. Progressive pernicious anemia has sometimes been arrested by Phosphorus in very small doses, while in impotence of functional character there is no remedy so effective. In wakefulness of the aged and that due to cerebral anemia small doses of the pill or tincture are sometimes remarkably beneficial. In certain skin diseases (acne, psoriasis, lupus), it is an excellent substitute for arsenic. Neuralgia is often cured by Phosphorus, but large doses are necessary, at least gr. ʒj every four hours. A solution in Retinol is very stable, and is recommended for the external and internal use of the drug.

Phosphoric Acid in the dilute form is employed as a refrigerant in fevers, and as a tonic to weak anemic children with the view of improving the quality of the blood and promoting the growth of the bones. It has been considered of value in strumous affections, but is of little real benefit, except as a feeble digestive stimulant.

Calcium Phosphate and the Hypophosphites are used with benefit in all diseases of mal-nutrition, and where the repair or development of the bones is required. They are particularly useful in protracted suppuration, osteomalacia, rachitis, caries, scrofulosis, chronic phthisis, and in the anemia and bone-softening of lactation. The Hypophosphites are much employed in nervous and general debility and in chronic lung diseases, and are supposed to act in the same manner as free phosphorus, but without irritation. They are prob-

ably converted into phosphates in the stomach, and hence may be expected to promote the growth and healing of bones, to stimulate the hepatic and intestinal secretions, and to affect the lymphatic glands and adenoid tissue. The Compound Syrup of the Hypophosphites is an excellent remedy in acne indurata.

Sodium Phosphate in doses of ʒj-ij thrice daily for adults (gr. x-xxx for children) is extremely useful as a laxative in conditions depending on catarrh of the bile-ducts and duodenum, as headache, jaundice, and chalky stools. Gallstones may be prevented from forming by scruple or drachm doses before meals for months at a time. It is an efficient agent in obesity, hepatic diabetes, incipient hepatic sclerosis, chronic infantile diarrhea, cerebral debility, bilious sick-headache, and the pasty, white stools of ill-conditioned children. Vichy-water contains this salt in the proportion of gr. ʒ to the pint, and is considered a valuable water in hepatic colic and kindred conditions. Hypodermic injections of Sodium Phosphate have been used with highly beneficial results in syringomyelitis and in unilateral astasia-abasia. Drs. Crocq and Luton of Rheims advocate the hypodermic use of this salt as a substitute for the organic extracts, and maintain that it is equally efficient in all cases in which these extracts have proved to be of value.

Glycero-phosphoric Acid and its salts are said to accelerate metabolism and the nitrogenous exchanges, to promote the assimilation of albuminoids, and to increase the excretion of nitrogen, the oxidation of broken-up sulphur compounds and the elimination of sodium chloride. They may favor the assimilation of the phosphates of the food and so protect the combined phosphorus of the nervous system from waste (Robin). The acid is highly valued as a nervine remedy and has been used with benefit in neurasthenia, locomotor ataxia, phosphaturia, lithemia and muscular atrophy. The Iron salt is praised in anemia and chlorosis.

PHYSOSTIGMA, Physostigma, (*Calabar Bean*),—is the ripe seed of *Physostigma venenosum*, nat. ord. Leguminosæ, a woody creeper of Calabar, West Africa, where it is used by the natives as an ordeal for witches, vomiting after its ingestion being held to establish the innocence of the accused. It contains the alkaloids, *Physostigmine* (*Eserine*), $C_{15}H_{21}N_3O_2$; *Calabarine*, a tetanizer like strychnine; and *Eseridine*, which acts like physostigmine but is less powerful. The two latter may be decomposition products of physostigmine, which is a very unstable body. Dose, gr. j-ij [av. gr. jss.] Physostigma should contain not less than 0.15 per cent. of alkaloids soluble in ether.

Preparations.

Extractum Physostigmatis, *Extract of Physostigma*,—an alcoholic extract, of which the usual dose is from gr. $\frac{1}{8}$ - $\frac{1}{4}$, [av. gr. $\frac{1}{8}$], but gr. j-iv are used in tetanus.

Tinctura Physostigmatis, *Tincture of Physostigma*,—10 per cent. Dose, ℥v-xx [av. ℥xv.]

Physostigminæ Salicylas, *Physostigmine Salicylate* (*Eserine Salicylate*),—colorless, columnar crystals, of bitter taste and neutral reaction, soluble in 150 of water and in 12 of alcohol. Dose, gr. $\frac{1}{60}$ - $\frac{1}{30}$ [av. gr. $\frac{1}{24}$].

Physostigminæ Sulphas, *Physostigmine Sulphate* (*Eserine Sulphate*),—a white, micro-crystalline powder, of bitter taste, very deliquescent in moist air, very soluble in water and in alcohol. Dose, gr. $\frac{1}{60}$ - $\frac{1}{30}$ [av. gr. $\frac{1}{24}$].

Incompatibles.

Incompatible with *Physostigma* preparations are: Caustic Alkalies, Tannic Acid and other alkaloidal precipitants (see page 5). Physiologically incompatible are Atropine, Caffeine, Chloral Hydrate, Morphine, Strychnine.

PHYSIOLOGICAL ACTION.

Physostigma depresses the spinal motor centres and the respiratory centres in the medulla, producing loss of reflex action and increasing motor paralysis, but not directly affecting sensation, the cerebral functions, or muscular irritability. It stimulates secretion, excites nausea and vomiting, salivation and diaphoresis. It stimulates involuntary muscular fibre, especially that of the intestines, stomach and bronchial tubes, and is laxative by increasing intestinal peristalsis and the intestinal secretions. It slows the heart by stimulating the peripheral terminations of the vagus, and increases its contractile force, raising the blood pressure. It contracts the pupils and causes spasm of accommodation, by direct stimulation of the oculo-motor nerve endings, and diminishes intra-ocular tension. Death occurs by paralysis of the respiratory centres in the medulla. It is rapidly absorbed, and is eliminated chiefly by the kidneys.

The alkaloid Physostigmine represents the action of the drug in its effects on the spinal centres, the eyes, and the involuntary muscles. Calabarine stimulates the spinal cord like strychnine, and interferes with the action of physostigmine when present in quantity, as it may be in old specimens of the bean. Eseridine acts similarly to physostigmine, but is much less poisonous.

THERAPEUTICS.

The applications of Physostigma are not many. It is efficient in constipation due to torpor of the bowels, in which condition it is usually combined with belladonna and nux vomica. In tetanus it has been used with advantage to diminish reflex excitability, but large doses (2 to 4 grains) must be given, and its effects must be carefully watched. In small doses it is a useful remedy in many nervous affections, such as locomotor ataxia, writers' cramp and the paraplegia due to myelitis, also in progressive paralysis of the insane, which is apparently retarded by it. The extract should be given in these diseases, in doses of gr. $\frac{1}{10}$ in pill every three hours; and if the treatment is kept up for six months or longer the results will prove very satisfactory, though the improvement will be slow (Murrell). While theoretically antagonistic in poisoning by atropine or strychnine, practically it is not of much value.

Physostigmine (*Eserine*) is used locally by ophthalmologists for many purposes in affections of the eye. In a solution of gr. ij to the ʒ of water dropped into the eye it is efficient in breaking up or preventing adhesions of the iris, diminishes intraocular tension, prevents suppuration after operations, contracts the pupil, diminishing the entrance of light in photophobia, and empties the vessels of the eye. It is very useful in keratitis, glaucoma, strumous ophthalmia, and neuralgia of the eyeball. The salts of Physostigmine in neutral solu-

tion may be used for these purposes, as well as to counteract the effects of atropine on the pupil. Gelatin disks medicated therewith may be obtained in the shops, and are a convenient form in which to use the drug for ophthalmic purposes. In dose of gr. $\frac{1}{100}$ hypodermically it has proved remarkably efficient as an occasional substitute for morphine, after the final withdrawal of that drug in the treatment of its habitués.

PHYTOLACCA, Phytolacca,—is the dried root (*Poke-root*) of *Phytolacca decandra*, a plant of the nat. ord. Phytolaccaceæ, found in all parts of the United States. It contains a neutral principle *Phytolaccin*, and an acid *Phytolaccic Acid*, also tannin, starch, fixed oil, etc. Dose, as an alterative gr. j-v [av. gr. ij]; as an emetic gr. x-xxx [av. gr. xv.]

Fluidextractum Phytolaccæ, Fluidextract of Phytolacca,—Dose, as an alterative $\mathfrak{m}j$ -iv [av. $\mathfrak{m}jss$]; as an emetic $\mathfrak{m}x$ -xxx [av. $\mathfrak{m}xv$.]

PHYSIOLOGICAL ACTION AND THERAPEUTICS.

Phytolacca is emeto-cathartic, acting slowly but persistently, with great nausea and considerable depression. It lowers the rate of respiration and of cardiac action, and is a motor depressant, paralyzing the spinal cord and the medulla, death occurring from paralysis of respiration preceded by tetanic convulsions. Several cases of poisoning by this plant have occurred. Its action is antagonized by alcohol, ether, opium, digitalis, and other motor-excitants.

Alterative powers have been ascribed to Phytolacca, and competent observers have reported curative results from its use in malignant tumors, varicose and other ulcers, obstinate eczema, sycosis, favus and other skin affections, employing it both internally and externally. It is a serviceable remedy in chronic rheumatism, and given internally has undoubtedly cured cases of granular conjunctivitis. Mastitis is sometimes aborted and suppuration of the breasts prevented by the use of the fluidextract internally while a solid extract is locally applied to the seat of the impending inflammation. In tonsillitis and diphtheritic sore throat, also in chronic follicular pharyngitis, it has been used with good results, especially when there is high fever and pains in the head, back and limbs. In true adynamic diphtheria it will do little good.

Phytolacca has long been known to promote the absorption of adipose tissue, and was suggested as a remedy for obesity as early as 1858. A resinoid preparation of the berries is on the market as an "anti-fat" remedy, under the name *Phytoline*, the dose of which is $\mathfrak{m}x$ six times a day, before and after each meal.

PICHI, (Unofficial),—is the shrub *Fabiana imbricata*, a member of the nat. ord. Solanaceæ, and a native of S. America. Among the Chilians it is prized as a remedy in cystitis with calculi and gravel, and in chronic catarrh of the bladder. It seems to have considerable power over the hematuria and pair of renal calculus. It is highly praised in dyspeptic disorders. Its medicinal virtues reside in oleoresinous constituents which are insoluble in water.

An extract is prepared from the leaves, of which the dose is gr. v-x in capsules. Dose of the fluidextract, \mathfrak{J} , but it should not be added to water.

PICROTOXINUM, Picrotoxin, Picrotoxic Acid, $C_{30}H_{34}O_{13}$, (Unofficial),—is a poisonous, neutral principle obtained from the seeds contained in the berries (*Cocculus Indicus*, fish-berries), of *Anamirta paniculata* (*Anamirta cocculus*, *Menispermum cocculus*), a climbing shrub of the nat. ord. Menispermaceæ, a native of the East Indies. The berries contain, besides Picrotoxin, a large quantity of fixed oil and other substances of less interest. In the shell are found *Menispermicin* an alkaline principle, *Paramenispermicin* which is neutral and crystalline, and *Hypopicrotoxic Acid*.

Picrotoxin occurs in colorless, flexible crystals, of bitter taste and neutral reaction, soluble in 240 of water and in 9 of alcohol, also in acids and in alkaline solutions. Dose by the stomach gr. $\frac{1}{60}$ - $\frac{1}{30}$, cautiously. For hypodermic use a solution in water of gr. ij in \mathfrak{J} may be used, in doses of gr. $\frac{1}{60}$ - $\frac{1}{40}$ of the principle, $\mathfrak{m}jv$ equalling gr. $\frac{1}{60}$.

Unofficial Preparations of Cocculus.

Tinctura Cocculi, Tincture of Cocculus,—i in 8. Dose, $\mathfrak{m}j$ -xv.

Fluidextractum Cocculi, Fluidextract of Cocculus,—Dose, $\mathfrak{m}j$ -ijj.

Planat's Tincture of Cocculus,—i in 4. Dose, $\mathfrak{m}j$ -v.

Incompatibles.

Acids are chemically incompatible. Chloral Hydrate, Morphine, and general Anesthetics are physiologically incompatible except to its depressant action on the heart and respiration.

PHYSIOLOGICAL ACTION.

Picrotoxin at first stimulates and finally paralyzes the centres in the medulla oblongata, and somewhat excites the spinal cord. The first symptoms of a physiological dose are vomiting, salivation, sweating, rapid respiration, muscular twitching, slowed pulse, and palpitation of the heart, followed by a period of stupor and unconsciousness. Then occurs a series of powerful convulsions, commencing in tonic spasms and quickly changing to clonic contractions of the jaws and limbs, during which respiration is interrupted and may cease altogether. The body temperature is raised, the reflexes are exalted, the heart is slowed, the arterial tension is increased, and the respiration, at first quickened, finally becomes slow and labored. Under a toxic dose the stimulant effects are rapidly followed by paralysis. Death occurs usually from asphyxia, due partly to the convulsions and partly to the final paralysis of the respiratory centres; in some cases from paralysis of the heart, which is arrested in diastole. The spasms caused by Picrotoxin are choreic and chiefly affect the flexor muscles,—those from Strychnine are tetanic, affecting principally the extensors. The order, succession and character of the phenomena produced by Picrotoxin resemble in marked degree those of the epileptic paroxysm. Picrotoxin is poisonous to the lower forms of life, and is therefore powerfully antiparasitic.